



# **CLEAN ENERGY AUSTRALIA**

**REPORT 2021**



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ENERGY  
COUNCIL**



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# INTRODUCTION



**Kane Thornton**  
Chief Executive,  
Clean Energy Council

Australia's clean energy transition accelerated again in 2020 as wind and rooftop solar set new records, battery storage came of age, and the hydrogen sector continued its rapid development. This all points to Australia realising its potential as a clean energy superpower.

The Australian renewable energy industry has come a long way in the past five years. In 2016, just 17 per cent of the country's electricity came from renewables, and the majority of this was due to New South Wales and Tasmania's long-serving hydro systems.

Fast forward to 2020, and more than 27 per cent of Australia's electricity

came from clean energy sources, with wind and rooftop solar leading the way. This represents a massive transformation that makes Australia's electricity system cheaper, more reliable and, most importantly, cleaner. But the best news is that the shift is showing no sign of slowing down.

An enormous amount of new clean energy capacity was added in 2020 as both the rooftop solar and wind sectors set new annual records. Emerging technologies also made rapid progress, with several major utility-scale battery announcements and considerable investment in renewable hydrogen building strong momentum for these exciting new technologies.

Much of this progress was driven by state and territory governments, which introduced a number of world-leading renewable energy policies and targets in 2020. However, the states and

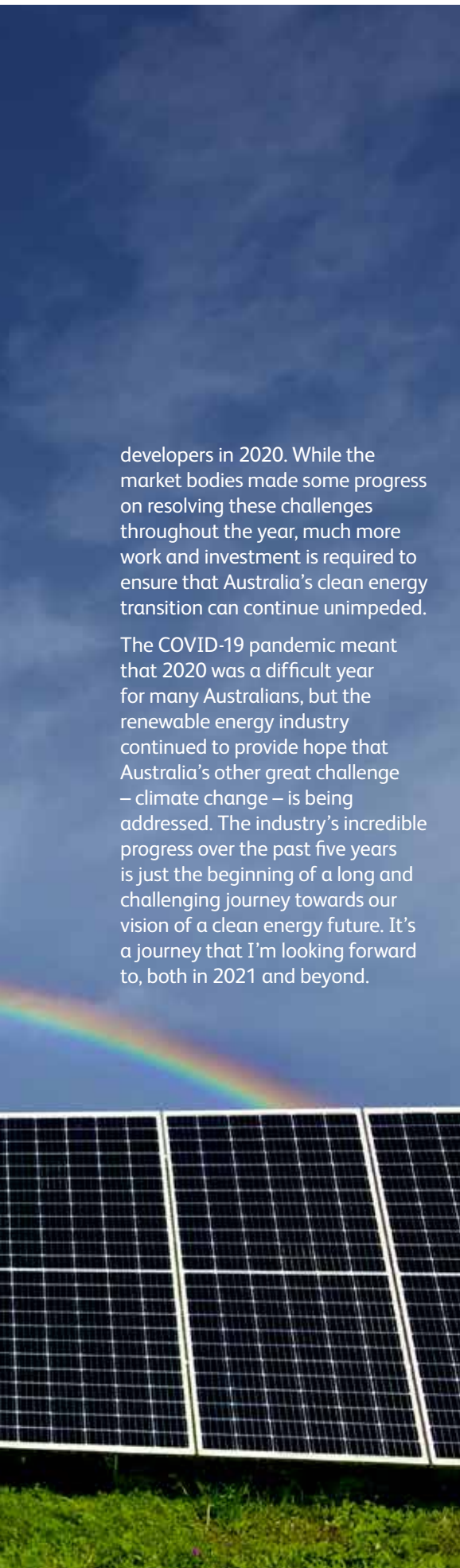
territories' progressive energy policies only served to highlight the ongoing failures at the federal level, where arguments about government support for gas and coal overshadowed some genuinely positive developments.

These included the continued growth of clean energy jobs, with the industry employing more than 25,000 Australians in 2020, and the hundreds of dollars that households and businesses saved on their electricity bills due to the recent influx of new renewable generation. These are just a small sample of the benefits of renewable energy, and there is enormous potential for more in the coming years as the industry continues to grow.

First though, the industry will need to overcome ongoing grid connection and transmission challenges, which continued to plague renewable energy



Image: Warwick Solar Farm, Queensland



developers in 2020. While the market bodies made some progress on resolving these challenges throughout the year, much more work and investment is required to ensure that Australia's clean energy transition can continue unimpeded.

The COVID-19 pandemic meant that 2020 was a difficult year for many Australians, but the renewable energy industry continued to provide hope that Australia's other great challenge – climate change – is being addressed. The industry's incredible progress over the past five years is just the beginning of a long and challenging journey towards our vision of a clean energy future. It's a journey that I'm looking forward to, both in 2021 and beyond.

# ABOUT US

The Clean Energy Council is the peak body for the renewable energy and energy storage industry in Australia. We represent and work with hundreds of leading businesses operating in solar, wind, hydro, bioenergy, energy storage, hydrogen and emerging technologies along with more than 7500 solar and battery storage installers.

We are committed to accelerating the transformation of Australia's energy system to one that is smarter and cleaner. The Clean Energy Council leads and supports the growth of the clean energy industry in Australia by:

- providing a strong voice for our members
- standing up for the industry
- developing and driving effective policy and advocacy
- working with industry to continually improve standards and maintain integrity
- working closely with local, state and federal governments to increase demand for clean energy products
- providing services and initiatives to members and the wider industry that help to grow the sector
- promoting the clean energy industry.



# 2020 SNAPSHOT



Image: Panel installation, Warwick Solar Farm, Queensland

# 27.7%

Australia's electricity generation from renewable sources in 2020

# >3 GW

small-scale solar capacity added in 2020

# 76

large-scale wind and solar projects under construction at the end of 2020

# 12 GW

new transmission capacity promised by the New South Wales Government's Electricity Infrastructure Roadmap

The Australian renewable energy industry's record-breaking run continued in 2020, despite the impacts of the COVID-19 pandemic.

The growth of Australia's renewable energy industry showed no sign of slowing in 2020 as increased support from state and territory governments saw numerous records set across the large- and small-scale sectors.

The industry passed a significant milestone in 2020, with more than a quarter of the country's total electricity generation coming from renewable sources for the first time. Renewables were responsible for 27.7 per cent of total generation in 2020, an increase of 3.7 percentage points compared to 2019.

Much of this increase was due to the small-scale solar sector, which added more than 3 GW of new capacity in 2020 to record its fourth-straight record-breaking year. This brought the sector's share of Australia's renewable energy generation to 23.5 per cent, pushing it past hydro into second place for the first time.

The large-scale sector contributed almost 2 GW of new capacity in 2020 as 32 projects were completed around the country. While the majority of these projects were large-scale solar farms, representing 893 MW of new capacity, the wind sector accounted for the bulk of new generation, adding 1097 MW throughout the year. This was a new record for the sector, comfortably surpassing the 837 MW record set in 2019.

A further 76 large-scale wind and solar projects were under construction at the end of 2020, representing more than 8 GW of new capacity and employing over 9000 Australian workers. Of these projects, 49 were

large-scale solar farms, 21 were wind farms, three were bioenergy plants, while three were hybrid plants producing at least two different types of renewable energy.

The expansion of Australia's large-scale renewable energy industry is being led by state and territory governments, who made considerable new commitments to the industry in 2020. The New South Wales Government's Electricity Infrastructure Roadmap was the most ambitious renewable energy policy released during the year, promising to deliver 12 GW of new transmission capacity to facilitate the construction of three renewable energy zones across the state.

Tasmania passed a major milestone in 2020, becoming the first Australian state to source 100 per cent of its electricity from renewable sources. The Tasmanian Government has now set a 200 per cent renewable energy target by 2040, which is the world's most ambitious target for renewables. South Australia passed its own significant milestone in October 2020, when 100 per cent of its electricity came from solar for one hour, the first time this had been achieved by a jurisdiction as large as South Australia anywhere in the world.

Federal politics was dominated by the COVID-19 pandemic in 2020. As the immediate health crisis abated, the focus turned to economic recovery and the opportunity to stimulate the economy by accelerating the clean energy transition. Rather than grasping this opportunity, the government opted for a "gas-fired



# 2020 SNAPSHOT CONTINUED

## 16

utility-scale batteries under construction at the end of 2020

## 23,796

small-scale batteries installed by Australian households in 2020

## 238 MWh

combined capacity of household batteries installed in 2020

recovery” that included a threat to build a government-owned 1000 MW gas-fired power station in New South Wales.

However, pressure on the government to increase its emissions reduction ambitions began to grow towards the end of 2020 following the election of Joe Biden as US President and several of Australia’s major trading partners adopting a net-zero emissions target by 2050.

The challenges associated with grid connection and transmission continued in 2020 as the need for additional investment in transmission capacity to allow more renewable energy connections became more urgent. However, the announcement of renewable energy zones by several state governments should help to ease pressure on the grid, as will Federal Government funding for some key transmission projects to help unlock additional renewable energy resources.

The battery storage sector rose to prominence in 2020, with 16 utility-scale batteries under construction at the end of 2020, representing more than 595 MW of new capacity. This will increase significantly in the coming years following the announcement of several major utility-scale batteries throughout the year, including several projects that will again make Australia home to the world’s largest battery. Australian households installed 23,796 small-scale batteries with a combined capacity of 238 MWh in 2020.

Several noteworthy steps were taken in 2020 to develop Australia’s emerging renewable hydrogen industry. The most significant of these was the technology’s inclusion in the Federal Government’s Technology Investment Roadmap. The states and territories also upped their investment in renewable hydrogen, committing millions of dollars to various pilot projects and new initiatives throughout the year.

1 Green Energy Markets. Electricity generation equivalent in households is calculated using a weighted national average consumption level of 4.596 MWh (from Australian Energy Market Commission, *Residential electricity price trends 2018*, 21 December 2018, [aemc.gov.au/sites/default/files/2018-12/2018%20Price%20Trends%20-%20Final%20Report%20-%20CLEAN.PDF](https://aemc.gov.au/sites/default/files/2018-12/2018%20Price%20Trends%20-%20Final%20Report%20-%20CLEAN.PDF))



## RENEWABLE ENERGY GENERATION<sup>1</sup>

TECHNOLOGY	GENERATION (GWh)	PERCENTAGE OF RENEWABLE GENERATION	PERCENTAGE OF TOTAL GENERATION	EQUIVALENT NUMBER OF HOUSEHOLDS POWERED OVER COURSE OF THE YEAR
Wind	22,605	35.9%	9.9%	4,918,363
Small-scale solar PV	14,807	23.5%	6.5%	3,221,737
Hydro	14,638	23.3%	6.4%	3,184,968
Large-scale solar PV	6835	10.9%	3.0%	1,487,155
Bioenergy	3164	5.0%	1.4%	688,427
Medium-scale solar PV	868	1.4%	0.4%	188,910
<b>TOTAL</b>	<b>62,917</b>	<b>100.0%</b>	<b>27.7%</b>	<b>13,689,560</b>

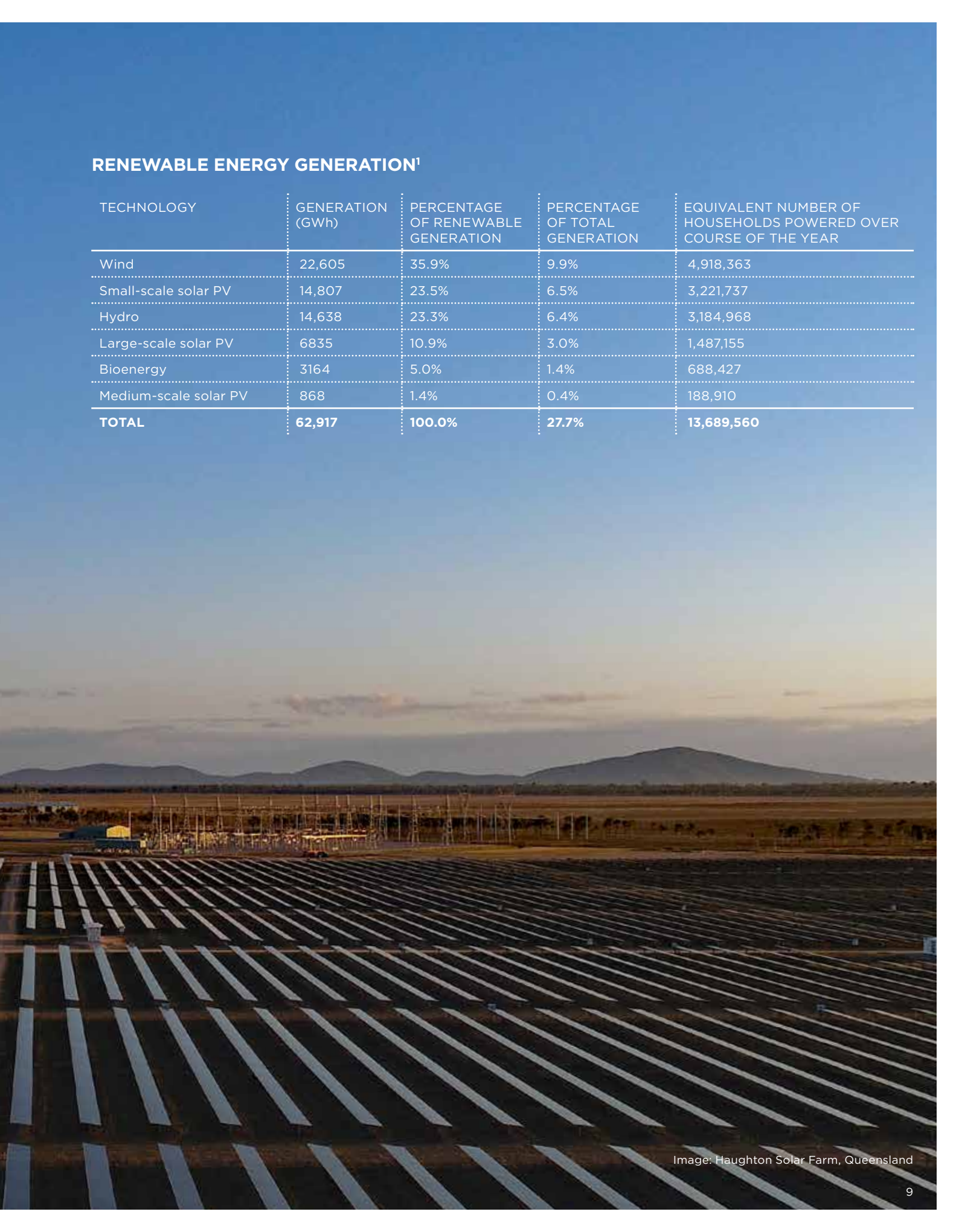
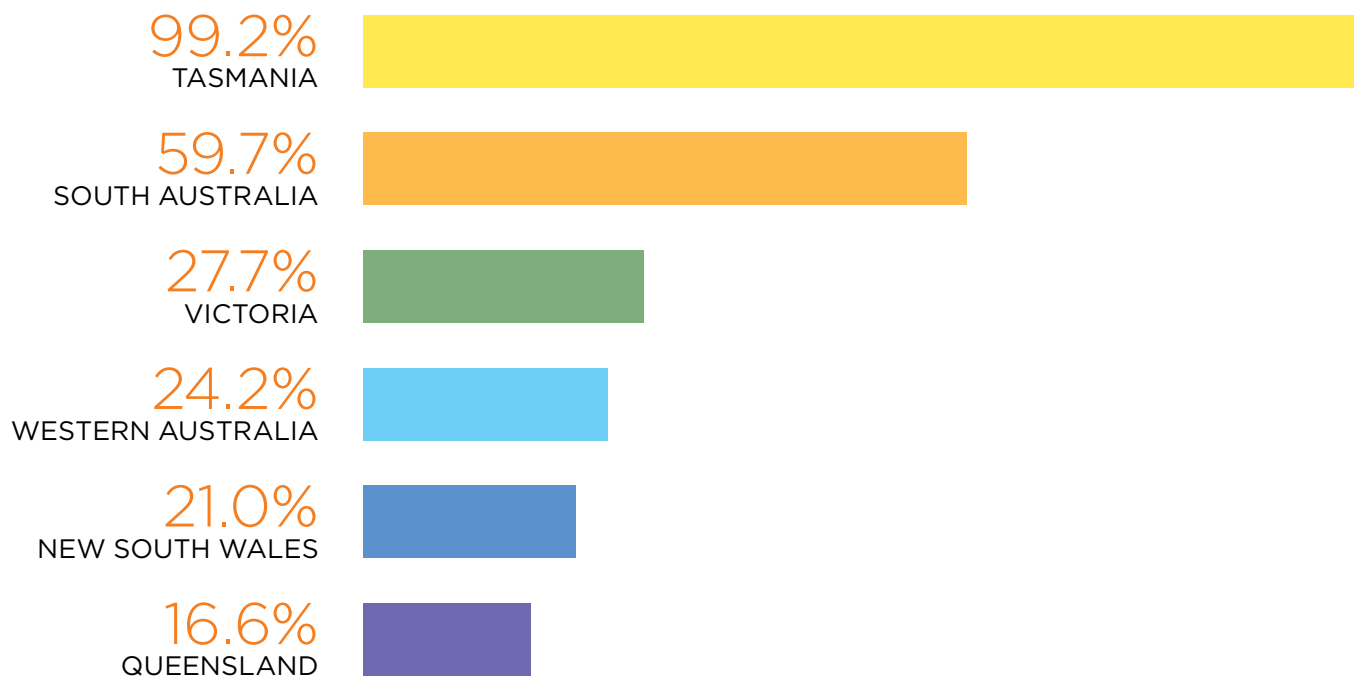


Image: Houghton Solar Farm, Queensland

# 2020 SNAPSHOT CONTINUED

## RENEWABLE ENERGY PENETRATION BY STATE AS A PROPORTION OF GENERATION



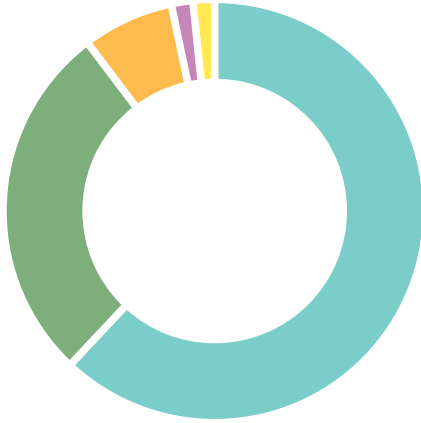
## RENEWABLE ENERGY PENETRATION BY STATE<sup>2</sup>

STATE	TOTAL GENERATION (GWH)	FOSSIL FUEL GENERATION (GWH)	TOTAL RENEWABLE GENERATION (GWH)	PENETRATION OF RENEWABLES AS PROPORTION OF GENERATION	PENETRATION OF RENEWABLES AS PROPORTION OF CONSUMPTION
TAS	10,956	90	10,866	99.2%	100.6%
SA	14,285	5763	8523	59.7%	60.1%
VIC	49,390	35,705	13,685	27.7%	28.4%
WA	19,171	14,528	4643	24.2%	24.2%
NSW	68,158	53,846	14,312	21.0%	19.1%
QLD	65,426	54,537	10,888	16.6%	18.0%
<b>NATIONAL</b>	<b>227,386</b>	<b>164,469</b>	<b>62,917</b>	<b>27.7%</b>	<b>27.7%</b>

<sup>2</sup> Green Energy Markets. Total generation includes NEM and WEM data and small-scale solar. The ACT is part of the NSW region and there is no data available for the small NT grid.

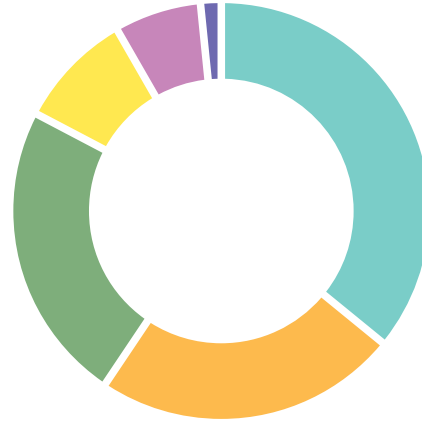


## ANNUAL ELECTRICITY GENERATION IN 2020



<span style="color: #00A09A;">●</span> Coal	62.0%
<span style="color: #4CAF50;">●</span> Renewables	27.7%
<span style="color: #FF9800;">●</span> Gas	9.9%
<span style="color: #9C27B0;">●</span> Waste coal mine gas	0.4%
<span style="color: #FFEB3B;">●</span> Liquids	0.1%

## RENEWABLE GENERATION BY TECHNOLOGY TYPE



<span style="color: #00A09A;">●</span> Wind	35.9%
<span style="color: #FF9800;">●</span> Small-scale solar	23.5%
<span style="color: #4CAF50;">●</span> Hydro	23.3%
<span style="color: #FFEB3B;">●</span> Large-scale solar	10.9%
<span style="color: #9C27B0;">●</span> Bioenergy	5.0%
<span style="color: #3949AB;">●</span> Medium-scale solar	1.4%

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- Greater thermal stability and power density
- Advanced features: LVRT, P/Q Control...
- Power stack protection: IP65



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JOBS AND  
INVESTMENT  
IN RENEWABLE  
ENERGY  
**BY STATE**



# THE CONSTRUCTION BOOM FOR LARGE-SCALE RENEWABLE ENERGY PROJECTS

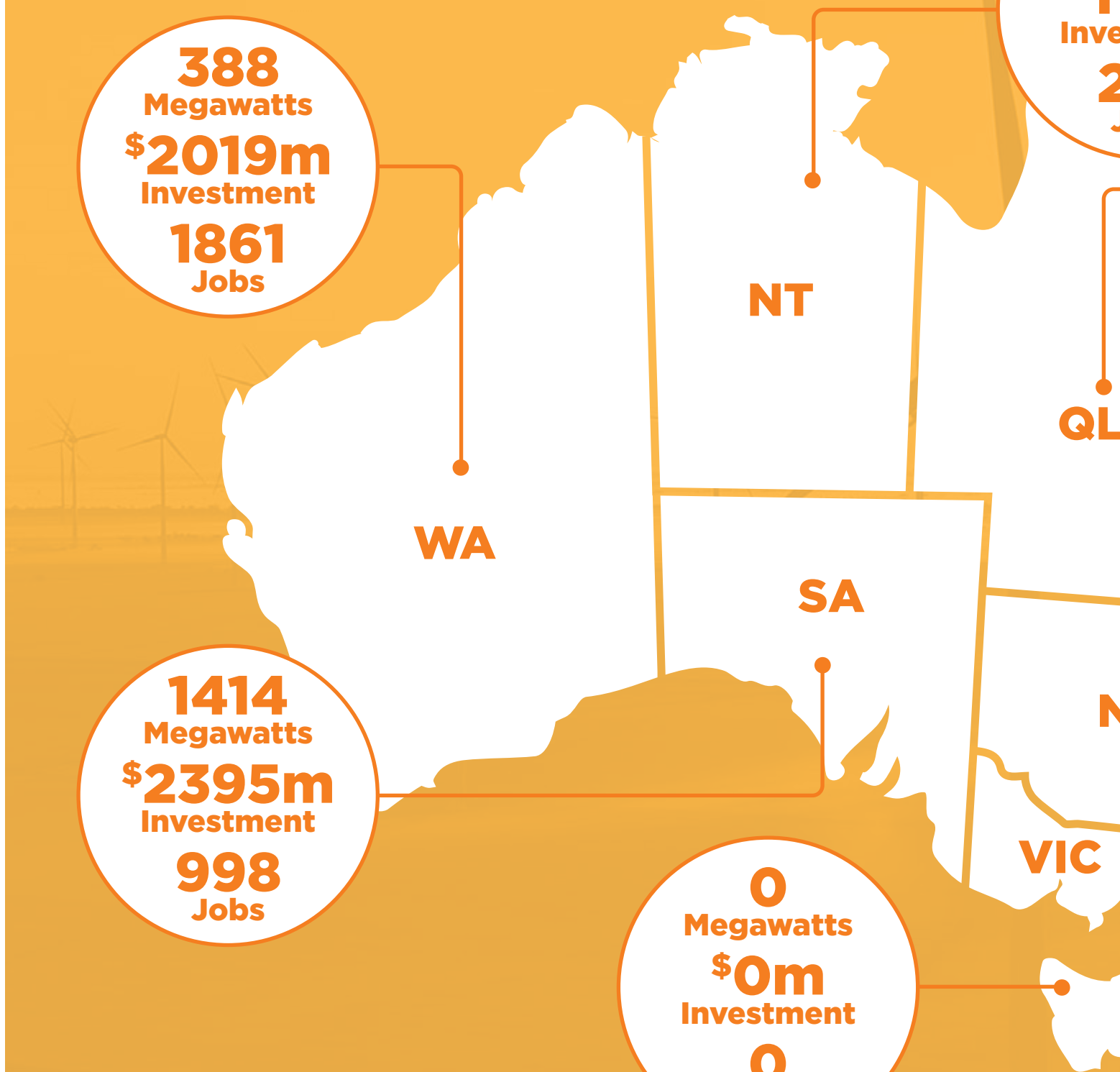
(PROJECTS UNDER CONSTRUCTION OR FINANCIALLY COMMITTED)\*

**388**  
Megawatts  
**\$2019m**  
Investment  
**1861**  
Jobs

**1414**  
Megawatts  
**\$2395m**  
Investment  
**998**  
Jobs

**0**  
Megawatts  
**\$0m**  
Investment  
**0**  
Jobs

**0**  
Megawatts  
**\$11**  
Investment  
**2**  
Jobs



\* From 2017 to 19 March 2021

LE

**64**  
Megawatts  
**19m**  
Investment  
**272**  
Jobs

**1962**  
Megawatts  
**\$3441m**  
Investment  
**2594**  
Jobs

**3612**  
Megawatts  
**\$5600m**  
Investment  
**4194**  
Jobs

**2955**  
Megawatts  
**\$5064m**  
Investment  
**3584**  
Jobs

D

ISW

TAS

## TOTALS

**10,395**  
Megawatts

**\$18.6b**  
Investment

**13,502**  
Jobs



# PROJECT TRACKER

## RENEWABLE ENERGY PROJECTS COMPLETED IN 2020

TECH	STATE	PROJECT	OWNER	CAPACITY (MW)
Wind	VIC	Murra Warra Wind Farm - Stage 1	Partners Group	226
Wind	WA	Warradarge Wind Farm	Bright Energy Investments	184
Wind	TAS	Cattle Hill Wind Farm	Goldwind Australia/Power China Group	148
Wind	VIC	Mt Gellibrand Wind Farm - Stage 1	ACCIONA	132
Wind	SA	Lincoln Gap Wind Farm - Stage 1	Nexif Energy	126
Wind	TAS	Granville Harbour Wind Farm	Palisade Asset Management	112
Solar	SA	Bungala Solar Farm - Stage 2	Enel Green Power/Dutch Infrastructure Fund	110
Solar	NSW	Nevertire Solar Farm	Elliott Green Power	105
Solar	NSW	Bomen Solar Farm	Spark Infrastructure	100
Solar	QLD	Yarranlea Solar Farm	Risen Energy	100
Solar	WA	Merredin Solar Farm	Risen Energy	100
Solar	VIC	Bannerton Solar Park	Foresight Solar Fund	88
Wind	VIC	Lal Lal Wind Farm - Elaine section	Northleaf Capital/InfraRed Capital Partners/ Macquarie Capital	84
Solar	NSW	Goonumbla Solar Farm	Fotowatio Renewable Ventures	68
Wind	VIC	Cherry Tree Wind Farm	John Laing	58
Solar	QLD	Oakey Solar Farm - Stage 2	Foresight Group	55
Solar	QLD	Collinsville Solar Farm	RATCH-Australia	43
Solar	WA	Greenough River Solar Farm upgrade	Bright Energy Investments	30
Solar	NSW	Limondale Solar Farm - Stage 2	Innogy	29
Wind	WA	Agnew Mine Wind and Solar Project	Energy Developments Limited	18
Wind	VIC	Ferguson Wind Farm	BayWa r.e.	11
Solar	VIC	Katamatite Solar Farm	Diamond Energy	8
Solar	VIC	Numurkah Solar Project	Diamond Energy	8
Solar	VIC	Robinvale Solar Farm	Suntech Power Development Australia	7
Hybrid	WA	Nova Power Station Solar	Zenith Energy	6
Solar	NSW	EP Sunspot 2 Solar Farm	Enerparc Australia	5
Solar	NSW	Schwartz Solar Farm	Schwartz Hotels	5
Solar	SA	Bungama Solar Farm - Stage 2	Astronergy Solar Australia	5
Solar	SA	Kadina Solar Farm - Stage 1	Astronergy Solar Australia	5
Solar	SA	Baroota Solar Farm	Flagstaff Enterprises	5
Solar	VIC	Stanhope Solar Project No. 2	Diamond Energy	5
Solar	VIC	Girgarre Solar Project No. 2	Diamond Energy	5



# SMALL-SCALE RENEWABLE ENERGY

Despite the COVID-19 pandemic, the small-scale solar sector showed no sign of slowing down in 2020 as more than 3 GW of new capacity was added to Australian rooftops.



Image: Rooftop solar installation, New South Wales





## >3 GW

new capacity added to Australian rooftops in 2020 – a new record

## 23,796

household batteries installed in 2020

## 378,451

systems installed in 2020 – also a new record

## 927 MW

rooftop solar capacity installed in New South Wales in 2020

The small-scale solar sector recorded its fourth-straight record-breaking year in 2020, easily surpassing 2019's record of 2.2 GW of new capacity. The 378,451 systems installed in 2020 was also a record, overtaking the previous best set back in 2012.

The industry's success was seen right across the country as every state and territory besides Tasmania – which recorded its second-best ever year – set a new record for installed capacity. New South Wales was Australia's small-scale solar leader in 2020, adding 927 MW of new capacity, followed by Queensland with 787 MW and Victoria with 559 MW. Victoria's 2020 performance is particularly notable considering that its entire small-scale solar industry was forced to shut down for almost two months in mid-2020 due to the state's devastating COVID-19 outbreak.

The household battery sector continued to grow in 2020, with 23,796 batteries with a combined capacity of 238 MWh installed throughout the year. Unsurprisingly, the states with government-backed battery installation support schemes saw the most installations, with South Australia, New South Wales and Victoria leading the way.

The remarkable growth of the Clean Energy Council's Approved Solar Retailer

program continued in 2020 as more governments made it mandatory for companies to sign up to the program to participate in their solar schemes. By the end of 2020, the program had grown to 1141 participating companies, an increase of 66 per cent on 2019. The Solar Retailer Code of Conduct was re-authorised by the Australian Competition and Consumer Commission in 2020, with a number of minor amendments made to bring it up to date and in line with industry developments.

This will allow the gradual transition of signatories to the New Energy Tech Consumer Code (NETCC), which was authorised by the Australian Competition Tribunal in September 2020. The NETCC will eventually replace the Solar Retailer Code of Conduct to include solar, battery energy storage systems, electric vehicle charging products, energy management systems and software, and other emerging products and services for homes and businesses.

The number of Clean Energy Council accredited installers also grew strongly in 2020, increasing by 17 per cent to 7713. The program has seen remarkable growth alongside the solar industry, with the number of accredited installers surging by more than 3000 over the past five years.





Image: Spicer's Retreat, Queensland

## **CASE STUDY SMART SOLUTIONS NEEDED TO MEET GRID CHALLENGES AS ROOFTOP SOLAR BOOMS**

The rooftop solar industry has experienced phenomenal growth in recent years, with the record for installed capacity having been broken in each of the past four years. However, the rapid rise of rooftop solar capacity has raised a number of challenges related to the stability and management of the electricity system.

This has been most evident in South Australia, where rooftop solar met over 70 per cent of the state's total electricity demand at times during 2020. While this is a fantastic result for Australia's clean energy transition, the influx of solar electricity creates challenges for managing the grid, especially on the rare occasions when the South Australian grid is disconnected from the rest of the grid on Australia's east coast.

Low minimum demand can make managing the grid challenging because

the system, as it is currently designed, relies on a minimum level of what is termed 'synchronous generation'. Traditional thermal power plants are 'synchronous', which means they involve tons of spinning metal. Solar is considered 'asynchronous'. Eventually, we will re-engineer our system using batteries, energy storage and devices called 'synchronous condensers' so that we can deal with large amounts of asynchronous generation. Until then, low levels of minimum demand are an issue we need to manage.

Several solutions have already been proposed. Large amounts of zero marginal cost generation is a good problem to have, and perhaps the best solution to the issues of minimum demand is to develop industries that can compete by using low-cost energy when it is in excess. Hydrogen production could be an ideal industry

for this application, and electric vehicles could be a new source of demand for cheap, renewable electricity. Tariffs that encourage greater energy usage during peak solar hours or programs to drive the uptake of home batteries are another example of encouraging load to take advantage of an abundance of zero marginal cost electricity.

Another solution being trialled in South Australia is giving the market operator the ability to remotely turn off rooftop solar systems when the state is disconnected from the rest of the grid and low minimum demand is causing problems. A better, long-term solution is something called a 'dynamic operating envelope'. This approach would result in an export limitation on solar systems, with the limit varying according to load, generation and the conditions of the grid.





Image: Daramu House, New South Wales

## **CASE STUDY INNOVATIVE INSTALLATION GIVES SOLAR POWER PLANTS A WHOLE NEW MEANING**

As more homeowners and businesses look to join the rooftop solar revolution, designers and installers are being asked to install systems that would have once been considered too difficult or too expensive.

However, as expertise in the industry has increased and prices have come down, designers and installers are coming up with increasingly innovative solutions to meet the more challenging requirements of their customers.

Nowhere is this innovation better illustrated than the installation on Daramu House in the centre of the Sydney CBD. The installation was required to be seamlessly integrated into the building's wooden construction and green roof, allowing for plant growth throughout the solar array

and underneath the panels. Also, the system had to meet strict requirements to contribute to the building's targeted 6 Star Green Star rating.

The resulting system is a striking demonstration of how solar technology can function in harmony with green spaces, and even in a mutually beneficial relationship.

After the system was installed, it became apparent that the use of plants in and around the solar panels absorbed some of the heat. This lowered the temperature of the panels and allowed them to operate more efficiently, while the combination of shade and ambient light provided by the panels allowed for better than expected plant growth.

The system's prominent location and aesthetically pleasing design means that it serves as a stunning visual endorsement of the possibilities of utilising rooftop areas for green spaces and renewable energy.

The project's unique design and innovative solutions earned Autonomous Energy's Matthew Linney and Jarrod Shepherd a 2020 Clean Energy Council Solar Design and Installation Award in the 30-240 kW category.



# LARGE-SCALE RENEWABLE ENERGY



Image: Houghton Solar Farm, Queensland





76

large-scale projects under construction at the end of 2020

9000

workers constructing large-scale projects at the end of 2020

When the extent of the COVID-19 pandemic first became apparent in the early months of 2020, there were some dire predictions about the prospects for the large-scale renewable energy industry.

However, the sector was able to ride through most of these challenges, completing 32 projects with a capacity of almost 2 GW throughout the year.

A further 76 large-scale renewable energy projects were under construction at the end of 2020, representing more than 8 GW of new capacity and employing over 9000 Australian workers, often in regional areas. Of these projects, 49 were large-scale solar farms, 21 were wind farms and three were bioenergy plants. A further three were hybrid plants, producing at least two different types of renewable energy. Despite making up just over a quarter of all projects under construction, the wind sector is responsible for over half of the new capacity, with more than 4 GW of new wind generation currently being built.

The utility-scale battery sector saw a number of significant developments in 2020. The most notable of these was the expansion of the Hornsdale Power Reserve to 150 MW/194 MWh, which will allow Australia's biggest battery to provide additional grid support services such as inertia to help stabilise the grid.

An additional 16 utility-scale batteries were under construction at the end of 2020, representing more than 595 MW of new capacity. Several new major project announcements in 2020 provided a further boost to the sector, including a 300 MW battery

in Victoria, Western Australia's first large-scale battery and a plan to install a mammoth 1.2 GW battery in New South Wales' Hunter Valley.


The development of Snowy 2.0 and the Battery of the Nation hydro projects continued to make steady progress in 2020. Snowy 2.0 received state and federal environmental approval during the year and a \$125 million transmission investment from the Clean Energy Finance Corporation, putting the project on track to begin construction in 2021. In Tasmania, the Battery of the Nation named its first pumped hydro site, while Marinus Link – the interconnector that is a critical component of the project – received a \$94 million commitment from the Federal Government.

The large-scale sector faced its fair share of obstacles during the year. The most prominent challenges continue to be related to the electricity grid and the lack of a federal energy policy, with the convoluted grid connection process, network congestion and energy policy inaction causing significant uncertainty for developers. While reform initiatives such as the Energy Security Board's post-2025 market review are working to alleviate grid-related issues and state and territory governments are taking energy policy into their own hands, it will take significant time and effort to solve the problems caused by years of inaction and neglect.

# FEDERAL POLITICS

With fires raging across much of Australia at the beginning of the year, it seemed inevitable that climate change would drive the political agenda in 2020. However, the arrival of COVID-19 in March changed the political narrative to one of bipartisanship and cooperation as the country came together to overcome the pandemic's immediate health impacts.





As the worst effects of the pandemic abated, the focus shifted to the economic recovery, with a multitude of organisations, including the Clean Energy Council, calling on the Federal Government to stimulate the economy by accelerating the clean energy transition and introducing measures to reduce Australia's emissions profile. The government instead opted for a "gas-fired recovery" that included a threat to build a government-owned 1000 MW gas-fired power station in NSW.

While this debate signified a continuation of the political deadlock that has so afflicted national climate and energy policy over the past 15 years, there were some very positive developments in 2020. In September, the government released its much-anticipated Technology Investment Roadmap, which it is heavily relying on to help the country meet its emissions reduction targets. While the roadmap's prioritisation of renewable hydrogen, energy storage and green steel were steps in the right direction, the plan passed up the opportunity to better

utilise and integrate Australia's existing wind and solar resources and drive the uptake of new technologies such as electric vehicles and offshore wind.

The government also provided \$1.9 billion to extend the Australian Renewable Energy Agency (ARENA) for another decade in September 2020. While the extension of one of Australia's few renewable energy policy success stories was a welcome announcement, some of the gloss was taken off by the caveat that will change the remit of ARENA and the Clean Energy Finance Corporation to encourage investment in carbon capture and storage, and gas projects. This change risks undermining investor confidence in Australia's energy system transition and could further politicise energy policy.

On the other side of the aisle, the Federal Labor party introduced the Rewiring the Nation initiative in October 2020. The plan would establish a government-owned entity that will offer \$20 billion in low-cost finance to build out the strategic

transmission projects outlined in the Australian Energy Market Operator's Integrated System Plan. The new entity, which mandates the use of local supply and labour, would provide the necessary investment to expedite the modernisation of Australia's electricity system and unlock the full potential of Australia's renewable energy resources.

Towards the end of 2020, the pressure on the Federal Government to increase its emissions reduction ambitions ramped up again following the election of Joe Biden as US President and several of Australia's major trading partners – including Japan, China and South Korea – adopting a target of zero net emissions by 2050 or 2060. While the Federal Government has so far stubbornly resisted calls to adopt a similar mark, the momentum generated by the states and territories and the growing impatience of the international community may well force the government's hand in 2021 and in the lead up to the next federal election.





# STATE POLICIES

In the continued absence of federal energy policy, the states and territories took the lead in 2020, introducing a range of ambitious policies to accelerate Australia's renewable energy transition.

Most positively, these policies occurred across the political divide, with Liberal and Labor governments alike making strong commitments to renewable energy.

This is already having a noticeable impact on the electricity system, with many states and territories recording new records for renewable generation throughout the year and the proportion of renewable energy in almost every state and territory increasing significantly.





## KEY INITIATIVES

- **Pledge to install a 250 MW battery network**
- **Net-zero emissions by 2045**
- **Phasing out all gas use by 2045**

Despite achieving its 100 per cent renewable energy target in 2019, the ACT didn't sit back and admire its nation-leading achievements in 2020. Instead, the territory undertook its fourth renewable energy auction during the year to ensure that it stays at 100 per cent clean energy as its population grows, the adoption of electric vehicles increases and more households make the shift from gas to electric appliances.

The auction secured 200 MW of new wind generation from Neoen's Goyder Renewables Zone in South Australia and Global Power Generation's Berrybank Wind Farm in Western Victoria, both at prices lower than any other publicly disclosed in Australia so far. The auction also required that storage be included as part of each bid, which will result in a 50 MW battery and a 10 MW/20 MWh battery being built in the territory.<sup>3</sup>

The ACT went to the polls in October 2020, with renewable energy and climate change firmly on the policy agenda. Labor and the ACT Greens, who had governed in a coalition since 2008, both took ambitious renewable energy and climate policies to the election, while the Liberal campaign focused strongly on cost-of-living considerations.

Labor pledged to install a 250 MW battery network across the ACT, expand the uptake of distributed energy resources and improve the electrification of public transport. The Greens committed to a 2045 net-zero emissions target and increased efforts to drive greater electrification of homes and businesses in the ACT, with the aim of phasing out all gas use in the territory by 2045. The Liberal party recommitted to the ACT's 100 per cent renewable energy target and introduced several initiatives to improve recycling in the territory.

The election resulted in the comfortable re-election of the Labor-Greens coalition for a fourth term, with the Greens gain of four seats serving as a strong endorsement of the party's ambitious climate platform.

In December 2020, the ACT Minister for Energy, Water and Emissions Reduction announced that the ACT is the first jurisdiction with a population of more than 100,000 people outside of Europe to reach 100 per cent renewable energy.<sup>4</sup> This achievement has not only reduced electricity prices for Canberrans, which will be 2.56 per cent lower in the 2020/21 financial year, it has also put the ACT firmly at the forefront of Australia's renewable energy transition and demonstrates the possibilities of powering a large city with renewable energy.

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<sup>4</sup> N Fuller, *Canberra Weekly, ACT a 'nation-leader' in renewable energy*, 4 December 2020, [canberraweekly.com.au/act-a-nation-leader-in-renewable-energy](https://canberraweekly.com.au/act-a-nation-leader-in-renewable-energy)



# 250 MW

size of a battery network to be installed across the ACT

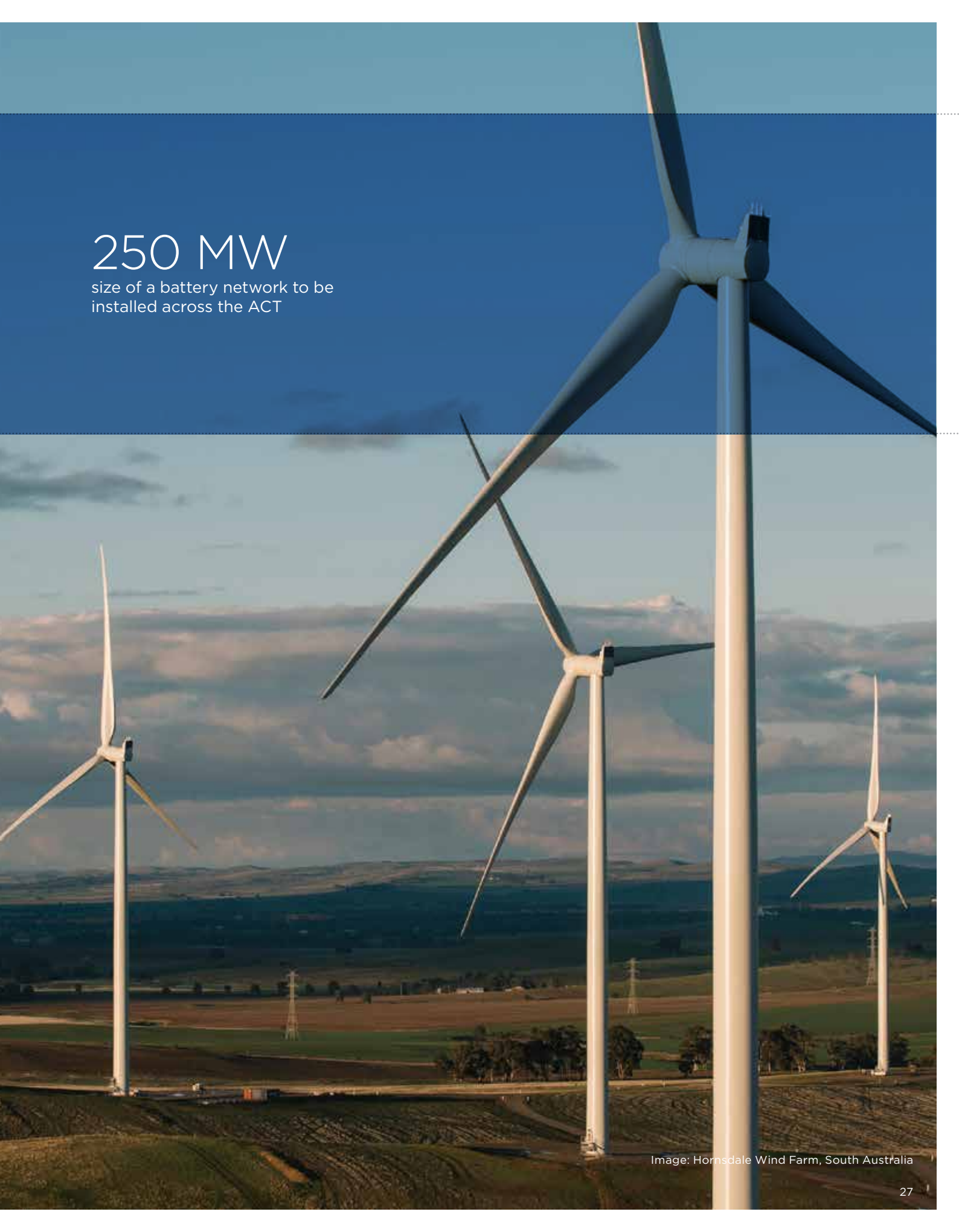


Image: Hornsdale Wind Farm, South Australia



## KEY INITIATIVES

- **Energy Infrastructure Roadmap to deliver 12 GW of new transmission capacity**
- **The roadmap will increase NSW's renewable energy penetration to over 60 per cent by 2030**

After lagging behind many of its state and territory counterparts on renewable energy policy in recent years, New South Wales vaulted into the lead in 2020 after releasing Australia's most ambitious renewable energy plan.

The Electricity Infrastructure Roadmap will deliver 12 GW of new transmission capacity in NSW through the Central-West Orana, New England and South West renewable energy zones, attracting up to \$32 billion in private investment and supporting 3 GW of long-duration storage and firming projects, including pumped hydro, by 2030. The roadmap will also create 6300 construction and 2800 ongoing jobs in regional Australia, reduce electricity prices in the state by \$130 per year for households and \$430 for small businesses, and reduce NSW's carbon emissions by an estimated 90 million tonnes.<sup>5</sup> By the time it is complete, the roadmap will have installed as much

renewable energy in NSW as is currently installed in the whole of Australia and will increase the state's renewable energy penetration from its current level of 16 per cent to over 60 per cent by 2030.<sup>6</sup>

Despite receiving some strong opposition from the usual suspects in the Federal Government, the policy, which was introduced by the Liberal Berejiklian Government, received bipartisan support from NSW Labor and the Greens. This cross-party support for renewable energy is a promising development that has been a feature of state and territory politics throughout 2020.

One of the key drivers of the Electricity Infrastructure Roadmap is the imminent closure of several of NSW's coal-fired power stations, the first of which will be the Liddell power station in 2023. The closure of Liddell continued to be

a significant point of contention in 2020, with the Morrison Government threatening to build a 1000 MW gas-fired power station in the Hunter Valley if the private sector fails to replace Liddell's capacity by April 2021. This plan was widely condemned by the renewable energy industry, which pointed out that the Australian Energy Market Operator has only forecast a 150 MW shortfall when Liddell closes and the clean energy commitments made by AGL and other private businesses will more than replace the retired generation.<sup>7</sup>

As the events of 2020 show, renewable energy is still a hotly-contested topic in NSW. But after a sluggish start, Australia's largest state is now well and truly on the way to becoming an attractive destination for renewable energy investment.

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7 L Tingle, ABC News, *The Government's backing of a new power plant is a gas-fired distraction*, 19 September 2020, [abc.net.au/news/2020-09-19/government-backing-power-plant-gas-fired-distraction/12677222](https://abc.net.au/news/2020-09-19/government-backing-power-plant-gas-fired-distraction/12677222)

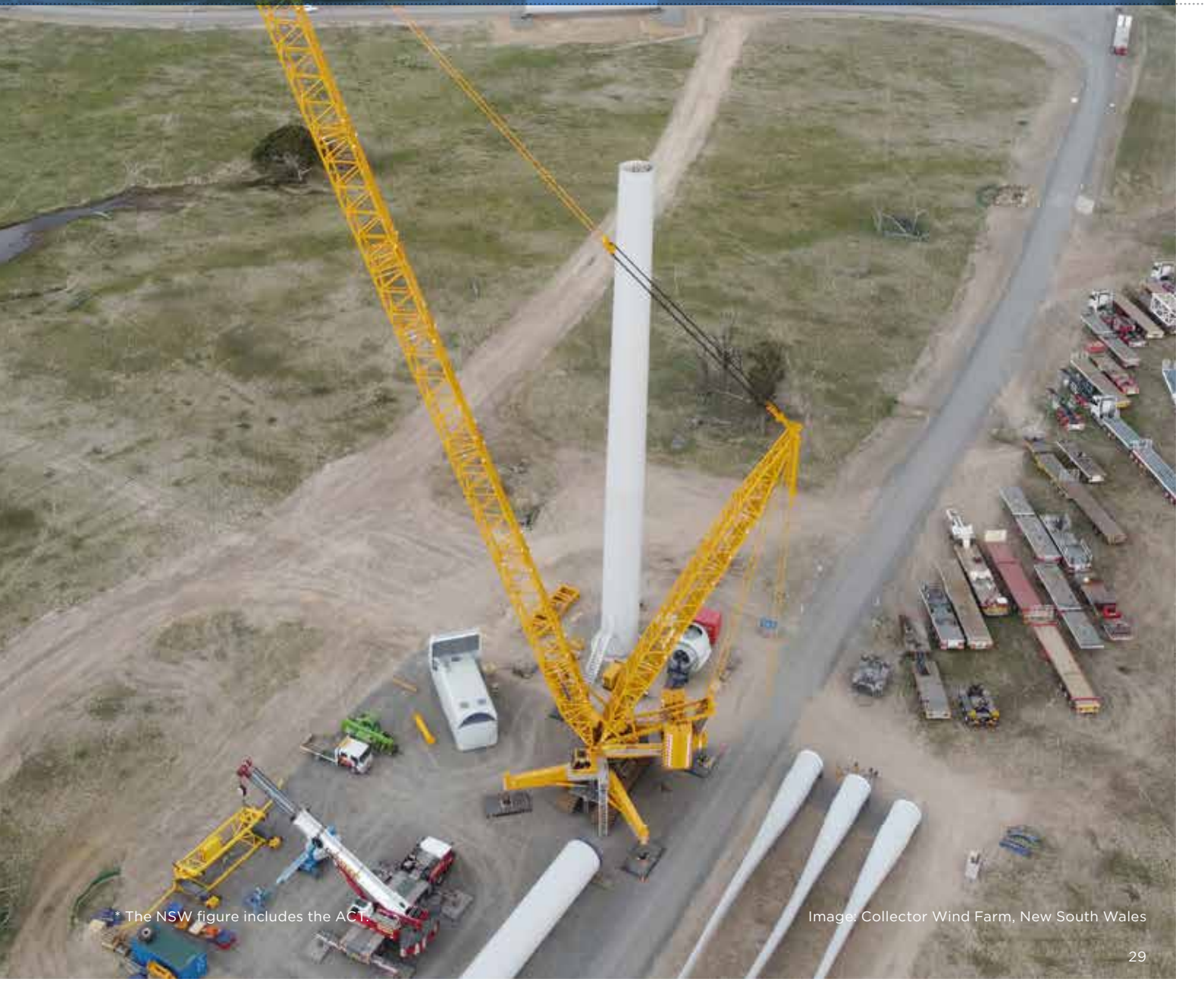




21.0%  
of New South Wales' electricity generation came from renewables in 2020\*



19.1%  
of New South Wales' electricity consumption was served by renewables in 2020\*



\* The NSW figure includes the ACT.

Image: Collector Wind Farm, New South Wales



## KEY INITIATIVES

- **50 per cent renewable energy target by 2030**
- **35 MW battery to support the Darwin-Katherine grid**
- **\$6000 grants available through the Household and Business Battery Scheme**

In 2020, the Northern Territory continued to make steady progress towards its target of 50 per cent renewable energy by 2030, with the territory sourcing 16 per cent of its electricity from renewables, up from 8 per cent the previous year.<sup>8</sup>

The industry was given a significant boost in April 2020, when the NT Government announced that it would procure a 35 MW battery to enable more renewable energy from large-scale solar projects, reduce electricity prices and cut carbon emissions. The battery, which will be installed to support the Darwin-Katherine grid, is expected to become operational in the second half of 2022. The government also announced the Household and Business Battery Scheme at the same time, which offers NT households and businesses a \$6000 grant to install a battery with a new or existing rooftop solar system.

Both these battery announcements were designed to improve grid stability in the territory, which emerged as a significant issue in 2020. This was largely due to inadequate planning for the rapid influx of renewable energy into the system, which forced the territory's Utilities Commission to introduce tough new technical requirements on large-scale solar generators and resulted in a significant reduction in the NT's solar feed-in tariff from \$0.24/kWh to \$0.08/kWh.<sup>9</sup>

The Federal Government granted the Sun Cable project 'major project status' in July 2020<sup>10</sup>, which will make it easier for the mega-project to navigate through various approval processes. Sun Cable is planning to build a 10 GW solar farm halfway between Darwin and Alice Springs, and export the electricity produced to Singapore and Indonesia via an undersea cable.

The NT Government also unveiled its Renewable Hydrogen Strategy in July 2020, which outlines the territory's "aspiration to be an international-scale renewable hydrogen technology research, production and downstream manufacturing centre."<sup>11</sup>

The 2020 NT election was an important one for renewable energy in the top end, with the Country Liberal Party promising to scrap the territory's renewable energy target if it was elected. However, the Labor Government was re-elected for a second term, albeit with a reduced majority, and has pledged to keep working towards the NT's goals of reaching 50 per cent renewables by 2030 and achieving net-zero emissions by 2050.

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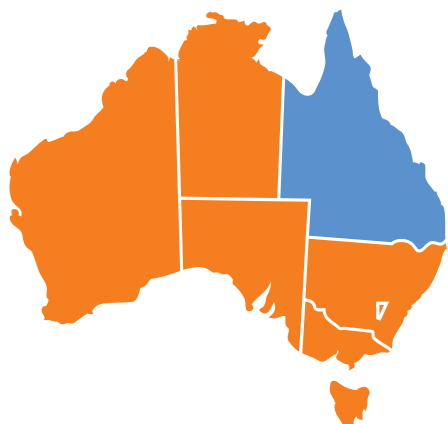
35 MW

size of a new battery to support the Darwin-Katherine grid



Image: Yulara Solar Farm, Northern Territory





## KEY INITIATIVES

- **\$145 million to support three new renewable energy corridors**
- **50 per cent renewable energy target by 2030**
- **\$500 million Renewable Energy Fund to support renewable energy projects**

The most significant renewables development in Queensland in 2020 was the state government's announcement of three new renewable energy corridors in the north, central and south-west parts of the state. These corridors will be supported by \$145 million in infrastructure investment, with the idea that each corridor will host several renewable energy zones (REZs). The plan gained further momentum in September 2020, when the government devoted half of its \$1 billion COVID-19 recovery spending in the state budget to a Renewable Energy Fund. The \$500 million fund will allow Queensland's "publicly-owned energy corporations to increase public ownership of commercial renewable energy projects and support infrastructure"<sup>12</sup>, which will likely occur in REZs across the state.

These investments gave a much-needed boost to renewable energy development in Queensland, which has slowed in recent years, with just three large-scale projects being financially committed in the 18 months from January 2019 to June 2020. With renewables currently representing around 20 per cent of

Queensland's energy mix, there is still a lot of work to be done if the state is to reach its target of 50 per cent renewable energy by 2030.

Several developments in North Queensland in 2020 will help the state towards its 2030 target, including the CopperString 2.0 transmission line and Genex's Kidston pumped hydro project. CopperString 2.0, an 1100 km transmission link between Townsville and Mt Isa, received \$14.8 million from the Queensland Government in May 2020 and further support in the Federal Budget that could result in construction starting in 2021.

After overcoming several challenges in recent years, Genex's Kidston pumped hydro inched closer to financial close in 2020, with the company signing a revised offtake agreement with EnergyAustralia in March. The project, which has received a \$132 million commitment from the Queensland Government and a \$610 million loan from the Northern Australia Infrastructure Facility, is expected to begin construction in 2021.

The two major parties were neck and neck heading into the Queensland state election in October 2020, with Queensland Premier Annastacia Palaszczuk seeking an historic third term in government. In a campaign dominated by COVID-19, the incumbent Labor government presented a series of strong renewable energy commitments to the electorate, including \$30 million to install rooftop solar systems on public hospitals and \$10 million for the state's emerging hydrogen industry. In contrast, the Liberal National Party pledged to scrap Queensland's 2030 renewable energy target and net-zero emissions by 2050 goal if it was elected, instead aligning the state with the Federal Government's far less ambitious targets.<sup>13</sup>

Despite predictions of a closely-fought contest, the Labor party won comfortably, increasing its majority and reinforcing the state's commitment to take positive action on renewable energy and climate change.

<sup>12</sup> T Crockford, Brisbane Times, *Queensland's \$500m surge to help meet 2030 renewable energy target*, 7 September 2020, [brisbanetimes.com.au/national/queensland/queensland-s-500m-surge-to-help-meet-2030-renewable-energy-target-20200907-p55t23.html](https://www.brisbanetimes.com.au/national/queensland/queensland-s-500m-surge-to-help-meet-2030-renewable-energy-target-20200907-p55t23.html)

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16.6%  
of Queensland's  
electricity generation  
came from renewables  
in 2020



18.0%  
of Queensland's  
electricity  
consumption  
was served by  
renewables in 2020



Image: Warwick Solar Farm, Queensland





## KEY INITIATIVES

- **Plan for renewable energy to account for more than 500 per cent of the state's electricity demand**
- **Three renewable hydrogen export hubs featuring electrolyzers of up to 2.6 GW**
- **\$3 billion wind and solar project with a 900 MW/1800 MWh battery**

The remarkable work done in recent years to transform South Australia into a renewable energy powerhouse came to fruition in 2020, with the state breaking several clean energy records during the year as it rapidly approaches its 100 per cent renewable energy target.

The most notable of these records was broken in October 2020, when 100 per cent of SA's power was supplied by solar over a one-hour period. This was the first time that such a milestone had been achieved by a jurisdiction as large as SA anywhere in the world.<sup>14</sup> However, the overwhelming success of rooftop solar in SA has increased pressure on the grid, resulting in the introduction of new technical requirements that allow the market operator to remotely

turn off rooftop solar systems and new tariffs to encourage increased energy usage during peak solar hours.

SA got 60 per cent of its electricity from renewables in 2020<sup>15</sup>, with generation peaking at 73 per cent for the month of September.<sup>16</sup> As a result, the Australian Energy Market Operator expects SA to achieve its 100 per cent renewable energy target by 2025, five years ahead of schedule.<sup>17</sup> SA's increased renewable energy generation has translated into significant price reductions, with the state recording the lowest wholesale prices in the National Electricity Market for the last four months of 2020.<sup>18</sup>

With significant new clean energy and storage projects planned for the state in coming years – including a proposed

\$3 billion wind and solar project that will include a 900 MW/1800 MWh battery<sup>19</sup> – the SA Government has already begun to look beyond 2030. Its 2021–2025 Climate Change Action Plan, released in December 2020, envisaged a future where renewable energy accounts for more than 500 per cent of the state's electricity demand.<sup>20</sup>

Much of this excess electricity is expected to fuel SA's nascent renewable hydrogen sector, which made some significant advances in 2020. This included plans for three renewable hydrogen export hubs featuring electrolyzers of up to 2.6 GW and the Hydrogen Park South Australia project, an Australian first that involved adding a 5 per cent hydrogen blend into the gas supply of an Adelaide suburb.<sup>21</sup>

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59.7%  
of South Australia's  
electricity generation  
came from renewables  
in 2020



60.1%  
of South Australia's  
electricity  
consumption  
was served by  
renewables in 2020



Image: Hornsdale Power Reserve, South Australia



## KEY INITIATIVES

- **200 per cent renewable energy target by 2040**
- **Renewable Hydrogen Action Plan to make Tasmania a significant global producer and exporter of renewable hydrogen by 2030**
- **Battery of the Nation names first pumped hydro site**

Tasmania achieved a significant milestone in 2020, becoming the first Australian state to reach 100 per cent renewable energy in November 2020. The mark was reached well ahead of the original schedule of 2022 and put Tasmania in the illustrious company of the few jurisdictions worldwide – including Scotland, Iceland and Costa Rica – that have made the transition to 100 per cent clean energy.<sup>22</sup>

However, instead of resting on its laurels, the Tasmanian Government increased its ambition in May 2020, indicating that it would pursue a 200 per cent renewable energy target by 2040. The Tasmanian Renewable Energy Target was legislated by the Tasmanian Parliament in November 2020, making it the world's most ambitious renewable energy target and cementing the state as a world leader in renewable energy.

According to the Tasmanian Government's Renewable Hydrogen Action Plan, much of this excess renewable energy capacity will be used to build a substantial renewable hydrogen export industry. The ambitious plan sets goals for Tasmania to begin producing renewable hydrogen by 2024, exporting it by 2027 and for the state to become a significant global producer and exporter of renewable hydrogen by 2030.<sup>23</sup> In addition, the state plans to use hydrogen for a considerable proportion of local energy consumption. The government released a status report outlining its progress in November 2020<sup>24</sup>, which showed that the state is on track to achieve its goals.

The Battery of the Nation project continues to make steady progress, with Hydro Tasmania naming Lake

Cethana in north-west Tasmania as its first pumped hydro site for the project.<sup>25</sup> The Battery of the Nation project depends on Marinus Link's construction, a second interconnector between Tasmania and Victoria used to export excess Tasmanian renewable energy to the mainland. This crucial project received a considerable boost towards the end of 2020, with the Federal Government making a \$94 million commitment to take the interconnector to the final investment decision stage. While it is still undecided how the funding for the \$3.5 billion project will be distributed between Tasmania, Victoria and the Commonwealth, the continued progress is a positive sign that Marinus Link will get the green light and unlock Tasmania's considerable renewable energy potential.

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99.2%  
of Tasmania's  
electricity generation  
came from renewables  
in 2020



100.6%  
of Tasmania's  
electricity  
consumption  
was served by  
renewables in 2020



Image: Granville Harbour Wind Farm, Tasmania



## KEY INITIATIVES

- **Second renewable energy auction to procure 600 MW of new solar and wind energy**
- **\$540 million committed to establish six renewable energy zones**
- **Solar Homes program expanded to landlords and renters**

COVID-19 had a major impact on the Victorian renewable energy industry in 2020. The state's lockdown forced the rooftop solar industry to shut down completely for almost two months in the middle of the year. However, this failed to dent the industry's momentum in the state, with new records set for both rooftop solar capacity and installations.

The strong performance of rooftop solar is largely due to the Solar Homes program, which was expanded in July 2020 to encourage more solar installations on rental properties. The program now offers interest-free loans to landlords that install solar on their rental properties on top of the rebate they can already receive, allowing more renters to reap the benefits of rooftop solar.<sup>26</sup>

After overcoming the second wave of the pandemic, attention quickly

turned to the economic recovery, and the Victorian Government placed renewable energy at the forefront of its plans. In September 2020, the government announced a second auction as part of the Victorian Renewable Energy Target that will seek to procure 600 MW of new solar and wind energy for the state.<sup>27</sup> While the auction is still in the early stages of development, the additional 600 MW of clean energy will allow all government operations in the state to be powered by 100 per cent renewable energy and help Victoria achieve its ambitious target of 50 per cent renewables by 2030.

To further support the target, the Victorian Government committed \$540 million to establish six renewable energy zones (REZs) in its November 2020 state budget. The six REZs will focus on solar in the north of the state,

wind in the south-west and Gippsland, and pumped hydro in the Victorian Alps. The REZs are designed to solve some of the challenges that the Victorian transmission network faced in 2020, with the prime example being the five operational solar farms in the state's north-west that were required to severely curtail their output to ensure grid stability in early 2020.<sup>28</sup>

Further strengthening the grid to allow for more renewable capacity to be added was a focus for the Victorian Government in 2020. As such, several new utility-scale batteries were announced over the course of the year, including a 300 MW battery near Geelong to be built by Neoen<sup>29</sup> and a 200 MW/800 MWh battery to be built by AGL at the site of the Loy Yang coal-fired power station.<sup>30</sup>

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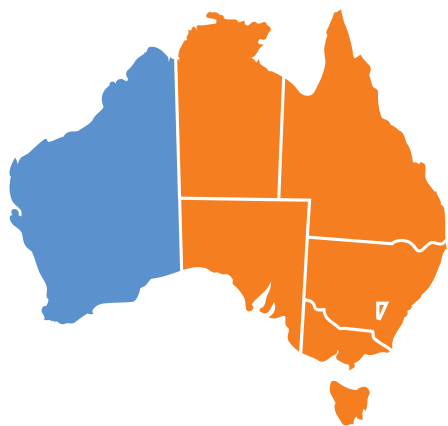
27.7%  
of Victoria's electricity  
generation came from  
renewables in 2020



28.4%  
of Victoria's  
electricity  
consumption  
was served by  
renewables in 2020



Image: Dundonnell Wind Farm, Victoria



## KEY INITIATIVES

- **100 MW/200 MWh battery planned, the first on WA's main grid**
- **Renewables expected to account for 70 per cent of generation by 2040**
- **\$22 million investment to bring forward renewable hydrogen targets to 2030**

Despite traditionally lagging behind the eastern states when it comes to renewable energy, Western Australia made up significant ground in 2020 off the back of its substantial distributed energy resources and increasing ambition in utility-scale clean energy.

The most significant development in 2020 was the release of WA's first Whole of System Plan (WOSP), which provides a 20-year outlook on the future of the South West Interconnected System. The WOSP modelled four scenarios for WA's main grid, with renewables expected to account for at least 70 per cent of generation capacity under all four scenarios by 2040. Wind was the preferred form of large-scale capacity in the WOSP, with the highest demand scenario expected to see more than 3000 MW of new wind capacity added over the next 20 years.<sup>31</sup>

The WA Government announced plans to build a 100 MW/200 MWh battery

at the decommissioned Kwinana power station in October 2020. This will be the first battery built on the state's main grid and will be the second-largest battery in Australia upon completion, which is expected in 2022. The battery is designed to support the integration of more renewable energy and improve grid security, and it will help to soak up some of the excess solar power produced by WA's strong uptake of rooftop solar, which is forecast to increase to 50 per cent of all WA households by 2030.<sup>32</sup>

When it comes to new innovative uses for rooftop solar and batteries, WA is well ahead of its eastern counterparts. Legislation passed in 2020 by the WA Parliament will allow the use of stand-alone power systems to serve customers in rural and remote locations. The WA Government also introduced a policy in 2020 to allow the use of neighbourhood batteries, which will enable customers to

store excess solar electricity generated during the day and withdraw it at night or share it with their neighbours. WA is the first state in Australia to introduce such policies, making it a leader in exploring the exciting possibilities enabled by a distributed energy future.

WA also began looking to the future of hydrogen in 2020, making several significant investments in the emerging technology. This included a \$22 million investment by the WA Government in August 2020, which involved bringing forward the state's renewable hydrogen targets from 2040 to 2030 and a proposal to develop a 1.5 GW renewable energy and hydrogen hub north of Geraldton.

31 I Hartmann, Energy Magazine, *WA's Whole of System Plan forecasts renewable generation on the rise*, 13 October 2020, [energymagazine.com.au/was-whole-of-system-plan-forecasts-renewable-generation-on-the-rise](https://energymagazine.com.au/was-whole-of-system-plan-forecasts-renewable-generation-on-the-rise)

32 G Parkinson, RenewEconomy, *West Australia to build 100MW big battery - the first on state's main grid*, 3 October 2020, [reneweconomy.com.au/west-australia-to-build-100mw-big-battery-the-first-on-states-main-grid-78594](https://reneweconomy.com.au/west-australia-to-build-100mw-big-battery-the-first-on-states-main-grid-78594)





24.2%  
of Western Australia's  
electricity generation  
came from renewables  
in 2020



24.2%  
of Western  
Australia's electricity  
consumption  
was served by  
renewables in 2020



Image: Ord River Hydro Power Station, Western Australia



# EMPLOYMENT



Image: Warwick Solar Farm, Queensland

The Australian renewable energy industry employed over 25,000 people in 2019, and the prospects for further job creation are bright as the sector continues to expand.

In 2019, the Clean Energy Council commissioned the University of Technology Sydney's Institute for Sustainable Futures to conduct a study of employment in the Australian renewable energy industry. This is the first-ever national study of employment in the sector and provides a comprehensive insight into the number of people currently employed in renewable energy, the jobs they are performing and the future prospects for employment in the industry.

The study found that more than a third of renewable energy jobs in 2019 were in the small-scale solar segment, with 37 per cent of the clean energy workforce involved in installing solar on the rooftops of Australian homes and businesses. This is reflected in

the continued growth in the number of Clean Energy Council Accredited Installers, which grew by 17 per cent in 2020 to reach 7713, and Approved Solar Retailers, which grew by 66 per cent to pass 1100 for the first time.

Wind was the clean energy industry's second-largest employment segment in 2019, employing 7200 people to account for 28 per cent of jobs. It was followed by large-scale solar with 13 per cent and hydro with 10 per cent. Battery installation and solar water heating made up the remainder of jobs in the industry.

Victoria was the leading jurisdiction for clean energy jobs, employing 30 per cent of Australia's clean energy workforce. However, New South Wales and Queensland weren't far behind, with

both states accounting for 24 per cent of clean energy workers.

Unsurprisingly, the vast majority of jobs in the industry were in the development, construction and installation of new renewable energy projects, representing 72 per cent of employment. However, this is expected to shift considerably as the industry matures over the next decade. Some scenarios forecast that up to 50 per cent of jobs could be ongoing positions in operations and maintenance at existing clean energy sites.

Skills shortages continue to be a challenge for renewable energy developers and installers, with policy uncertainty, the project-based nature of construction and installation jobs, remote site locations and salary competition with other industries making





25,000+  
jobs in renewables

37%  
proportion of clean energy  
jobs in rooftop solar

30%  
proportion of clean energy  
workforce employed in Victoria

72%  
proportion of clean energy  
jobs in the construction and  
installation sectors

it difficult for the industry to attract and retain suitably qualified employees.

In the large-scale sector, employers have found it particularly difficult to attract construction managers and engineers, while the small-scale sector has experienced the most trouble sourcing appropriately qualified electricians, supervisors and roofers.

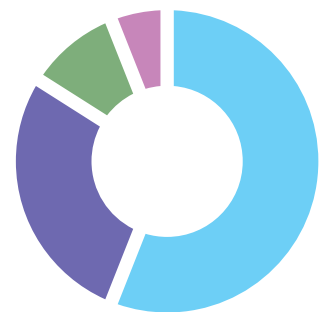
Regardless of these challenges, the study presents a comprehensive snapshot of the quality job opportunities provided to thousands of Australians by the renewable energy industry. Employment in clean energy will grow strongly in the coming years as the renewable energy transition gathers pace, allowing more Australians to earn a living from renewable energy.

### RENEWABLE ENERGY JOBS BY STATE, 2019



Victoria	30%
Queensland	24%
New South Wales	24%
South Australia	9%
Western Australia	9%
Tasmania	4%

### RENEWABLE ENERGY JOBS BY TECHNOLOGY, 2019



Solar	56%
Wind	28%
Hydro	10%
Batteries	6%

## CASE STUDY

# INDUSTRY POISED TO LEAD COVID-19 RECOVERY IF CLEAN ENERGY IS PUT TO WORK

In mid-2019, the Clean Energy Council commissioned the University of Technology Sydney's Institute for Sustainable Futures to undertake research to understand the size and characteristics of the Australian renewable energy workforce. The result of this research was *Clean Energy at Work*, the first comprehensive study of current and projected employment in the Australian renewable energy industry.

The *Clean Energy at Work* report found that at least 25,000 people were employed across the renewable energy industry in 2019.

In addition to measuring current employment, the report also estimated future job creation by formulating employment factors for clean energy in Australia and then applying them to the scenarios developed in the Australian Energy Market Operator's (AEMO) 2020 draft Integrated System Plan.

This found that the Australian renewable energy industry could employ as many as 44,000 people by 2025 if Australia adopts AEMO's Step Change Scenario. However, if the industry continues on its current trajectory – what AEMO deems its Central Scenario, where no additional state or federal policies are put in place – the industry could lose upwards of 11,000 jobs in the next three years.

The creation of almost 20,000 new jobs over the next five years is ideally timed to help the many Australians who have been directly impacted by the COVID-19 pandemic. As the *Clean Energy at Work* report shows, the renewable energy industry is ready to provide these much-needed job opportunities if the federal and state governments are willing to embrace an ambitious clean energy transition.



Image: Warwick Solar Farm, Queensland



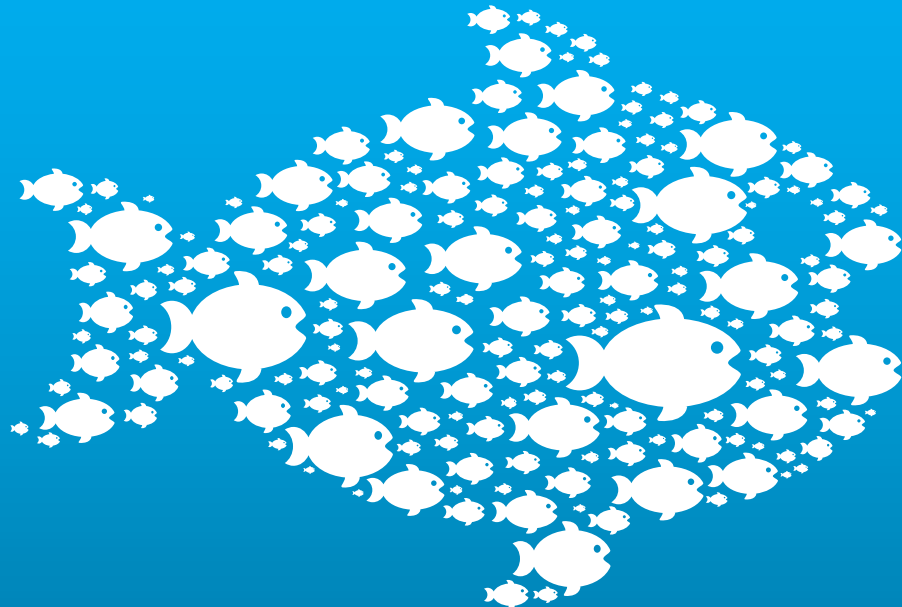
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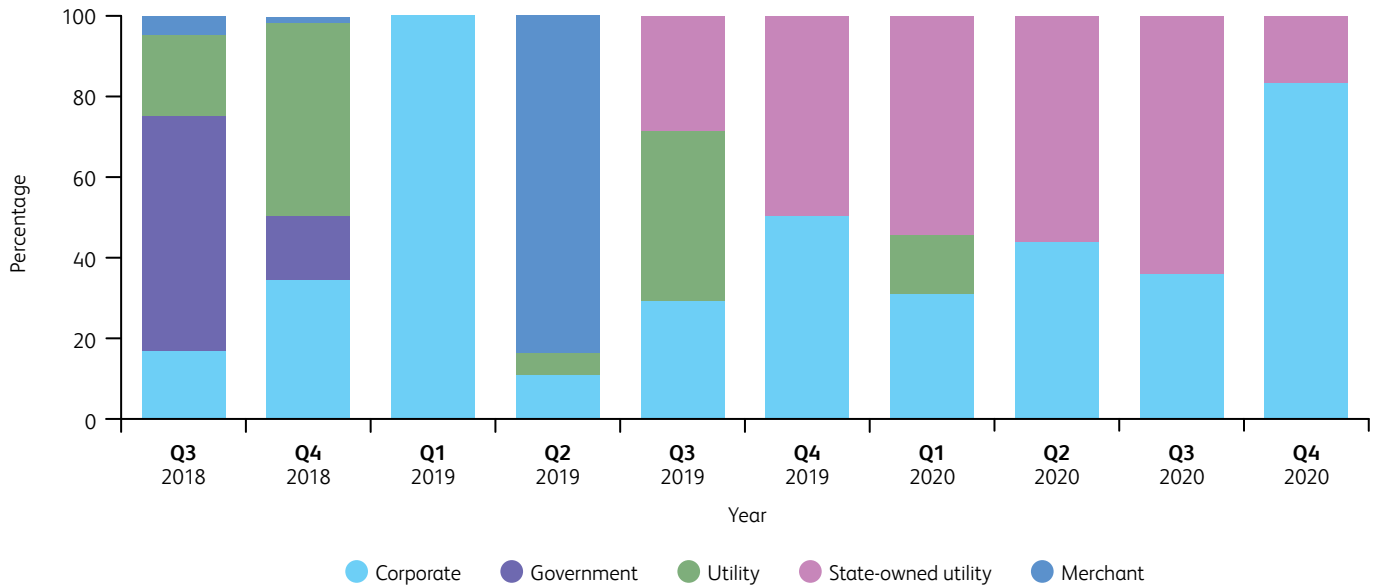
# In the Peter Lee Associates Large Corporate & Institutional Relationship Banking surveys, New Zealand and Australia, ANZ Bank New Zealand Limited was Rated No.1 for Relationship Strength Index in the 2010 through to 2019 surveys and Australia and New Zealand Banking Group Limited was Rated No.1 for Relationship Strength Index in the 2014 through to 2019 surveys. \*ANZ and the transaction for A\$1.25 billion (\$903 million) Sustainable Development Goals bond. \*\*FinanceAsia Australia & NZ Achievement Awards 2020. \*\*\*IFR Asia Awards 2020. \*\*\*\*Asset Triple A Infrastructure Awards Asia 2020. Australia and New Zealand Banking Group Limited (ANZ) ABN 11 005 357 522.



# RENEWABLES FOR BUSINESS

After a dip in 2019, Australian corporate renewable power purchase agreements (PPAs) had a record year in 2020, passing the 1 GW mark for the first time.

## CORPORATE PPA MARKET SEGMENTS, 2018-20<sup>33</sup>



There were 26 corporate renewable PPAs announced in 2020, directly contracting 1.3 GW and supporting more than 4.5 GW of renewable energy generation. More than \$2 billion was invested in renewable energy through corporate PPAs throughout the year, led by well-known businesses such as Aldi, Amazon and Coles, large energy users such as Transurban and Newcrest Mining, and a range of mid-sized public sector buyers including Macquarie University, the City of Adelaide and CSIRO.

Some of the noteworthy deals in 2020 included:

- BHP signed two corporate PPAs, including a contract for 420 GWh from Australia’s largest wind and solar farms – the 400 MW Western Downs Solar Farm and the 1000 MW MacIntyre Wind Farm
- Amazon entered into PPAs with the 146 MW Gunnedah Solar Farm and the 150 MW Suntop Solar Farm in New South Wales and Victoria’s 97 MW Hawkesdale Wind Farm
- Aldi signed PPAs with the 227 MW Collector Wind Farm in New South Wales and the 336 MW Dundonnell Wind Farm in Victoria

- Newcrest Mining headlined growing interest in the resource sector by purchasing 220 MW from the 400 MW Rye Park Wind Farm in New South Wales
- the City of Melbourne completed its second PPA, with a buyers group (the Melbourne Renewable Energy Project II) facilitating a group PPA with the Yaloak South Wind Farm and universities, real estate businesses and construction firms.

The surge in corporate PPAs, in conjunction with PPAs signed by publicly owned retailers such as CleanCo, Stanwell and CS Energy in Queensland and Snowy Hydro in New South Wales, helped to support



# 26

corporate PPAs signed in 2020

# >\$2 B

invested in renewable energy through corporate PPAs

# >4.5 GW

renewable energy generation supported by corporate PPAs

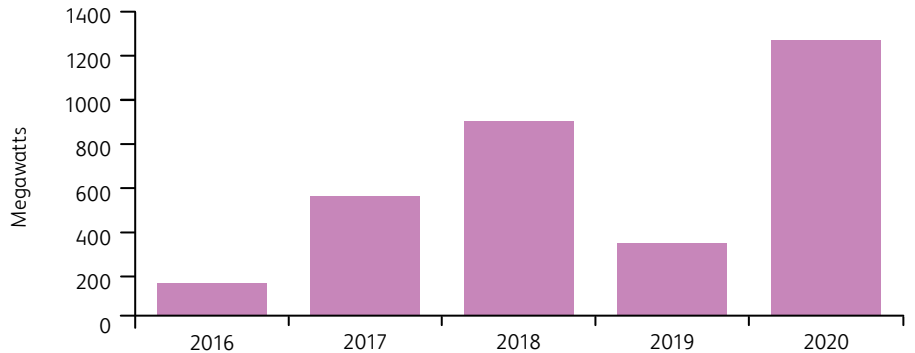
# 1.3 GW

renewable energy directly contracted by corporate PPAs

renewable energy investment as retailers withdrew from the market following the achievement of the Renewable Energy Target in 2019. Corporate PPAs generally constituted around 40 per cent of market volume throughout the year, keeping investment flowing into solar and wind farms.

This was an unexpected result given the backdrop of recession, global pandemic and sharp declines in wholesale electricity prices in 2020, reducing the short-term financial incentive for PPAs. There were a number of factors behind the strong performance of corporate renewable PPAs in 2020, including:

## CORPORATE PPA VOLUMES, 2016–2020<sup>33</sup>



## CORPORATE RENEWABLE PPAs BY STATE, 2020<sup>33</sup>



- A survey by the Business Renewables Centre Australia of PPA buyers, renewable energy developers and consultants found that COVID-19 had a relatively modest impact on PPA demand. Only around a quarter of developers and just under a third of consultants and advisers observed a negative impact on buyer demand.
- As corporate renewable PPAs generally take 12 months (or longer), many of these agreements were underway before COVID-19 hit. However, it is still testament to the resilience of the PPA market that deals were able to be executed amidst the turbulence.
- Buyers are less motivated by immediate electricity price pressures and more by ambitious sustainability targets and/or a longer-term perspective on the value of the PPA as a hedge against future electricity price volatility.

Whereas the early years of the sector were dominated by large users signing wholesale PPAs directly with projects, the market has diversified through different models of retail PPAs, enabling electricity users with a growing spread of loads to access the market. While large buyers still usually prefer the scale and lower pricing of wholesale deals with new projects, mid-sized buyers (around 5–50 GWh

# RENEWABLES FOR BUSINESS CONTINUED

2

corporate PPAs signed by BHP in 2020

220 MW

purchased by Newcrest Mining from the Rye Park Wind Farm

per annum) typically use a retailer as an intermediary and increasingly deal with operating projects or projects that have already achieved financial close. As a result, the size of the wholesale and retail PPA markets was largely the same in 2020.

Even though the impact of COVID-19 on the PPA market was less than expected, there could be a hangover in 2021. However, the increased adoption of ambitious renewable energy and emission reduction targets, landmark

state government initiatives such as renewable energy zones and reverse auctions, and a maturing market with a diversified product offering are likely to underpin a healthy corporate PPA market in the coming years.

Although the Australian PPA market is relatively immature compared to jurisdictions such as the United States, corporate PPAs have rapidly grown to become a mainstream renewables finance market segment.



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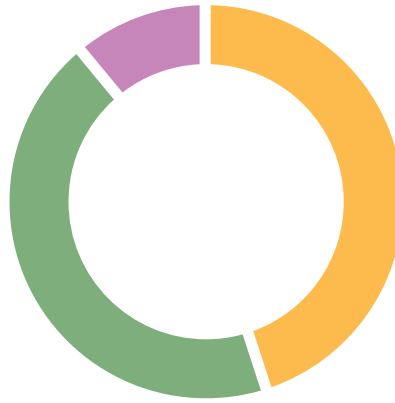


**CORPORATE PPAs BY PROJECT STAGE, 2020<sup>34</sup>**



● New	42%
● Committed	34%
● Operating	24%

**CORPORATE PPAs BY DEAL TYPE, 2020<sup>34</sup>**



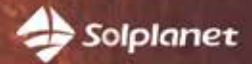
● Retail	45%
● Wholesale	44%
● Other	10%

**CORPORATE PPAs BY TECHNOLOGY, 2020<sup>34</sup>**



● Solar	59%
● Wind	41%

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# INTERNATIONAL UPDATE

205 GW

wind and solar capacity added worldwide in 2020

7%

increase in worldwide generation of renewable energy

US\$81.8 B

European investment in renewable energy

177%

increase in investment in renewable energy in the United Kingdom



Despite the impact of the COVID-19 pandemic, global investment in renewable energy increased by 2 per cent in 2020, growing to US\$303.5 billion to record its second-best yearly result.<sup>35</sup>

Both the wind and solar sectors installed record amounts of new capacity in 2020, with 132 GW of new solar capacity added and 73 GW of wind. The record level of new wind capacity came despite investment in the sector falling by 6 per cent compared to 2019, highlighting continued falls in the cost of the technology. Solar was responsible for US\$148.6 billion of investment in 2020, an increase of 12 per cent compared to 2019, and wind investment was US\$142.7 billion, down 6 per cent on 2019. While worldwide investment in hydrogen fell by 20 per cent in 2020, the US\$1.5 billion invested was still the industry's second-best year.<sup>36</sup>

At US\$81.8 billion, Europe's renewable energy investment almost overtook China, whose investment of US\$83.6

billion was 12 per cent lower than in 2019. The biggest gains were made in the Netherlands and the UK, which saw investment increases of 221 per cent and 177 per cent respectively, while India (down 36 per cent) and the US (down 20 per cent) saw the biggest falls.<sup>37</sup>

A study by the International Energy Agency found that although global electricity demand fell by 2 per cent in 2020, the biggest annual decline since the middle of the 20th century, renewable energy generation increased by 7 per cent. Much of this gain came at the expense of fossil fuel generation, with coal-fired power generation experiencing a 5 per cent decline and gas generation falling by 2 per cent. While the proportion of renewable generation is forecast to grow again

in 2021, coal and gas-fired power is expected to rebound, although not to the same levels seen before the pandemic.<sup>38</sup>

At the end of 2020, more than 120 countries had committed to a target of net-zero emissions by 2050.<sup>39</sup> A number of significant new signatories signed up to the pledge in 2020, including the United States, Japan and South Korea, while China committed to carbon neutrality by 2060. This means that more than 70 per cent of Australia's two-way trade partners have now signed up to the commitment<sup>40</sup>, which will become a significant issue if countries go ahead with their plans to introduce carbon border taxes.

35 V Henze, Bloomberg New Energy Finance, *Energy Transition Investment Hit \$500 Billion in 2020 - For First Time*, 19 January 2021, about.bnef.com/blog/energy-transition-investment-hit-500-billion-in-2020-for-first-time

36 Ibid.

37 Ibid.

38 International Energy Agency, *Electricity Market Report - December 2020*, [iea.org/reports/electricity-market-report-december-2020](https://www.iea.org/reports/electricity-market-report-december-2020)

39 Global Climate Action, *Climate Ambition Alliance: Net Zero 2050*, [climateaction.unfccc.int/views/cooperative-initiative-details.html?id=94](https://climateaction.unfccc.int/views/cooperative-initiative-details.html?id=94)

40 M Johnson, The New Daily, *Japan's net-zero pledge adds more pressure on Australia*, 27 October 2020, [thenewdaily.com.au/finance/finance-news/2020/10/27/japan-australia-net-zero-emissions](https://thenewdaily.com.au/finance/finance-news/2020/10/27/japan-australia-net-zero-emissions)

# ELECTRICITY PRICES

Reduced demand due to COVID-19 and an influx of new renewable generation resulted in lower electricity prices in 2020, a downward trend that will continue over the next several years.

Wholesale electricity prices fell to a five-year low in 2020 as the COVID-19 pandemic triggered a drop in demand, a flood of new renewable generation entered the market and gas prices plummeted. The states with the most renewable energy saw the most significant falls, with Tasmania recording a 67 per cent reduction<sup>41</sup> and South Australia's wholesale price falling below New South Wales and Victoria's for the first time in seven years.<sup>42</sup>

While the Federal Government tried to claim that its "big stick" legislation was partly responsible for the dramatic fall in wholesale prices, this is a long bow to draw considering that the laws are primarily designed to influence retail prices.

The comparatively modest reduction in retail prices seen so far, which averaged a fall of just 3.5 per cent for residential customers and 1.5 per cent for small businesses,<sup>43</sup> could put pressure on the Federal Government to wield its "big stick" to force retailers to pass wholesale

cost savings on to consumers. Whether the government is willing to intervene in the market if retail price reductions do not meet its expectations will be something to watch in 2021.

The economic effects of the COVID-19 pandemic meant that a lot of Australian households faced difficulties paying their electricity bills in 2020, with more than 1000 customers per week seeking payment assistance from their electricity retailer when the crisis was at its worst.<sup>44</sup> However, the Australian Energy Market Commission's (AEMC) latest report on residential electricity price trends shows that some relief is on its way for households doing it tough.

According to the AEMC, annual residential electricity bills will fall by 8.7 per cent between 2020 and 2023, representing a saving of \$117 for Australian households. Lower wholesale prices are responsible for the majority of this decrease, falling by 27.4 per cent (\$152) as significant new renewable energy resources are commissioned and

gas prices remain low. Environmental costs will decline by 5.2 per cent (\$5) over the period, falling to under \$100 in the 2022/23 financial year when they will make up the smallest proportion of residential electricity bills.<sup>45</sup>

After falling to a low of \$1158 in 2021/22, prices are expected to rise by \$62 the following year as the Liddell coal-fired power station's closure leads to an increase in wholesale prices. This will be most keenly felt in New South Wales, which will only see a 2 per cent decline in electricity prices between 2020 and 2023, and the ACT, where prices will rise by 2 per cent over the period. The other states and territories will fare better, with Victoria, Queensland and South Australia seeing double-digit price declines over the period and Tasmania expected to experience a fall of 4 per cent. It should be noted that Western Australia and the Northern Territory are not included in the AEMC's analysis this year due to data not being available.<sup>46</sup>

## WHAT MAKES UP YOUR POWER BILL, 2019–20<sup>47</sup>



● Poles and wires \$579 ● Generating electricity \$556 ● Environmental costs \$104 ● Electricity company costs \$98

41 E Fowler, Australian Financial Review, *Renewables surge, black coal dips in NEM shake-up*, 2 July 2020, afr.com/companies/energy/renewables-surge-black-coal-dips-in-nem-shake-up-20200702-p558ak

42 D Wills, The Advertiser, *SA wholesale power prices drop below NSW and Victoria for the first time in seven years, with households to get the savings*, 12 July 2020, adalaidenow.com.au/news/south-australia/sa-wholesale-power-prices-drop-below-nsw-and-victoria-for-the-first-time-in-seven-years-with-households-to-get-the-savings/news-story/69d09c31154b3e4b6ce2e97c3584e581

43 M Foley, The Sydney Morning Herald, *Coronavirus shutdowns, renewables drive low wholesale power prices*, 13 November 2020, smh.com.au/politics/federal/coronavirus-shutdowns-renewables-drive-low-wholesale-power-prices-20201112-p56e5b.html

44 M Foley and N Toscano, The Sydney Morning Herald, *Millions of households seek help with power bills amid COVID downturn*, 2 July 2020, smh.com.au/politics/federal/millions-of-households-seek-help-with-power-bills-amid-covid-downturn-20200702-p558dh.html

45 Australian Energy Market Commission, *Residential electricity price trends 2020 – final report*, 21 December 2020, aemc.gov.au/sites/default/files/2020-12/2020%20Residential%20Electricity%20Price%20Trends%20report%20-%2015122020.pdf

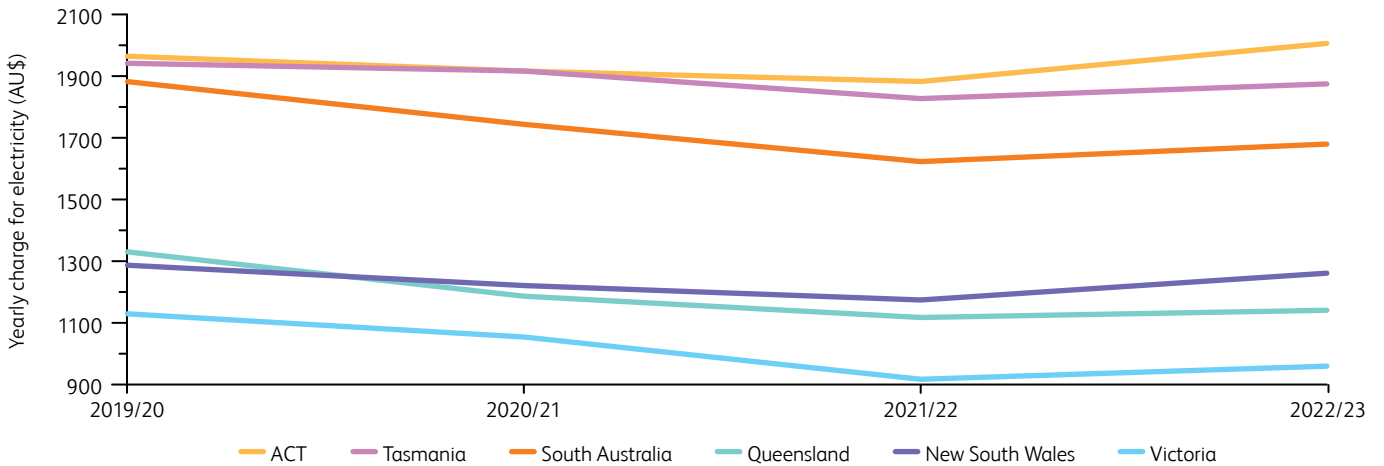
46 Ibid.

47 Ibid.

48 Ibid.



## EXPECTED RESIDENTIAL ELECTRICITY PRICES, 2019-2023<sup>48</sup>



Note: Western Australia and the Northern Territory were not included in the AEMC's 2020 analysis due to data not being available.

### CASE STUDY

## PROGRESS MADE AS WOMEN IN RENEWABLES CONTINUES TO STRIVE FOR GREATER GENDER DIVERSITY



Image: Merryn York

The appointment of Merryn York as acting chair of the Australian Energy Market Commission in July 2020 represented a significant milestone for the Australian energy industry as for the first time, all four of Australia's national electricity regulatory bodies were helmed by women. This remarkable achievement serves as a strong endorsement of the hard work being done by everyone across the industry to improve gender diversity.

The Clean Energy Council's Women in Renewables initiative plays an important role in these efforts,

working to attract women to the sector and support those already working in the industry to advance their careers.

To further support women working in clean energy, the Clean Energy Council launched the Women in Renewables Mentoring Program in late 2020. The program features some of the renewable energy industry's most senior men and women as mentors, who will provide women looking to advance their careers in the industry with guidance and support.

The highly respected Women in Renewables Speakers Guide was revamped in 2020, with over 160 women making themselves available to speak at renewable energy events. The industry-first Speakers Guide is an excellent showcase of the breadth and depth of the expertise and knowledge offered by women in the Australian renewable energy sector. It encourages event organisers to

promote gender diversity on their speaking panels.

The Women in Renewables scholarship program continues to be one of the most popular parts of the Women in Renewables initiative, with large numbers of women applying for the scholarships offered in conjunction with the Monash Business School and the Australian Institute of Company Directors (AICD). The 2020 Monash Business School scholarship was awarded to Bridget Ryan, the Policy and Government Lead at GreenSync, while the 2020 AICD scholarship was presented to Hannah Heath, the Chief Strategy Officer at Nectr.

Through initiatives such as these, as well as the leaders' and panel pledges and numerous networking events, the Women in Renewables program plays a crucial role in fostering the positive change necessary to make the renewable energy industry more inclusive and supportive of women.

# TRANSMISSION

## \$93.9 M

contributed to Marinus Link by the Federal Government in December 2020

## \$540 M

committed to establish six renewable energy zones by the Victorian Government

## \$145 M

committed to establish three renewable energy zones by the Queensland Government

As more renewable projects connect to the grid in remote parts of the network far away from load centres, the network is becoming more congested and generators are increasingly being constrained.

There is a pressing need for more investment in transmission capacity to elevate these constraints and allow more renewable energy connections so that low-cost energy can be delivered to consumers.

In July 2020, the Australian Energy Market Operator (AEMO) released its 2020 Integrated System Plan (ISP). In this first updated ISP since the inaugural release in 2018, AEMO updated its optimal development path for the National Electricity Market over the next 20 years. The highest-priority transmission projects identified in the ISP are those considered 'actionable', which are the projects most critical to address cost, security and reliability issues, and are either already progressing or are to commence immediately after the publication of the 2020 ISP. These projects include:

- VNI Minor, a minor upgrade to the existing Victoria – New South Wales Interconnector (VNI)
- Project EnergyConnect, a new 330 kV double-circuit interconnector between South Australia and NSW
- HumeLink, a 500 kV transmission upgrade to reinforce the NSW southern shared network and increase transfer capacity between the Snowy Mountains hydroelectric scheme and the region's demand centres

- Central-West Orana Renewable Energy Zone (REZ) Transmission Link, involving network augmentations to support the development of the Central-West Orana REZ as defined in the NSW Electricity Strategy, and transfer capacity between the Central-West Orana REZ and major load centres of NSW.

Significant transmission projects need to undergo the regulatory investment test for transmission (RIT-T), which is the public economic cost benefit test administered by the Australian Energy Regulator. However, governments are recognising the critical need for these transmission projects. As a result, there have been a number of transmission announcements throughout the year.

In September 2020, the Commonwealth Government announced it would provide up to \$250 million to accelerate Marinus Link, Project EnergyConnect and VNI West. Subsequently, in November 2020, the Commonwealth and Victorian governments announced they would jointly underwrite early works to progress VNI West, although no funding figure accompanied this announcement. In December 2020, as part of the Tasmanian State Energy and Emissions Reduction deal between Tasmania and the Commonwealth, the Federal Government announced that it would contribute \$93.9 million to the Marinus Link project (in addition to \$56 million committed in 2019). No further

announcement has been made yet regarding Commonwealth funding for Project EnergyConnect.

In 2020, three state governments announced ambitious REZ plans:

- In August 2020, Queensland committed \$145 million to establish three REZs in Southern, Central and Northern Queensland.
- In November 2020, NSW released its Electricity Infrastructure Roadmap, with the accompanying legislation passed through NSW Parliament in early December 2020. Amongst other things, the roadmap declares five REZs in the Central West Orana, Illawarra, New England, South West and Hunter-Central Coast regions. These REZs will deliver an intended network capacity of 12 GW. The legislation also allows NSW to establish a Transmission Development Scheme, which will be a bespoke NSW regime, similar to the RIT-T and National Electricity Rules cost recovery provisions for REZ transmission projects, to allow scale-efficient transmission investments to proceed.
- In the November 2020 state budget, Victoria committed \$540 million to fund six REZs for the Central North, Gippsland, Murray River, Ovens Murray, South Victoria and Western Victoria regions.





Image: Warwick Solar Farm, Queensland

In recognition of the cumbersome nature of the current RIT-T process, the Victorian Government has passed legislation that effectively allows the Victorian Energy Minister to exempt certain new transmission investments from the usual RIT-T process. This legislation was used to allow AEMO to complete a System Integrity Protection Scheme (SIPS) procurement process on behalf of the Victorian Government. In November 2020, the Victorian Government announced that Neoen had been successful in obtaining the SIPS contract, which will see it build a 300 MW utility-scale battery. Under the agreement, 250 MW of the battery's capacity will be reserved for AEMO during peak periods to allow it to increase the capability of the VNI and respond to unexpected network outages in Victoria from November 2021.

Throughout 2020, work continued on potential transmission and access reform. The Australian Energy Market Commission's access reform proposal (commonly referred to as COGATI – coordination of generation and transmission investment) had been slated for implementation in July 2022. Given widespread industry concern with the proposal, its immediate implementation has been deferred and consideration of transmission and access reform has been subsumed into the Energy Security Board's post-2025 market design process.

## **CASE STUDY RHOMBUS OF REGRET HIGHLIGHTS NEED FOR TRANSMISSION INVESTMENT**

The West Murray region in north-west Victoria and southern New South Wales is one of the best places in Australia to grow citrus fruits and grapes due to its abundant sunshine and wide-open plains. This also makes the region a perfect location for large-scale wind and solar, with renewable energy developers flocking to the area since 2016 to take advantage of the favourable conditions.

However, in 2019 the Australian Energy Market Operator (AEMO) identified system strength issues in the West Murray, resulting in five operational solar farms having their output severely curtailed to ensure grid stability in the region. In addition, 20 wind and solar projects that were under construction or already completed but still undertaking commissioning were told that they would face long delays before being able to connect to the grid.

The millions of dollars in lost revenue for the owners of the affected solar farms and the threat to the pipeline of

new projects, which was expected to bring over \$6 billion in investment to the region and create more than 5000 jobs, earned the region the moniker "the rhombus of regret".

Following a mammoth collective effort by the Clean Energy Council, the affected projects, AEMO, inverter manufacturer SMA and network service providers, the constraints on the solar farms were provisionally lifted in April 2020, and a sequencing process was put in place to allow the project pipeline to progress their connections.

The experience in the West Murray illustrates some of the transmission challenges that will need to be overcome as Australia's renewable energy transition continues. Currently, many of the country's best clean energy resources aren't served by strong transmission links, meaning that significant investment and careful planning will be required to ensure that the problems seen in the rhombus of regret aren't repeated elsewhere.

# ENERGY RELIABILITY

Energy reliability improved in 2020, but undependable fossil fuel generators and a failure to plan for the future continued to present significant challenges.

For the first time in several years, the Australian Energy Market Operator (AEMO) didn't forecast any supply shortfalls for the 2020/21 summer, despite maximum demand forecasts being similar or only slightly lower than in 2019/20.<sup>49</sup> The major factor in the improved outlook was the more than 5 GW of new renewable energy generation that recently entered the market, which has eased the supply shortages seen in previous years. The lack of a shortfall is all the more impressive considering that much stricter reliability standards were put in place for the 2020/21 summer.

An unplanned outage at the Liddell coal-fired power plant in late December 2020 once again highlighted the unreliability of Australia's ageing fossil fuel generation fleet. Of significant concern was a study by The Australia Institute released in September 2020, which found that some of the country's newest gas and coal-fired power stations were among the least reliable.

The study showed that the Kogan Creek plant was the most unreliable single generating unit in the National Electricity Market despite being Australia's newest coal-fired power station.<sup>50</sup>

The ongoing failure to formulate a viable energy policy to prepare the grid for the transition to a clean energy future began to have a real impact on energy security and reliability in 2020. A report released by the Energy Security Board (ESB) in early 2021 found that AEMO was forced to intervene to keep the grid stable more than 250 times in the 2019/20 financial year, compared to fewer than 20 times three years earlier.<sup>51</sup>

A major factor in this is the insufficient work to integrate the recent influx of new renewable energy generation into the electricity grid. As a result, the ESB named maintaining the security of electricity supply as the most urgent matter currently facing the National Electricity Market, as AEMO struggles

to manage an increasingly renewables-centric grid using rules, processes and regulations designed for a centralised, fossil fuel-based electricity system. Thankfully, relief is in sight, with the ESB expected to deliver its blueprint for the future of Australia's electricity market towards the middle of 2021.

In recent years, the phenomenal growth of rooftop solar resulted in record low demand for grid power in several states in 2020.<sup>52</sup> While this is a positive development for emissions reduction and electricity prices, it also makes it increasingly difficult to maintain the security of the electricity system. As a result, state and territory governments began exploring new ways of soaking up excess supply in 2020. This included the announcement of several large utility-scale batteries in Victoria, Western Australia and New South Wales and the introduction of new tariff structures that encourage consumers to shift demand to periods of plentiful supply.

49 Australian Energy Market Operator, *Summer 2020-21 Readiness Plan*, 26 November 2020, [aemo.com.au/-/media/files/electricity/nem/system-operations/summer-operations/2020-21/summer-2020-21-readiness-plan.pdf](https://aemo.com.au/-/media/files/electricity/nem/system-operations/summer-operations/2020-21/summer-2020-21-readiness-plan.pdf)

50 G Roberts, ABC News, *Queensland's gas and coal-fired power stations have most outages in the country*, 7 September 2020, [abc.net.au/news/2020-09-07/qld-gas-coal-fired-power-stations-power-plant-outages/12635652](https://abc.net.au/news/2020-09-07/qld-gas-coal-fired-power-stations-power-plant-outages/12635652)

51 A Macdonald-Smith, Australian Financial Review, *Power fix 'urgent' as grid teeters*, 5 January 2021, [afr.com/companies/energy/power-fix-urgent-as-grid-teeters-20210104-p56rj1](https://afr.com/companies/energy/power-fix-urgent-as-grid-teeters-20210104-p56rj1)

52 A Macdonald-Smith, Australian Financial Review, *Grids struggle with solar splurge as records tumble*, 7 October 2020, [afr.com/companies/energy/grids-struggle-with-solar-splurge-as-records-tumble-20201006-p562cl](https://afr.com/companies/energy/grids-struggle-with-solar-splurge-as-records-tumble-20201006-p562cl)





## CASE STUDY

### POST-2025 MARKET REVIEW TO PROVIDE A GLIMPSE OF A CLEAN ENERGY FUTURE

The National Electricity Market (NEM) is a remarkable example of how engineering and policy can be used to solve a uniquely Australian problem. Stretching 5000 km from Port Douglas in Queensland to Port Lincoln in South Australia, the NEM is the longest interconnected power system in the world. However, a lot has changed since the NEM began operation in 1998, with many of the technologies, behaviours and assumptions that the system design was based on having changed significantly over the past two decades.

In recognition of this, the COAG Energy Council tasked the Energy

Security Board (ESB) with undertaking a comprehensive review of Australia's electricity market framework in March 2019. This review, called the post-2025 market review, will look at options to redesign the NEM to ensure that the inevitable transition from fossil fuels to renewable energy is done in a managed and streamlined way to deliver the right outcomes for consumers and confidence for investors.

In September 2020, the ESB released a consultation paper on the post-2025 market review, which outlined seven key focus areas, including managing the exit of ageing fossil fuel generators, developing fit-for-purpose

essential system services, valuing demand flexibility and integrating distributed energy resources (DER). Together, these will result in a fundamental transformation in the way that the NEM operates, equipping it to better manage a future dominated by large-scale wind and solar, utility-scale storage and DER.

The ESB is expected to deliver its final recommendations in mid-2021, and the entire Australian electricity industry will be eagerly awaiting its release to see just what the electricity market framework will look like in 2025 and beyond.



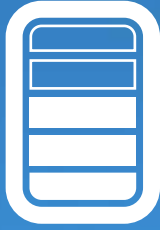
Image: Murra Warra Wind Farm, Victoria



# TECHNOLOGY PROFILES



# BATTERY STORAGE



While previous predictions that the battery market was poised to take off didn't necessarily eventuate, numerous announcements of new utility-scale batteries in 2020 and the continued uptake of household batteries mean that the battery boom is now well and truly underway.

The biggest news in the battery storage sector in 2020 was the expansion of the Hornsdale Power Reserve in South Australia.

The battery was expanded from 100 MW/129 MWh to 150 MW/194 MWh during the year, which will allow it to provide a range of new grid support services that are usually provided by traditional generators, including inertia to help stabilise the South Australian energy grid.<sup>53</sup> The big battery has now saved South Australian consumers more than \$150 million since it was first commissioned in 2017, and has served as an example of the vital role that batteries will play in the future energy landscape.

Despite its expansion, the Hornsdale Power Reserve lost its title as the "world's biggest battery" during the year after a 250 MW battery was constructed in California. However, several announcements during 2020 and in early 2021 mean that Australia could soon reclaim the title. The first of these was the Victorian Government's backing of a 300 MW battery to be built near Geelong. Dubbed the Victorian Big Battery, the project will help to reduce strain on the electricity grid by allowing the flow of power through the Victoria-NSW interconnector to increase by 250 MW and will help to facilitate the ongoing construction of new renewable energy projects in the west of the state.<sup>54</sup>

In early 2021, an announcement by renewable energy developer CEP Energy upped the ante further, with the company announcing a plan to install a 1.2 GW battery in New South Wales' Hunter Valley. The battery is projected to be commissioned in 2023 when it will play a crucial role in the New South Wales Government's Electricity Infrastructure Roadmap.



53 G Parkinson, RenewEconomy, *Expanded Tesla big battery at Hornsdale begins final testing*, 25 June 2020, [reneweconomy.wpengine.com/expanded-tesla-big-battery-at-hornsdale-begins-final-testing-96089](https://reneweconomy.wpengine.com/expanded-tesla-big-battery-at-hornsdale-begins-final-testing-96089)

54 N Toscano, M Perkins and A Prytz, *The Age, Victoria bets on big battery near Geelong to bolster grid reliability*, 5 November 2020, [theage.com.au/national/victoria/victoria-bets-on-big-battery-near-geelong-to-bolster-grid-reliability-20201105-p56buz.html](https://theage.com.au/national/victoria/victoria-bets-on-big-battery-near-geelong-to-bolster-grid-reliability-20201105-p56buz.html)

55 Green Energy Markets



# 300 MW

size of the Victorian Big Battery to be built near Geelong

# 16

large-scale batteries under construction at the end of 2020

# \$150 M

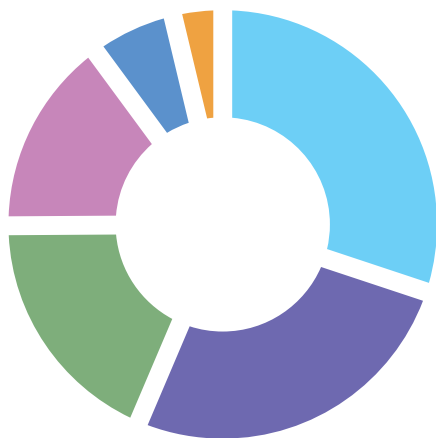
money saved by the Hornsdale Power Reserve since 2017

## UTILITY-SCALE BATTERY SYSTEMS UNDER CONSTRUCTION AS AT DECEMBER 2020<sup>55</sup>

STATE	PROJECT	OWNER	LOCALITY	SIZE
VIC	Victorian Big Battery	Neoen	Moorabool	300 MW/450 MWh
QLD	Wandoan South Battery Energy Storage System	Vena Energy	Wandoan South	100 MW/150 MWh
NSW	Wallgrove Grid Battery	Transgrid	Wallgrove	52 MW/78 MWh
NSW	New England Solar Farm Battery	UPC/AC Renewables Australia	Uralla	50 MW/50 MWh
WA	Koodaideri Mine Solar Farm	Rio Tinto	Newman	45 MW/12 MWh
VIC	Bulgana Green Power Hub	Neoen	Stawell	20 MW/34 MWh
NT	Katherine Solar Power Station	ENI Australia	Katherine	5.7 MW/2.9 MWh
VIC	West Gippsland Battery	E22	Longwarry	5 MW/7.5 MWh
WA	Gold Fields Gruyere Mine Microgrid	APA Group	Cosmo Newbery	4.4 MW/4.4 MWh
VIC	Mortlake South Wind Farm	ACCIONA	Mortlake	4-5 MW
NT	Darwin LNG Gas Generator Support Battery	Santos	Wickham	4 MW/2 MWh
SA	Happy Valley Reservoir Solar Farm	SA Water	Happy Valley	3.78 MW/10 MWh
SA	Ikea Adelaide Battery System	Epic Energy	Adelaide Airport	3.4 MWh
NSW	Lord Howe Island Microgrid	Lord Howe Island Board	Lord Howe Island	3.2 MWh
QLD	Kennedy Energy Park	Windlab	Hughenden	2 MW/4 MWh
VIC	Mallacoota Area Grid Storage	Ausnet	Mallacoota	1 MWh

Image: Bulgana Green Power Hub, Victoria

**NUMBER OF SMALL BEHIND-THE-METER BATTERY SYSTEMS INSTALLED IN 2020<sup>\*56</sup>**



State	Systems	Capacity (MWh)
SA	7152	71.5
NSW	6264	62.6
VIC	4476	44.7
QLD	3576	35.8
WA	1788	17.9
TAS	540	5.4
<b>TOTAL</b>	<b>23,796</b>	<b>237.9</b>

\* This figure is only an estimate due to incomplete data on battery installation numbers as a result of the lack of a universal national government support program covering batteries.

In addition to these mega-batteries, several other notable utility-scale battery projects were announced in 2020, including the New South Wales Government committing to build four new large-scale batteries under its Emerging Renewables program,<sup>57</sup> AGL's plans to build several big batteries on the sites of its existing fossil fuel power station assets and the Western Australian Government tendering for a 100 MW battery, the first to be built on the state's main grid.<sup>58</sup>

When added to the 16 large-scale batteries that were under construction at the end of 2020, representing more than 595 MW of new capacity, 2021 promises to be the biggest year yet for the

Australian large-scale storage industry.

Australian households' enthusiasm for batteries continued to build in 2020, with 23,796 batteries with a combined capacity of 238 MWh installed during the year. This was an increase on the 22,661 household batteries installed in 2019.

Despite cutting its solar battery rebate from \$6000 to \$3000 during the year, South Australia saw the most household battery installations in 2020. The South Australian Government's Home Battery Scheme has seen strong uptake since it was launched in 2018, and the government committed an additional \$18 million to the program

in November 2020 with the goal of increasing the amount of household battery capacity in the state to 440 MWh.<sup>59</sup>

The long-awaited launch of the Empowering Homes battery loan program in New South Wales saw households in the state install 6264 batteries in 2020, the second-most in the country. The program offers interest-free loans of up to \$14,000 to install a solar PV and battery system or \$8000 to retrofit a battery to an existing solar PV system.<sup>60</sup> The program, which requires suppliers to be accredited by the Clean Energy Council, is still in the pilot stage, with plans to expand it throughout the state in 2021.

<sup>56</sup> Green Energy Markets

<sup>57</sup> G Parkinson, RenewEconomy, *NSW to fund four new big battery projects as it readies to flick switch from coal*, 15 August 2020, [reneweconomy.com.au/nsw-to-fund-four-new-big-battery-projects-as-it-readies-to-flick-switch-from-coal-82272](https://reneweconomy.com.au/nsw-to-fund-four-new-big-battery-projects-as-it-readies-to-flick-switch-from-coal-82272)

<sup>58</sup> G Parkinson, RenewEconomy, *West Australia to build 100MW big battery - the first on state's main grid*, 3 October 2020, [reneweconomy.com.au/west-australia-to-build-100mw-big-battery-the-first-on-states-main-grid-78594](https://reneweconomy.com.au/west-australia-to-build-100mw-big-battery-the-first-on-states-main-grid-78594)

<sup>59</sup> South Australian Government, media release, *Pedal to the metal for an electrifying drive*, 6 November 2020, [premier.sa.gov.au/news/media-releases/news/pedal-to-the-metal-for-an-electrifying-drive](https://premier.sa.gov.au/news/media-releases/news/pedal-to-the-metal-for-an-electrifying-drive)

<sup>60</sup> New South Wales Government, *Empowering Homes solar battery loan offer*, [energysaver.nsw.gov.au/households/solar-and-battery-power/empowering-homes-solar-battery-loan-offer](https://energysaver.nsw.gov.au/households/solar-and-battery-power/empowering-homes-solar-battery-loan-offer)



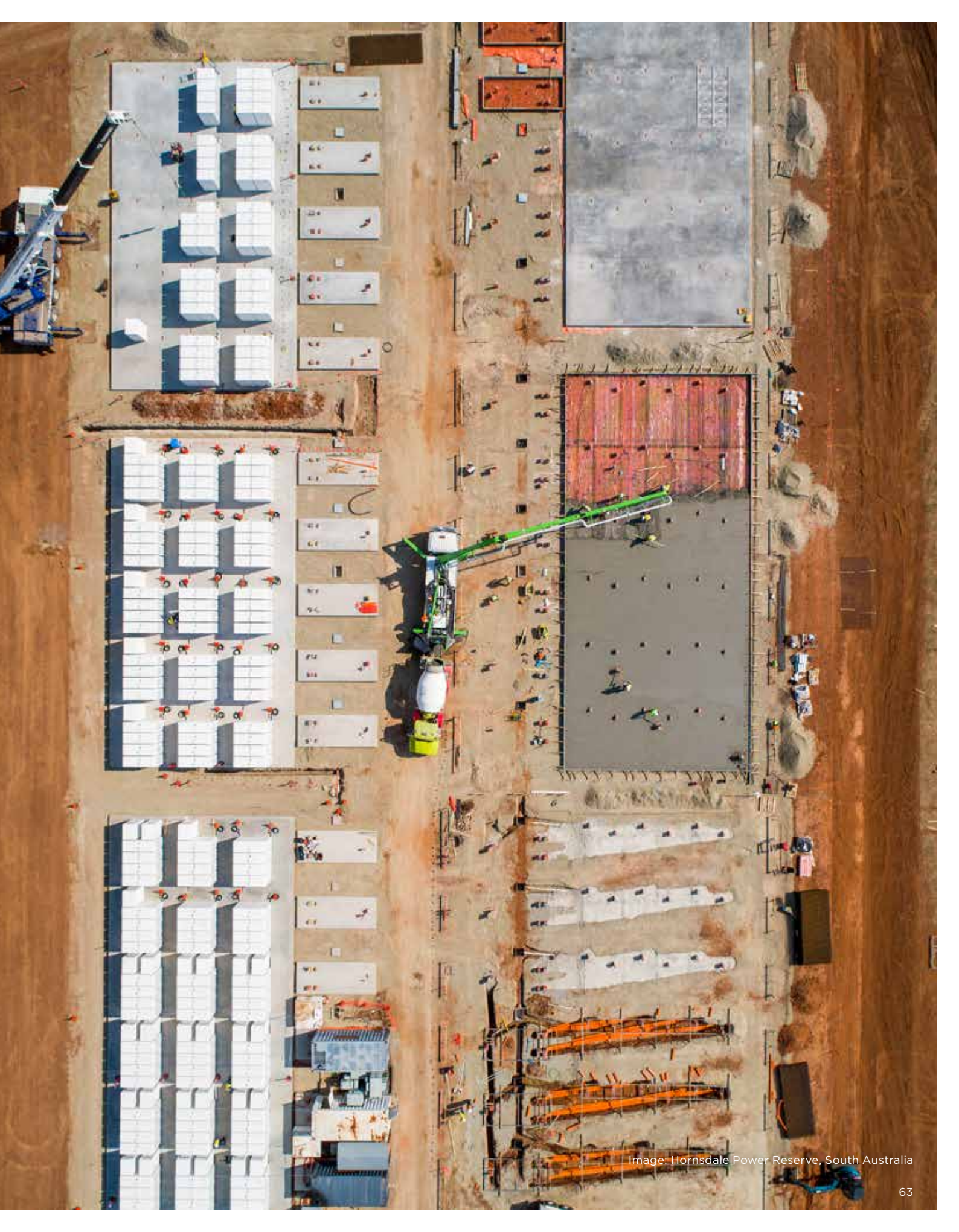


Image: Hornsdale Power Reserve, South Australia



Bioenergy delivers numerous benefits and can help overcome a range of challenges in Australia, including employment and economic development in regional communities, enhancing energy and fuel security, waste minimisation and emissions reduction.

**95 TJ**

capacity of the Malabar Biomethane Injection Project

The commitment to the development of a national Bioenergy Roadmap by the Federal Government was the most significant achievement in 2020. The roadmap, which is due for release in early 2021, will clearly identify the role that the bioenergy sector can play in accelerating Australia's clean energy transition.

the development of domestically produced sustainable aviation and marine fuels.

In addition to energy production, a notable initiative in 2020 was the bioenergy industry's ability to support the COVID-19 response through the increased production of pharmaceutical-grade ethanol, the active ingredient in hand sanitiser and surface disinfectant. Ethanol is part of the emerging biofuel industry in Australia and can provide increased employment and economic development in regional Australia moving forward.<sup>61</sup>

**6300**

number of homes whose gas needs will be met by the Malabar Biomethane Injection Project

Developed by the Australian Renewable Energy Agency on behalf of the Australian Government, this investment signifies the validity and value of the Australian bioenergy industry going forward.

Several notable bioenergy projects were announced in 2020, including the Malabar Biomethane Injection Project, the first of its kind in Australia. The project involves installing gas cleaning and upgrading equipment

**850 kW**

capacity of two bioenergy facilities that will utilise landfill biogas to produce electricity

There was a significant acceleration in the level of interest and development of bioenergy projects in 2020. Particular focus areas included the development of biomethane projects, industrial heat and a significant increase in interest surrounding

**BIOENERGY PROJECTS COMPLETED IN 2020 (ABOVE 1 MW)<sup>62</sup>**

STATE	PROJECT	OWNER	INSTALLED CAPACITY (MW)	FUEL SOURCE
ACT	Mugga Lane	Landfill Gas Industries	4.2	Landfill Gas
SA	Seaford Heights	LMS Energy	3.2	Landfill Gas

61 Bioenergy International, *Bioenergy Australia calls for ethanol industry investment to safeguard supply and fuel regional economies*, 3 June 2020, [bioenergyinternational.com/opinion-commentary/bioenergy-australia-calls-for-ethanol-industry-investment-to-safeguard-supply-and-fuel-regional-economies](https://bioenergyinternational.com/opinion-commentary/bioenergy-australia-calls-for-ethanol-industry-investment-to-safeguard-supply-and-fuel-regional-economies)

62 Green Energy Markets

63 Australian Renewable Energy Agency, *Malabar Biomethane Injection Project*, 19 January 2021, [arena.gov.au/projects/malabar-biomethane-injection-project](https://arena.gov.au/projects/malabar-biomethane-injection-project)

64 Australian Renewable Energy Agency, media release, *Australian first biomethane trial for NSW gas network*, 23 November 2020, [arena.gov.au/news/australian-first-biomethane-trial-for-nsw-gas-network](https://arena.gov.au/news/australian-first-biomethane-trial-for-nsw-gas-network)

65 CSIRO, *Hazer Commercial Demonstration Plant*, 23 September 2020, [research.csiro.au/hyresource/hazer-commercial-demonstration-plant/](https://research.csiro.au/hyresource/hazer-commercial-demonstration-plant/)

66 Sustainability Victoria, *Construction waste gets a new lease on life*, 10 November 2020, [sustainability.vic.gov.au/About-us/Latest-news/2020/11/09/04/48/Construction-waste-gets-new-lease-on-life](https://sustainability.vic.gov.au/About-us/Latest-news/2020/11/09/04/48/Construction-waste-gets-new-lease-on-life)

67 Green Energy Markets





**5.0%**  
of total clean energy  
generated in Australia  
in 2020



**1.4%**  
of total Australian  
electricity generated  
in 2020

that will be located at Sydney Water’s Malabar wastewater treatment plant. This infrastructure will upgrade biogas to biomethane and will be connected to Jemena’s natural gas network.<sup>63</sup> The project will see biomethane injected into the gas network, with an initial capacity of 95 terajoules of renewable green gas per year that will help meet the gas demand of approximately 6300 homes. This has the potential to be scaled up to 200 terajoules per year, enough to meet the gas demand of around 13,300 homes.<sup>64</sup>

Other significant projects that were announced or delivered in 2020 include:

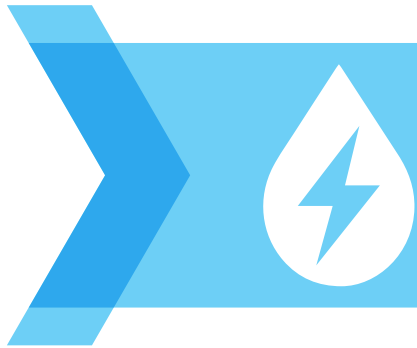
- a collaboration between the Queensland University of Technology and Griffith University to develop and demonstrate the production of compressed biomethane and biocrude oil from sugarcane trash and bagasse at pilot scale
- the Hazer commercial demonstration plant in WA, which will use biomethane produced at a wastewater treatment site as a feedstock to be converted into 100 tonnes of hydrogen per annum<sup>65</sup>
- two 850 kW bioenergy facilities being developed by LMS Energy at Reedy Creek and Caloundra in Queensland that will utilise landfill biogas to produce electricity
- the installation of a biomass boiler in Victoria that will use 2500 tonnes per annum of wood waste to generate renewable thermal energy to heat treat wooden pallets<sup>66</sup>
- a project in New South Wales to optimise a yeast biocatalyst for the efficient production of biofuels from non-food biomass.

## BIOENERGY PRODUCTION BY STATE, 2020<sup>67</sup>



State	GWh
QLD	1113
NSW	1059
VIC	712
WA	151
SA	99
TAS	29
<b>TOTAL</b>	<b>3164</b>

# HYDRO AND PUMPED HYDRO



Hydro's contribution to Australia's total renewable generation has fallen significantly in recent years, largely due to the rapid rise of wind and solar. However, with several large projects in the works, the technology is set to play a vital role in Australia's clean energy future.

## 473 GWh

increase in hydro generation in 2020

## 500 MW

size of pumped hydro project to be built at Dungowan Dam in NSW

## 130,000

number of concrete tunnel segments to be manufactured for Snowy 2.0

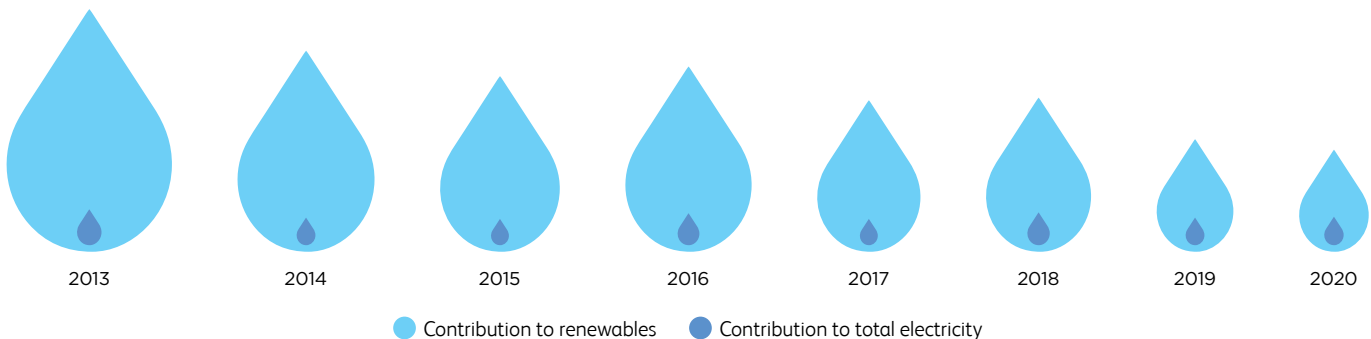
After losing its crown as Australia's leading renewable energy generator in 2019, hydro slipped to third place in 2020 as generation from the booming rooftop solar sector overtook hydro for the first time. This came despite hydro generation increasing by 473 GWh in 2020 to its highest level since 2018.

While the technology's share of renewable energy generation may have shrunk in recent years, its importance to the industry's future is growing with each new megawatt

of solar and wind capacity that is installed. This is because of the critical role that hydro will play in firming Australia's substantial wind and solar resources, with a number of major hydro projects currently under development that will enable further expansion of renewable energy in Australia.

The biggest of these projects is Snowy 2.0, which reached a number of significant development milestones in 2020. These included state<sup>68</sup> and federal environmental<sup>69</sup>

approval, which were both fast-tracked as part of the governments' COVID-19 recovery efforts, a \$125 million transmission investment by the Clean Energy Finance Corporation<sup>70</sup> and approval of a segment factory, which will manufacture 130,000 concrete tunnel segments for use during construction of the project.<sup>71</sup> Construction of Snowy 2.0 is expected to begin in 2021, with first power generation scheduled for 2025.

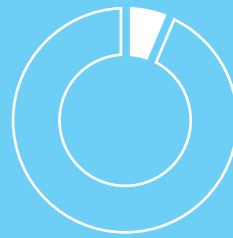


68 L Cox, The Guardian, *Snowy Hydro 2.0 approved by NSW government as part of Covid-19 economic stimulus*, 22 May 2020, [theguardian.com/australia-news/2020/may/21/snowy-hydro-20-approved-by-nsw-government-as-part-of-covid-19-economic-stimulus](https://theguardian.com/australia-news/2020/may/21/snowy-hydro-20-approved-by-nsw-government-as-part-of-covid-19-economic-stimulus)  
 69 M Mazengarb, RenewEconomy, *Snowy 2.0 clears last major hurdle as Morrison gives environmental approval*, 30 June 2020, [reneweconomy.com.au/snowy-2-0-clears-last-major-hurdle-as-morrison-gives-environmental-approval-63750/](https://reneweconomy.com.au/snowy-2-0-clears-last-major-hurdle-as-morrison-gives-environmental-approval-63750/)  
 70 A Macdonald-Smith and E Fowler, The Australian Financial Review, *CEFC makes first grid investment to back Snowy 2.0*, 27 November 2020, [afr.com/companies/energy/cefc-makes-first-grid-investment-to-back-snowy-2-0-20201126-p56i7k](https://www.afr.com/companies/energy/cefc-makes-first-grid-investment-to-back-snowy-2-0-20201126-p56i7k)  
 71 H McNab, The New Daily, *Project's green light is a big step forward for Snowy 2.0*, 5 April 2020, [thenewdaily.com.au/news/state/nsw/2020/04/05/snowy-2-0-stage-given-green-light/](https://thenewdaily.com.au/news/state/nsw/2020/04/05/snowy-2-0-stage-given-green-light/)





**23.3%**  
of total clean energy  
generated in Australia  
in 2020



**6.4%**  
of total Australian  
electricity generated  
in 2020

Tasmania's Battery of the Nation project continued to progress in 2020, with Hydro Tasmania naming Lake Cethana in north-west Tasmania as its first pumped hydro site for the project.<sup>72</sup> Marinus Link, a second interconnector connecting Tasmania to the mainland that is a critical component of the Battery of the Nation project, also took a step closer to realisation after the Federal Government committed

\$94 million to take the project to the final investment decision stage. The Tasmanian Government's commitment to a 200 per cent renewable energy target by 2040 is also a good sign for the project, signalling strong government support for the continued development of the state's unrivalled hydro potential.

The future of hydro also looks bright in New South Wales after the state

government committed \$50 million in grants to support the delivery of pumped hydro projects in the state as part of its Electricity Infrastructure Roadmap,<sup>73</sup> the proposed Oven Mountain pumped hydro project was deemed as Critical State Significant Infrastructure by the state government<sup>74</sup> and GE signed an agreement with Walcha Energy to develop a 500 MW pumped hydro project at Dungowan Dam.<sup>75</sup>

## HYDRO POWER'S CONTRIBUTION TO AUSTRALIAN ELECTRICITY GENERATION<sup>76</sup>

YEAR	GENERATION (GWh)	CONTRIBUTION TO RENEWABLES	CONTRIBUTION TO TOTAL ELECTRICITY
2013	19,243	55.4%	8.2%
2014	14,555	45.9%	6.2%
2015	14,046	40.1%	5.9%
2016	17,747	42.3%	7.3%
2017	13,331	34.6%	5.9%
2018	17,002	35.2%	7.5%
2019	14,166	25.7%	6.2%
2020	14,638	23.3%	6.4%

72 J Sampson, H2 View, *Lake Cethana named as first pumped hydro project*, 15 December 2020, [www.h2-view.com/story/lake-cethana-named-as-first-pumped-hydro-project](http://www.h2-view.com/story/lake-cethana-named-as-first-pumped-hydro-project)

73 A Macdonald-Smith, The Australian Financial Review, *NSW unveils 'energy superpower' vision, backed by batteries*, 9 November 2020, [afr.com/companies/energy/nsw-unveils-energy-superpower-vision-backed-by-batteries-20201107-p56cgm](http://afr.com/companies/energy/nsw-unveils-energy-superpower-vision-backed-by-batteries-20201107-p56cgm)

74 K Thomas and M Martin, ABC News, *NSW pumped hydro project fast-tracked to help replace ageing coal-fired power stations*, 12 October 2020, [abc.net.au/news/2020-10-12/new-hydro-power-project-to-be-fast-tracked-in-northern-nsw/12753306](http://abc.net.au/news/2020-10-12/new-hydro-power-project-to-be-fast-tracked-in-northern-nsw/12753306)

75 G Parkinson, RenewEconomy, *GE signs agreement to develop 500MW pumped hydro project in NSW*, 13 July 2020, [reneweconomy.com.au/ge-signs-agreement-to-develop-500mw-pumped-hydro-project-in-nsw-54177](http://reneweconomy.com.au/ge-signs-agreement-to-develop-500mw-pumped-hydro-project-in-nsw-54177)

76 Green Energy Markets



The hydrogen industry received significant new government and private investment in 2020, all but confirming the technology as Australia's next big export opportunity.

**\$70 M**

funding available through ARENA's Renewable Hydrogen Deployment Funding Round

**\$22 M**

additional funding committed to the sector by the Western Australian Government

**480 kg**

renewable hydrogen produced each day by Australia's largest electrolyser

The greatest boost for the renewable hydrogen sector in 2020 was its inclusion as one of five priority low emissions technologies in the Federal Government's Technology Investment Roadmap.<sup>77</sup> This means that hydrogen will be the focus of significant new public investment to produce "clean" hydrogen for under \$2 per kilogram. Disappointingly, the roadmap doesn't require hydrogen to be produced from renewable energy, leaving open the possibility of hydrogen derived from fossil fuels combined with carbon capture and storage.

The Australian Renewable Energy Agency (ARENA) held the Renewable Hydrogen Deployment Funding Round in 2020, which offered \$70 million to projects deploying electrolyzers of at least 5 MW, but preferably 10 MW or larger. The funding round received a phenomenal response, with ARENA receiving 36 expressions of interest from prospective projects representing more than \$1 billion, which was almost 15 times more than the available funding.<sup>78</sup>

In addition, the Federal Government established the Advancing Hydrogen

Fund in May 2020, a \$300 million program offered through the Clean Energy Finance Corporation that will provide concessional financing to support the development of an Australian hydrogen industry.

The states and territories also increased their hydrogen ambitions in 2020, with Western Australia and South Australia leading the way. Western Australia committed an additional \$22 million to the hydrogen sector in 2020 and brought forward its ambitious hydrogen targets from 2040 to 2030, when it aims to have a 12 per cent share of the global hydrogen market and a 10 per cent renewable hydrogen blend in its domestic gas network.

In South Australia, the government launched its hydrogen prospectus in October 2020, which outlined plans for three renewable hydrogen export hubs featuring electrolyzers of up to 2.6 GW that would require a significant expansion in South Australia's renewable energy capacity.

Not to be outdone, the private sector also unveiled a number of new projects

77 Australian Government, *Technology Investment Roadmap: First Low Emissions Technology Statement - 2020*, September 2020, industry.gov.au/sites/default/files/September%202020/document/first-low-emissions-technology-statement-2020.pdf

78 M Mazengarb, RenewEconomy, *ARENA flooded with applications for green hydrogen project funding*, 5 June 2020, reneweconomy.com.au/arena-flooded-with-applications-for-green-hydrogen-project-funding-72828

79 I Hartmann, Energy Magazine, *Australia's biggest electrolyser arrives*, 13 July 2020, energymagazine.com.au/australias-biggest-electrolyser-arrives

80 R Barrett, The Australian, *Hydrogen set to flow in green hub plan*, 12 November 2020, theaustralian.com.au/special-reports/hydrogen-set-to-flow-in-green-hub-plan/news-story/c08ea41d129f1ce74d6c13b776676006?btr=3a8925f05142eac6687ca9492bc18627

81 I Hartmann, Energy Magazine, *Major global hydrogen hub proceeds in the Pilbara*, 19 October 2020, energymagazine.com.au/major-global-hydrogen-hub-proceeds-in-the-pilbara

82 M Mazengarb, RenewEconomy, *Massive hydrogen project gets green light after securing \$300m investment*, 29 April 2020, reneweconomy.com.au/massive-hydrogen-project-gets-green-light-after-securing-300m-investment-68959

83 M Mazengarb, RenewEconomy, *Massive 1000MW "baseload" wind, solar and hydrogen plant pitched for NSW*, 20 May 2020, reneweconomy.com.au/massive-1000mw-baseload-wind-solar-and-hydrogen-plant-pitched-for-nsw-16049



in 2020 that will significantly expand Australia's emerging renewable hydrogen industry. The most exciting of these is the Australian Gas Infrastructure Group's Hydrogen Park South Australia (HyP SA) project. HyP SA is already producing 480 kg of renewable hydrogen per day using a 1.25 MW electrolyser, the largest in Australia.<sup>79</sup>

The project adds a 5 per cent hydrogen blend into the gas supply of 700 Adelaide homes, making it one of only a few projects worldwide that has successfully blended hydrogen into a public gas distribution network.<sup>80</sup>

Other notable projects include the Asian Renewable Energy Hub, a 15 GW wind and solar project in Western Australia's Pilbara region that will produce renewable hydrogen and ammonia for the global export market;<sup>81</sup> a facility in Western Australia that will use 85 MW of solar and 75 MW of wind to produce 25 tonnes of hydrogen per day;<sup>82</sup> and a 1000 MW solar, wind and hydrogen plant that will produce "baseload" electricity in New South Wales.<sup>83</sup>

## CASE STUDY

### LIGHTHOUSE PROJECTS LIGHT THE WAY TOWARDS AUSTRALIA'S EXPORT FUTURE

One of the biggest developments in the Australian renewable energy industry in recent years has been the emergence of several "lighthouse" projects. These developments, which are among the world's largest renewable energy projects, are thus named as they serve as a beacon for the future of renewable energy in Australia and around the world.

The largest of these projects is the Asian Renewable Energy Hub in Western Australia's East Pilbara region. The proposed hub includes a 26 GW wind and solar farm spread across 6500 km<sup>2</sup>, with 3 GW of the project's output to be used by businesses in the Pilbara region and the remainder to be used to produce renewable hydrogen and ammonia for export.

Another major development is the Sun Cable project in the Northern Territory, which plans to build the world's largest battery and solar farm to export electricity to Darwin,

Singapore and Indonesia via a 4500 km high voltage direct current undersea cable. Backed by Mike Cannon-Brookes and Andrew Forrest, Sun Cable will be the world's largest dispatchable renewable electricity system.

While both projects are still in the early phases of development and aren't expected to be complete until the mid- to late-2020s, they have both already been granted 'major project status' by the federal and state governments. This will expedite the various approval processes that the projects will have to go through as they get closer to realisation.

The potential for these projects to export Australia's considerable renewable energy resources around the world is enormous, and the leadership being shown will serve as a guiding light for many other similar, and potentially even more ambitious, projects to follow.



The rooftop solar boom continued in 2020, with more than 3 GW of new solar capacity added to Australian rooftops. This was the fourth record-breaking year in a row for the sector, and resulted in small-scale solar overtaking hydro as Australia's second-largest renewable energy generator.

## 378,451

rooftop solar installations  
in 2020

## 3 GW

rooftop solar capacity  
added in 2020

Records continued to tumble in the rooftop solar industry in 2020, with the sector recording its best-ever year for both the amount of installed capacity and the number of installations. The 378,451 systems installed throughout the year added 3 GW of new capacity to Australia's electricity system, easily beating the previous record of 2.2 GW in 2019. The size of rooftop solar systems installed by Australian households also increased again in 2020, with the average system size passing 8 kW for the first time. Australians' continued

enthusiasm for rooftop solar meant that the technology accounted for 23.5 per cent of Australia's total renewable energy generation in 2020, pushing it past hydro into second place for the first time.

Every state and territory besides Tasmania saw new records set for the amount of installed small-scale solar capacity in 2020, with Queensland leading the way from New South Wales and Victoria. Bundaberg was once again Australia's rooftop solar capital, installing 70,843 kW throughout the year, while

84 A Macdonald-Smith, The Australian Financial Review, *South Australia records 100pc solar in world first*, 22 October 2020, [afr.com/companies/energy/south-australia-records-100pc-solar-in-world-first-20201021-p567al](https://www.afr.com/companies/energy/south-australia-records-100pc-solar-in-world-first-20201021-p567al)

85 D Carroll, PV Magazine, *Australia No.1 in the world for installed solar PV capacity per capita*, 17 December 2020, [pv-magazine-australia.com/2020/12/17/australia-no-1-in-the-world-for-installed-solar-pv-capacity-per-capita/](https://www.pv-magazine-australia.com/2020/12/17/australia-no-1-in-the-world-for-installed-solar-pv-capacity-per-capita/)





**23.5%**  
of total clean energy  
generated in Australia  
in 2020



**6.5%**  
of total Australian  
electricity generated  
in 2020

Madora Bay in Western Australia entered the national top 10 for the first time.

The Clean Energy Council's Approved Solar Retailer program continued to grow in line with the industry in 2020, with the number of companies signing up to the program and committing to industry best practice increasing by 66 per cent to 1141. This strong growth was also seen in the number of Clean Energy Council accredited installers, which reached 7713, an increase of 17 per cent compared to 2019.

South Australia achieved a world first in October 2020, becoming the first major jurisdiction in the world to be powered entirely by solar power for one hour. This was largely due to rooftop solar, which contributed 77 per cent of the total, with the remainder supplied by large-scale solar.<sup>84</sup>

However, being at the global forefront of the solar revolution<sup>85</sup> brings several challenges, with low minimum demand causing issues related to the stability and management of the electricity system. Some of the solutions proposed in 2020

would result in extremely poor outcomes for the sector, such as charging rooftop solar customers to export to the grid. However, there were plenty of other more nuanced solutions – such as introducing tariffs that encourage greater usage during peak solar hours or formulating programs to drive the uptake of household batteries – that would help to solve the problem without diminishing Australian households' strong enthusiasm for rooftop solar.

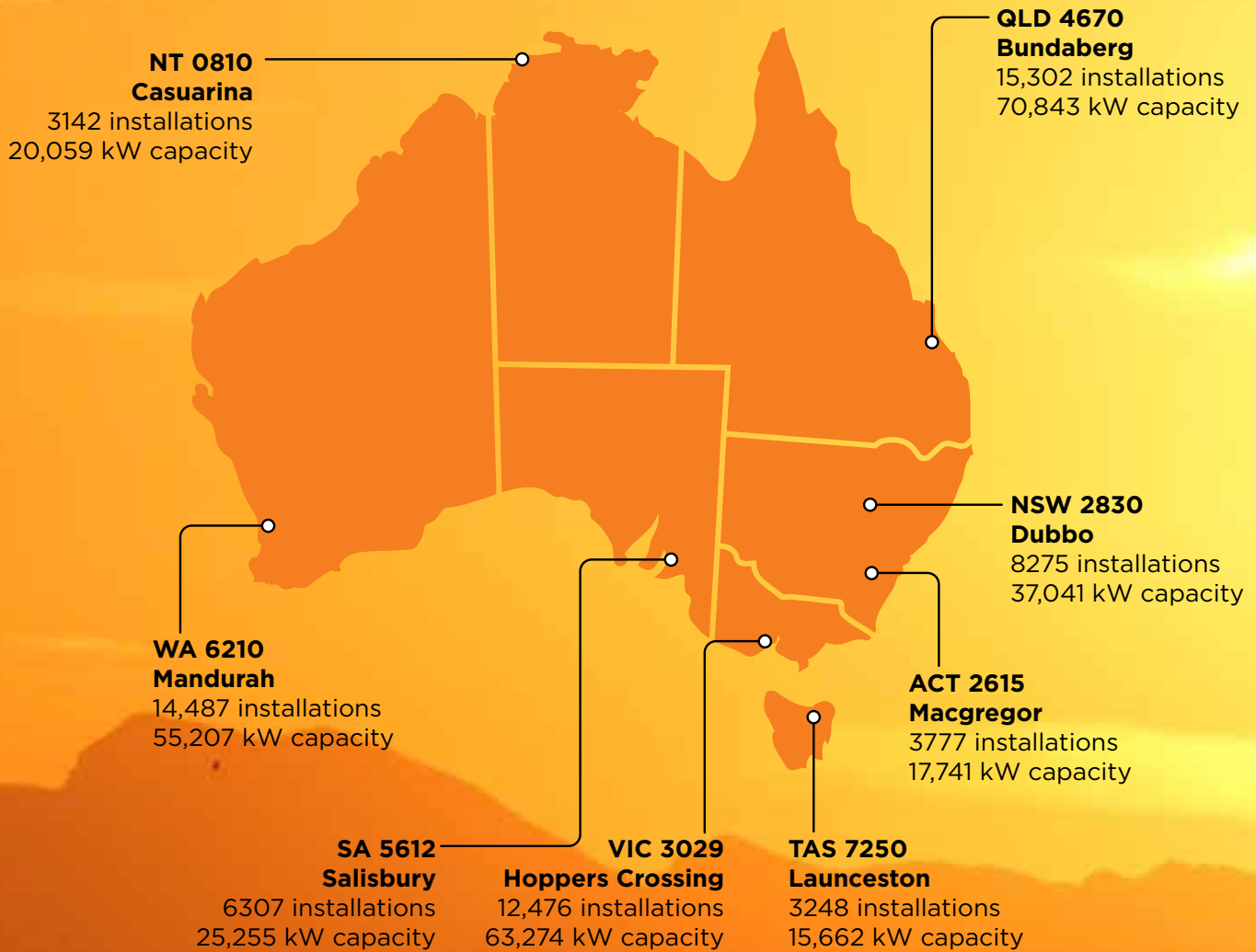


Image: Rooftop solar installation, Victoria

# SOLAR

SMALL-SCALE: SYSTEMS UP TO 100 KW (CONTINUED)

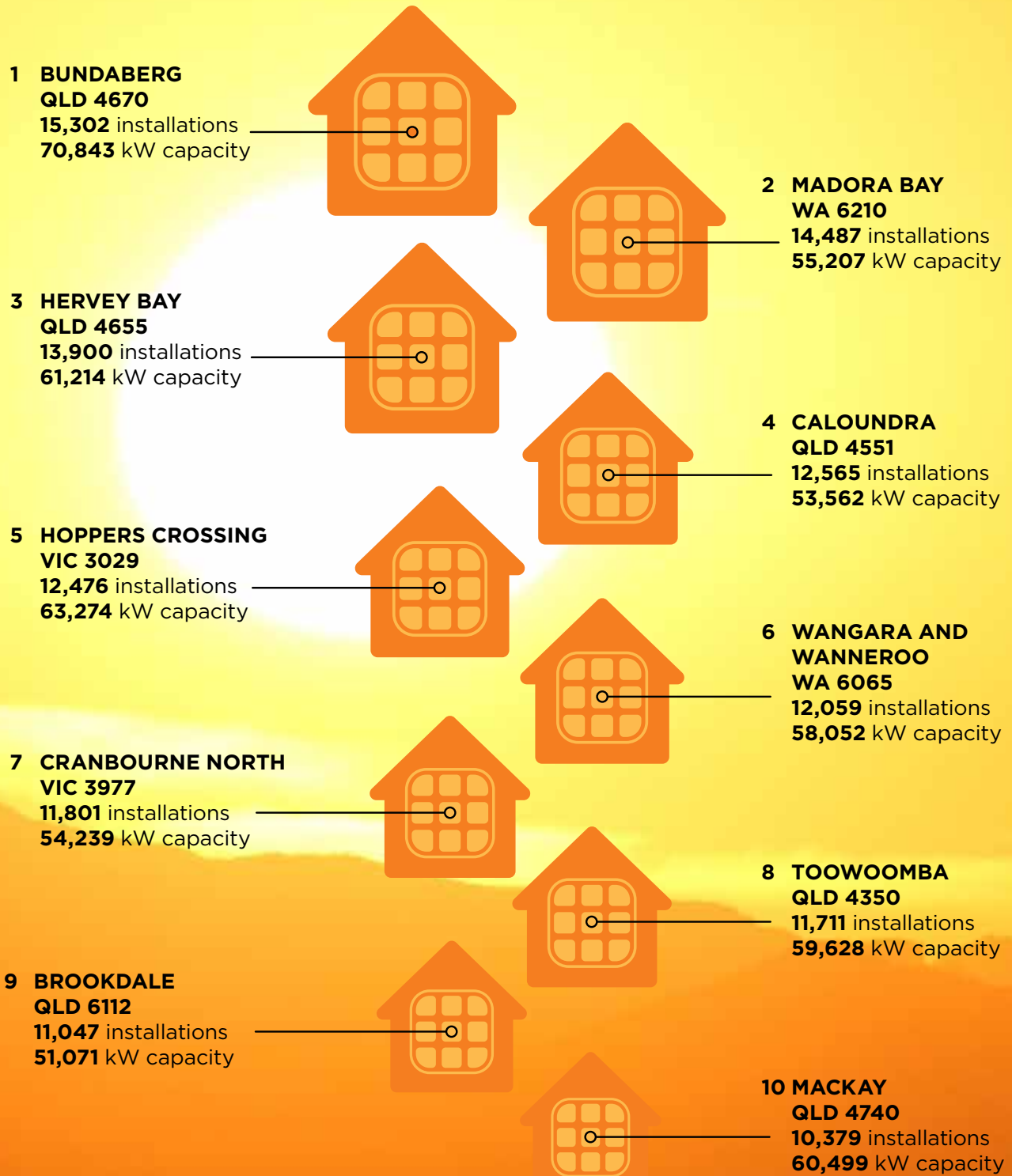
## TOP SOLAR POSTCODE IN EACH STATE BY NUMBER OF INSTALLATIONS<sup>86</sup>

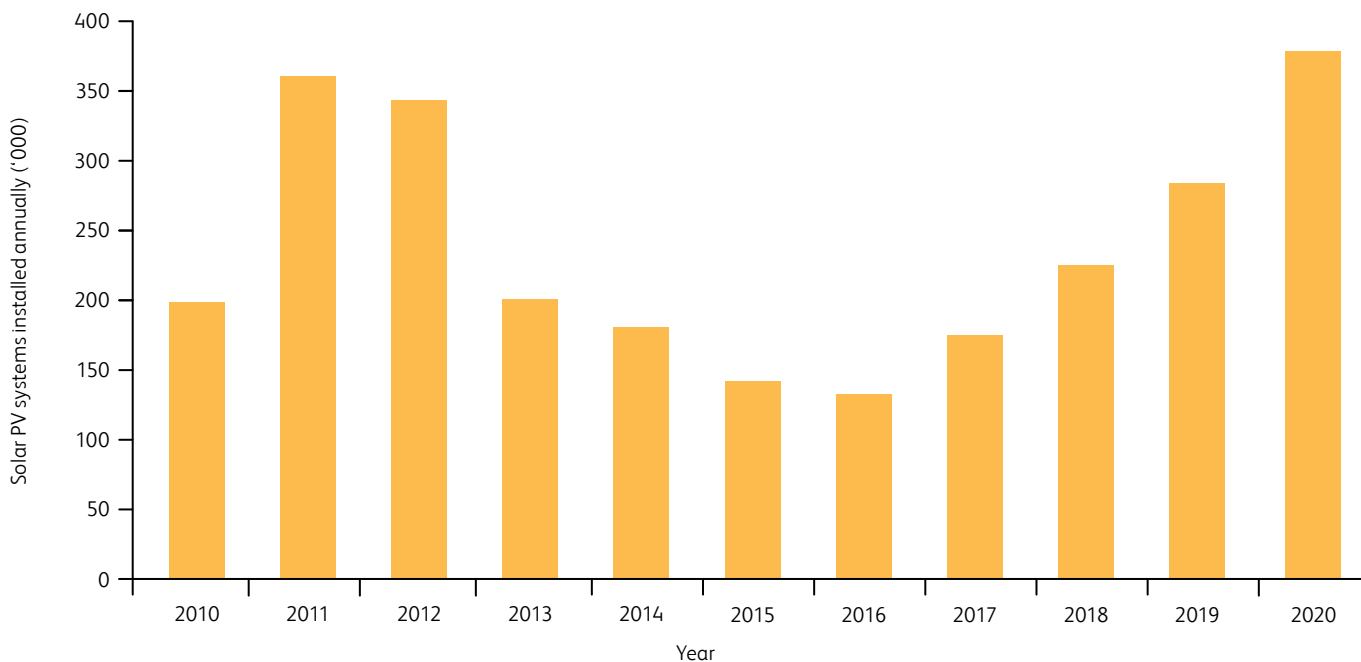


<sup>86</sup> Clean Energy Regulator, Green Energy Markets



## TOP TEN SOLAR POSTCODES IN AUSTRALIA BY NUMBER OF INSTALLATIONS<sup>86</sup>



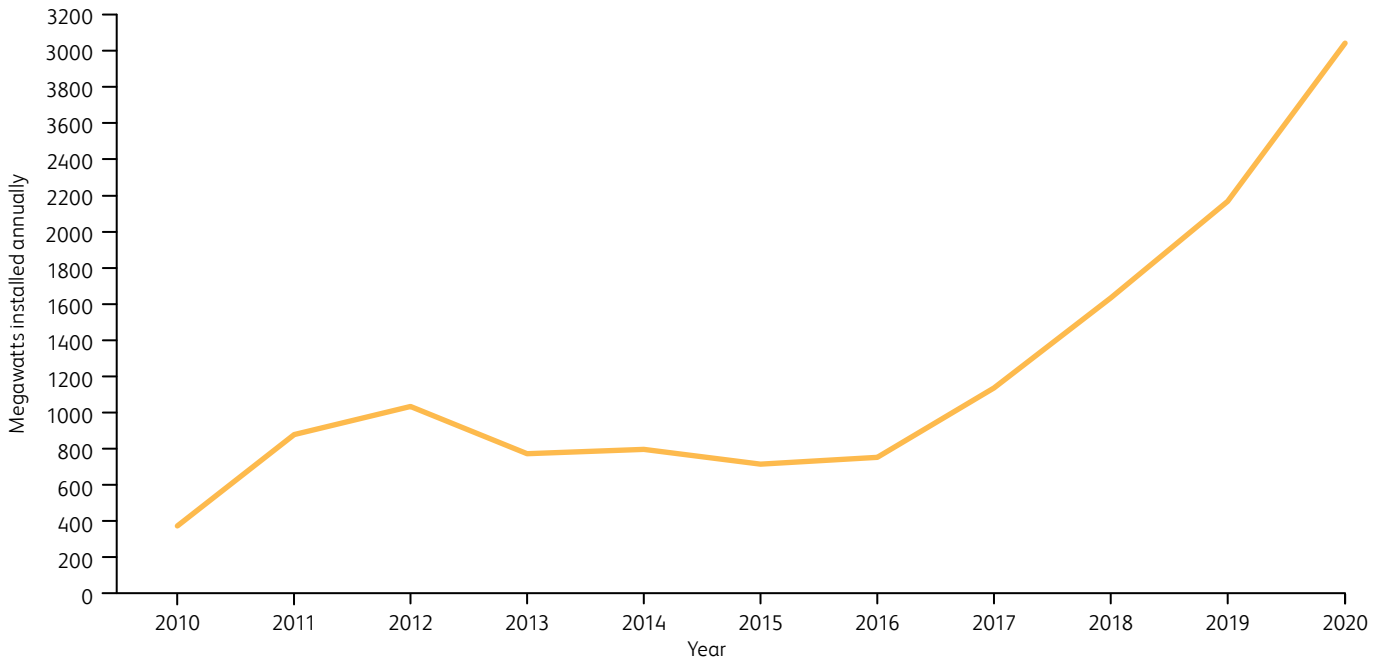
**ANNUAL SOLAR PV INSTALLATIONS<sup>87</sup>**

INSTALLATION YEAR	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	NATIONAL
2010	2323	69,988	637	48,697	16,705	1889	35,676	22,293	198,208
2011	6860	80,272	401	95,303	63,553	2475	60,214	51,667	360,745
2012	1522	53,961	513	130,252	41,851	6364	66,204	42,653	343,320
2013	2411	33,998	1024	71,197	29,187	7658	33,332	21,600	200,407
2014	1225	37,210	1026	57,748	15,166	4207	40,061	23,496	180,139
2015	1066	33,478	1197	39,507	12,081	2020	31,354	20,797	141,500
2016	1001	29,497	1745	34,423	12,604	2487	26,740	24,199	132,696
2017	1946	43,252	1950	46,448	16,190	2393	31,358	31,404	174,941
2018	3206	59,329	2365	55,087	21,894	2641	47,216	33,112	224,850
2019	3797	77,595	3505	70,700	27,086	2891	61,725	36,653	283,952
2020*	5632	114,936	3353	91,843	37,483	3488	71,433	50,287	378,451
TOTAL	32,137	652,104	18,149	764,166	308,349	40,195	517,344	371,872	2,704,312

\* 2020 numbers are based on STC creation up to 31 December 2020 and then adjusted for lags in audit invalidation and then upwards based on historical patterns that 8.46 per cent of installations only manage to create STCs in the subsequent year.

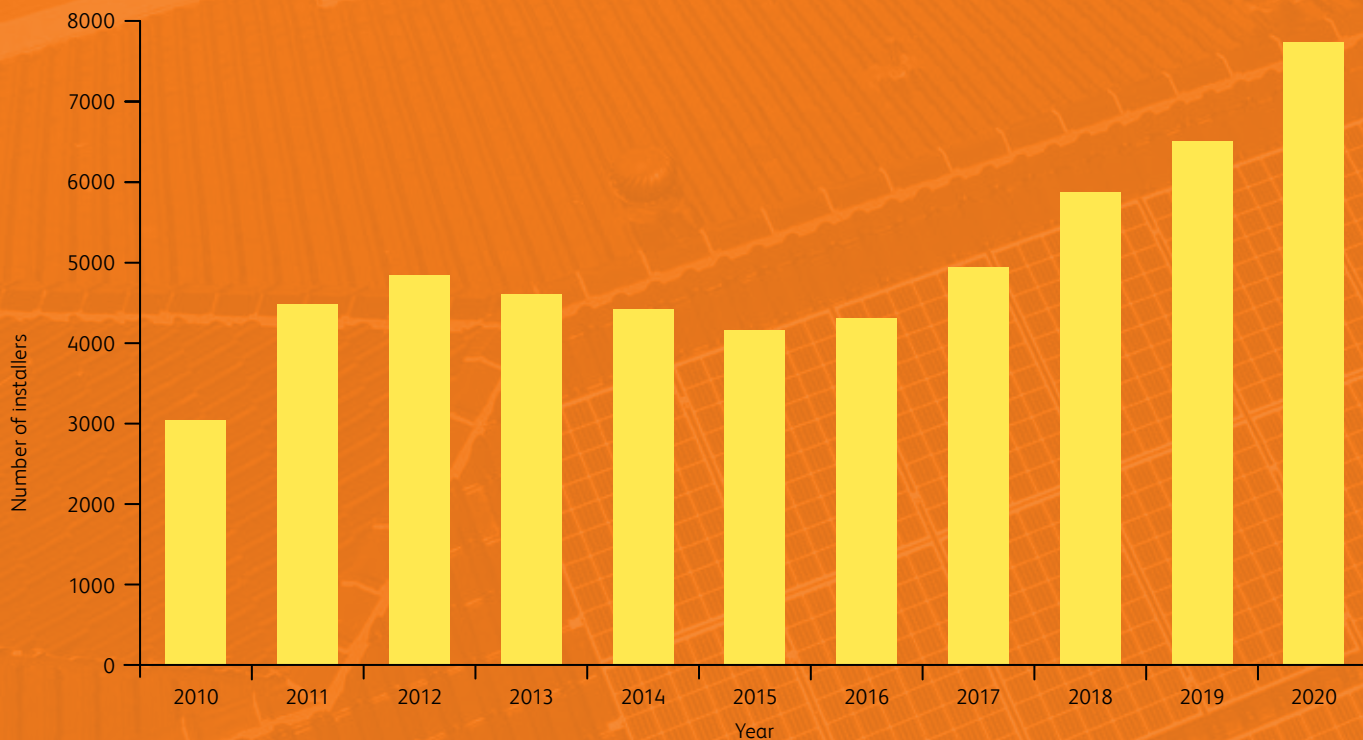


## ANNUAL INSTALLED CAPACITY OF SOLAR PV (MW)<sup>88</sup>



INSTALLATION YEAR	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	NATIONAL
2010	4.66	153.87	1.49	92.37	33.23	3.02	58.96	42.15	389.75
2011	15.86	196.52	1.80	225.19	163.52	5.91	140.41	123.01	872.24
2012	4.64	144.98	2.29	418.41	138.04	20.26	207.58	99.55	1035.75
2013	9.83	134.36	5.05	268.87	141.40	31.50	131.61	69.56	792.19
2014	4.51	172.35	6.12	248.79	82.54	18.96	171.70	95.30	800.26
2015	5.06	177.08	8.64	192.76	66.64	9.53	149.98	96.24	705.92
2016	6.21	167.35	12.70	199.53	77.67	11.84	144.46	128.05	747.82
2017	11.00	262.85	15.26	306.06	115.22	14.53	205.20	186.24	1116.37
2018	21.90	426.25	20.06	407.18	174.36	18.87	337.42	210.00	1616.03
2019	28.31	597.35	27.40	587.59	226.22	21.03	449.22	253.68	2190.81
2020*	47.11	927.08	28.20	786.73	316.01	28.53	559.42	350.35	3043.43
TOTAL	160.71	3383.61	129.93	3762.15	1552.19	185.94	2569.22	1671.34	13,415.09

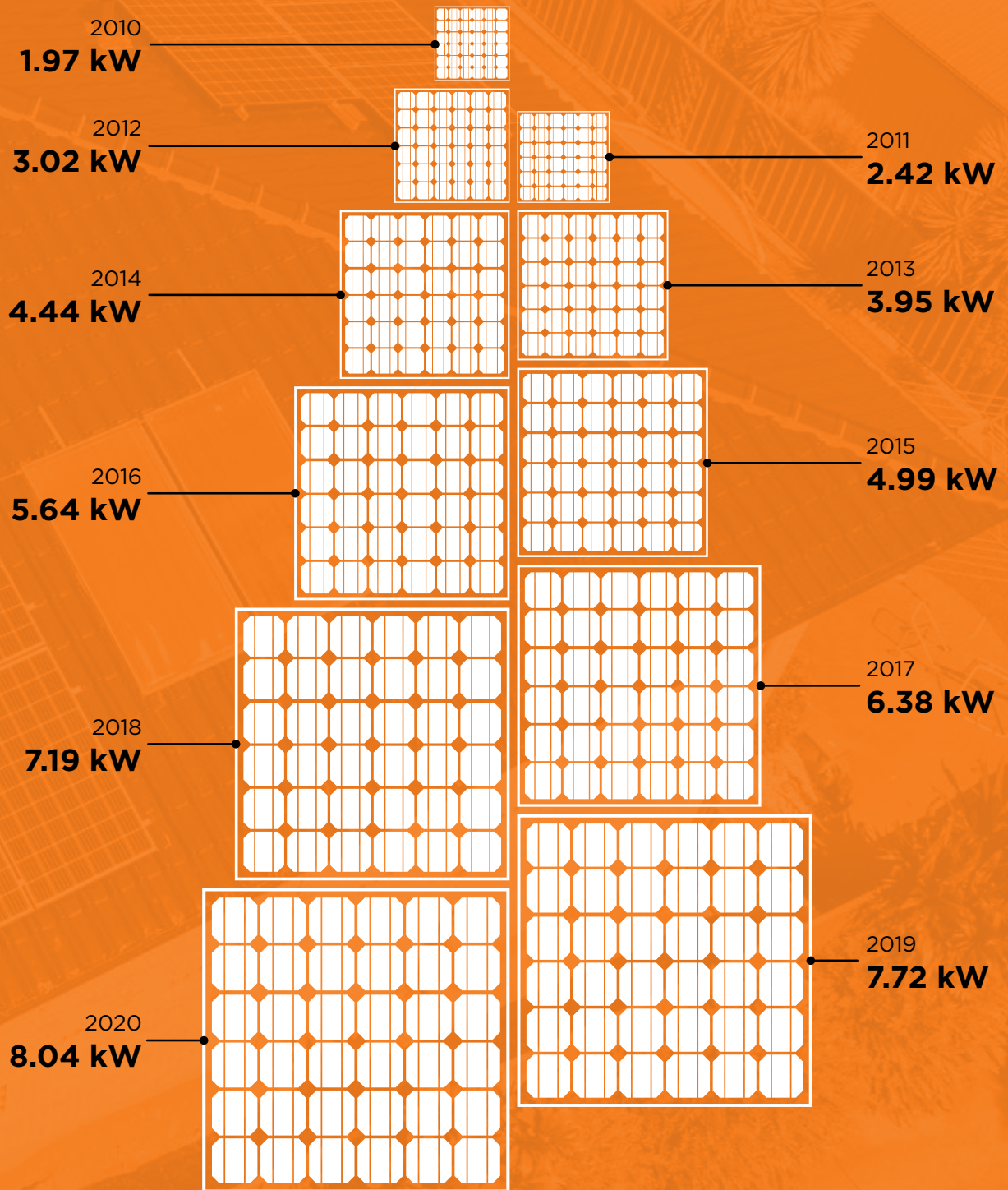
\* 2020 numbers are based on STC creation up to 31 December 2020 and then adjusted for lags in audit invalidation and then upwards based on historical patterns that 9.03 per cent of capacity create STCs in the subsequent year to installation.

**TOTAL NUMBER OF ACCREDITED INSTALLERS AND DESIGNERS**

YEAR	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Intl	TOTAL
2010	46	879	16	675	252	45	754	414	3	<b>3084</b>
2011	53	1034	22	1187	593	71	1004	531	2	<b>4497</b>
2012	48	948	28	1391	650	120	1122	514	3	<b>4824</b>
2013	44	894	41	1336	604	144	1093	439	6	<b>4601</b>
2014	44	908	47	1263	521	137	1075	401	8	<b>4404</b>
2015	44	916	51	1151	490	109	998	384	7	<b>4150</b>
2016	56	951	70	1188	500	101	974	465	7	<b>4312</b>
2017	66	1085	72	1354	552	112	1059	612	7	<b>4919</b>
2018	91	1323	81	1571	653	112	1316	712	5	<b>5864</b>
2019	103	1539	86	1797	694	116	1510	716	5	<b>6566</b>
2020	129	1905	117	2121	810	130	1707	793	1	<b>7713</b>



## NATIONAL AVERAGE SYSTEM SIZE (kW)<sup>89</sup>



89 Clean Energy Regulator, Green Energy Markets

# SOLAR

MEDIUM SCALE: SYSTEMS BETWEEN 100 KW AND 5 MW



The medium-scale solar sector added 117 MW of new capacity in 2020, which was a strong result considering the impact that the COVID-19 pandemic had on the Australian small business community.

## 117 MW

medium-scale solar capacity added in 2020

## 150

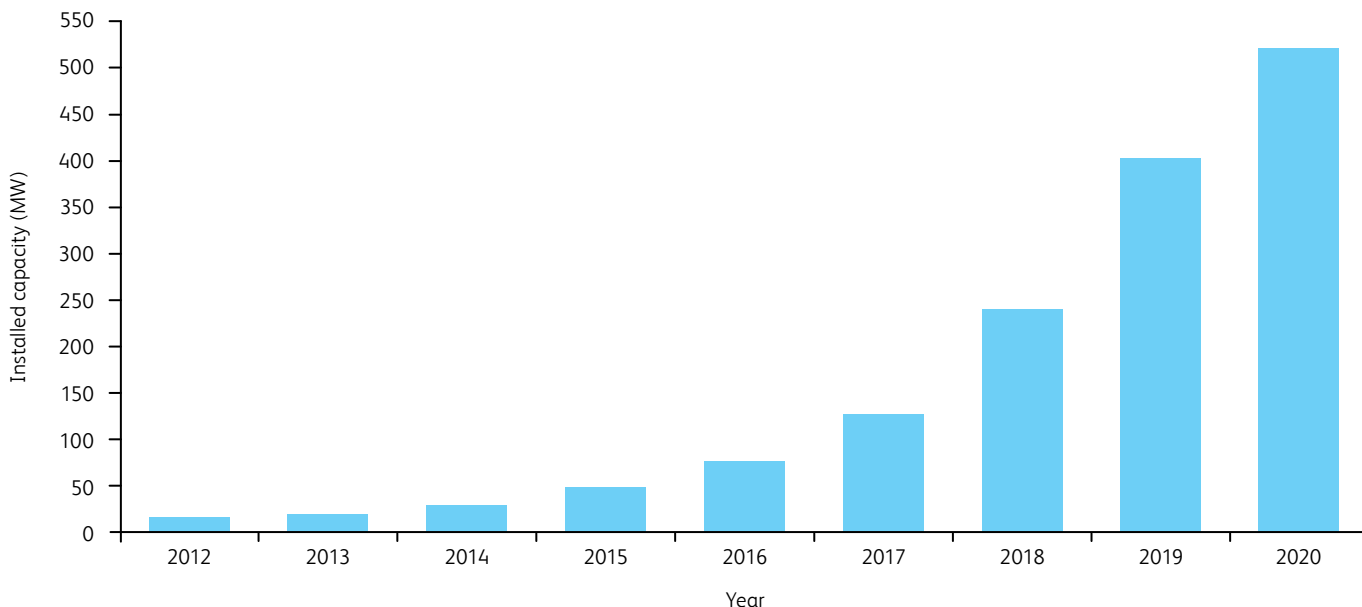
number of Woolworths stores with rooftop solar installed

The economic impact of the COVID-19 pandemic was evident in the medium-scale solar sector in 2020, with the amount of new capacity installed falling compared to 2019 as small businesses were forced to reduce their costs to survive. However, the 117 MW installed throughout 2020 was still the second-best year for medium-scale solar, and the size of the sector has more than doubled over the past two years so that it now

contributes 1.4 per cent to Australia's total renewable energy generation.

Despite the slight downturn in the sector, several exciting and innovative installations took place in 2020. In New South Wales, Smart Commercial Solar installed a 1.5 MW system on the roof of an industrial complex in Sydney's west with the help of a helicopter to lift the panels and other components

### CUMULATIVE INSTALLED CAPACITY OF MEDIUM-SCALE SOLAR SYSTEMS<sup>90</sup>



<sup>90</sup> Green Energy Markets

<sup>91</sup> B Peacock, PV Magazine, *Industrial property complex in Western Sydney fitted with 1.5 MW solar system*, 15 December 2020, [pv-magazine-australia.com/2020/12/15/industrial-property-complex-in-western-sydney-fitted-with-1-5-mw-solar-system](https://pv-magazine-australia.com/2020/12/15/industrial-property-complex-in-western-sydney-fitted-with-1-5-mw-solar-system)

<sup>92</sup> B Matich, PV Magazine, *Get to the chopper! How airlifting modules opens new solar frontiers*, 20 August 2020, [pv-magazine-australia.com/2020/08/20/get-to-the-chopper-how-airlifting-modules-opens-new-solar-frontiers/](https://pv-magazine-australia.com/2020/08/20/get-to-the-chopper-how-airlifting-modules-opens-new-solar-frontiers/)

<sup>93</sup> B Matich, PV Magazine, *Epho installs 100 solar systems in 100 days as Aldi Australia commits to 100% renewables*, 27 August 2020, [pv-magazine-australia.com/2020/08/27/epho-installs-100-solar-systems-in-100-days-as-aldi-australia-commits-to-100-renewables](https://pv-magazine-australia.com/2020/08/27/epho-installs-100-solar-systems-in-100-days-as-aldi-australia-commits-to-100-renewables)





**1.4%**  
of total clean energy  
generated in Australia  
in 2020



**0.4%**  
of total Australian  
electricity generated  
in 2020

into place. This helped to speed up the installation process and allowed materials to be placed onto areas of the roof that a traditional crane wasn't able to reach.<sup>91</sup>

The use of helicopters in the installation of commercial solar was a growing trend in 2020, with Epo also using a helicopter to help with the installation of a 572 kW solar system at the Woolworths headquarters in Sydney.<sup>92</sup>

The supermarket chains were one of the big drivers of the medium-scale solar sector in 2020, with both Woolworths and Aldi utilising their vast roof space to offset the electricity usage at their stores.

As part of its commitment to source 100 per cent of its electricity from renewables by the end of 2021, Aldi installed a large number of rooftop solar systems in 2020, meaning that 250 of its Australian stores and six

distribution centres had rooftop solar at the end of 2020.<sup>93</sup>

Woolworths also committed to 100 per cent renewable energy in 2020, and had installed rooftop solar systems on 150 of its stores by the end of 2020. This included an innovative installation in the shape of the Woolworths logo on a supermarket in Orange that was a finalist in the 2020 Solar Design and Installation Awards.

## CASE STUDY

### NEW SOLUTION BRINGS LARGE-SCALE SOLAR TO COMMERCIAL ROOFTOPS



Image: DHL Supply Chain solar installation, New South Wales

On first inspection, the solar installation on the roof of DHL Supply Chain's (DHL) Western Sydney distribution centre looks like any other commercial solar system. But if you take a look behind the scenes, you quickly realise that this is no ordinary solar project.

What makes this system unique is that it's the first urban solar plant in the world where the electricity generated can be simultaneously used for on-site consumption or directly traded on the National Electricity Market (NEM). The solution that enables this groundbreaking development is Epo's Bright Thinkers Power Station (BTPS), an innovative control system with switching technologies that segregates electricity through two separate channels.

The BTPS allowed DHL to install a 1.7 MW solar system on the roof of its warehouse, which was double the size it needed to offset its on-site daytime power needs. The excess electricity generated by the system can then be traded on the NEM, with an algorithm deciding the optimum mix based on

solar output, wholesale electricity market signals and tenant demand. The BTPS also solves the challenge that often arises for tenants looking to install a solar system on a rented building as the landlord is still able to trade on the NEM if the tenant moves out.

The potential for the BTPS to unlock gigawatts of solar power in industrial rooftops is enormous, opening a path to enable the development of NEM-connected rooftop power stations that could fundamentally change the commercial solar space.

The project earned Epo's Luke Butterworth, Marton Treuer, Alvin Lee, Tim Shield, Cameron Evans and Matthias Huchel a 2020 Clean Energy Council Solar Design and Installation Award in the Over 240 kW category.



After setting new records in each of the previous two years, the growth of the large-scale solar sector slowed in 2020 as policy uncertainty and grid connection issues began to have an impact. However, the sector still accounted for more than two-thirds of all large-scale projects commissioned in 2020.

## 52

large-scale solar farms under construction at the end of 2020

The large-scale solar sector's momentum slowed in 2020, but it still added 893 MW of new capacity across 22 projects. This brought the sector's total capacity to 3.9 GW and increased its contribution to Australia's renewable generation from 9.3 per cent in 2019 to 10.9 per cent in 2020. Queensland was Australia's leading large-scale solar state in 2020, generating 3.3 GWh of solar power throughout the year. It was followed by New South Wales with 2.4 GWh and Victoria with just over 1 GWh.

The largest commissioned solar farm in 2020 was the 110 MW second stage of the Bungala Solar Farm in South Australia. When combined with the first stage of the project, which was completed in 2018, the solar farm injects 220 MW of solar power into the South Australian electricity grid. Other notable projects to come online in 2020 included the

## 893 MW

new large-scale solar capacity added in 2020

105 MW Nevertire Solar Farm in New South Wales, the 100 MW Bomen Solar Farm in New South Wales, Western Australia's 100 MW Merredin Solar Farm and the 100 MW Yarranlea Solar Farm in Queensland.

In late 2019, five large-scale solar farms in Victoria and New South Wales were forced to significantly curtail their output after the Australian Energy Market Operator identified a system strength shortfall in the area. While the shortfall was resolved in April 2020, allowing the projects to return to full generation, the issue highlights some of the challenges faced by large-scale solar developers as the penetration of renewable energy increases.

The large-scale solar sector is expected to perform strongly in the next couple of years, with 52 large-scale solar farms under construction at the end of 2020.

## 3.3 GWh

large-scale solar power generated in Queensland

Among these are the 400 MW Western Downs Green Power Hub in Queensland and the 400 MW New England Solar Farm in New South Wales, both of which are expected to be completed in 2022. In what is becoming increasingly common, both projects will include a utility-scale battery to provide extra electricity into the grid outside of peak solar hours.

Also on the horizon is the Sun Cable project in the Northern Territory, which at 10 GW will be the world's largest solar farm and will feature a battery 150 times larger than South Australia's Hornsdale Power Reserve.<sup>94</sup> Although the megaproject isn't expected to generate electricity until 2026, its ongoing development is a strong signal of the large-scale solar industry's importance to Australia's, and the world's, transition to a renewable energy future.

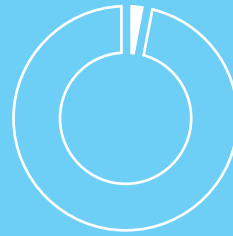
<sup>94</sup> S Vorrath, RenewEconomy, *Sun Cable earmarks site for 10GW solar farm at cattle station south of Darwin*, 22 October 2020, [reneweconomy.com.au/sun-cable-earmarks-site-for-10gw-solar-farm-at-cattle-station-south-of-darwin-60771](https://reneweconomy.com.au/sun-cable-earmarks-site-for-10gw-solar-farm-at-cattle-station-south-of-darwin-60771)

<sup>95</sup> Green Energy Markets





**10.9%**  
of total clean energy  
generated in Australia  
in 2020

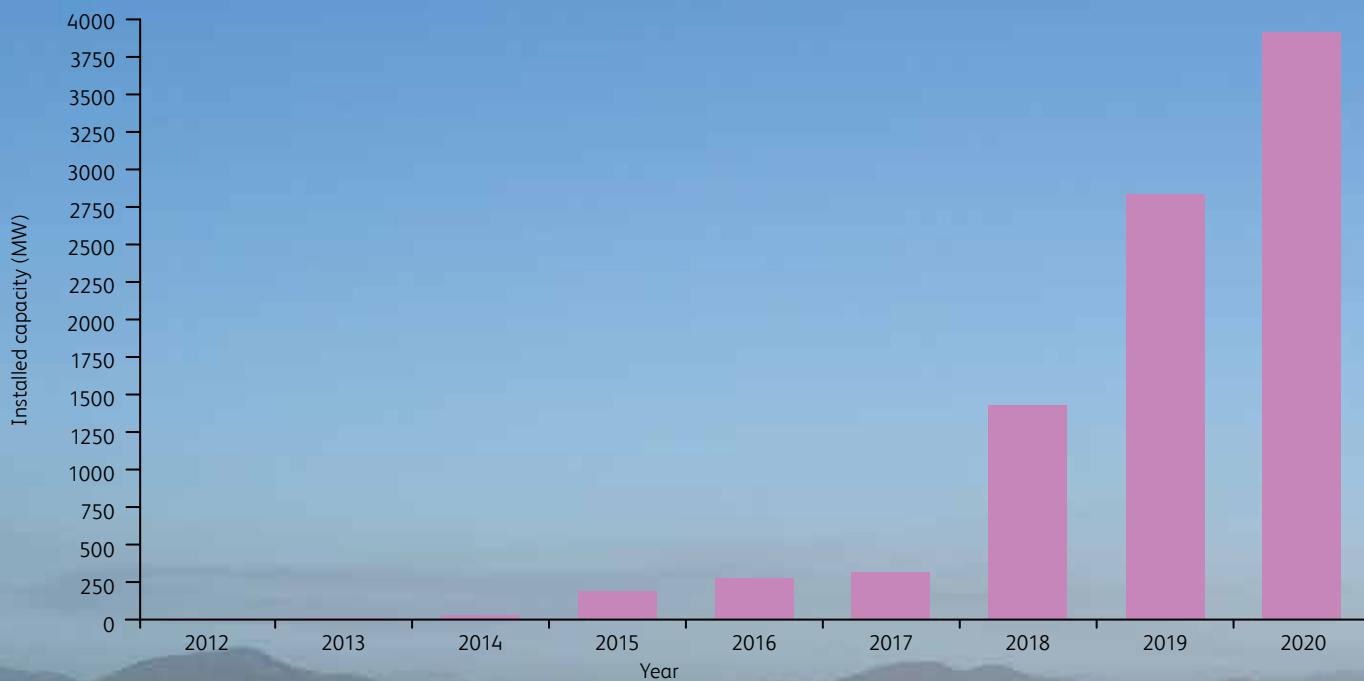


**3.0%**  
of total Australian  
electricity generated  
in 2020

## LARGE-SCALE SOLAR PLANTS COMMISSIONED IN 2020<sup>95</sup>

STATE	PROJECT	OWNER	CAPACITY (MW)
SA	Bungala Solar Farm - Stage 2	Enel Green Power/Dutch Infrastructure Fund	110
NSW	Nevertire Solar Farm	Elliott Green Power	105
NSW	Bomen Solar Farm	Spark Infrastructure	100
WA	Merredin Solar Farm	Risen Energy	100
QLD	Yarranlea Solar Farm	Risen Energy	100
VIC	Bannerton Solar Park	Foresight Solar Fund	88
NSW	Goonumbla Solar Farm	Fotowatio Renewable Ventures	68
QLD	Oakey Solar Farm - Stage 2	Foresight Group	55
QLD	Collinsville Solar Farm	RATCH-Australia	43
WA	Greenough River Solar Farm upgrade	Bright Energy Investments	30
NSW	Limondale Solar Farm - Stage 2	Innogy	29
VIC	Katamatite Solar Farm	Diamond Energy	8
VIC	Numurkah Solar Project	Diamond Energy	8
VIC	Robinvale Solar Farm	Suntech Power Development Australia	7
WA	Nova Power Station Solar	Zenith Energy	6
SA	Bungama Solar Farm - Stage 2	Astronergy Solar Australia	5
NSW	EP Sunspot 2 Solar Farm	Enerparc Australia	5
SA	Kadina Solar Farm - Stage 1	Astronergy Solar Australia	5
NSW	Schwartz Solar Farm	Schwartz Hotels	5
SA	Baroota Solar Farm	Flagstaff Enterprises	5
VIC	Girgarre Solar Project No. 2	Diamond Energy	5
VIC	Stanhope Solar Project No. 2	Diamond Energy	5

## CUMULATIVE INSTALLED LARGE-SCALE SOLAR CAPACITY<sup>96</sup>



96 Green Energy Markets



## ANNUAL INSTALLED CAPACITY (MW)<sup>96</sup>

YEAR	2013	2014	2015	2016	2017	2018	2019	2020
ANNUAL INSTALLED CAPACITY (MW)	0	20	155	90	51	935	1760	892

## TOP FIVE SOLAR FARMS BY SIZE

### COLEAMBALLY, NSW

Owner:  
Neoen

Commissioned:  
2018

**150 MW**

### DAYDREAM, QLD

Owner:  
Edify Energy

Commissioned:  
2019

**150 MW**

### FINLEY, NSW

Owner:  
John Laing

Commissioned:  
2019

**133 MW**

### SUN METALS TOWNSVILLE, QLD

Owner:  
Sun Metals

Commissioned:  
2018

**127 MW**

### ROSS RIVER, QLD

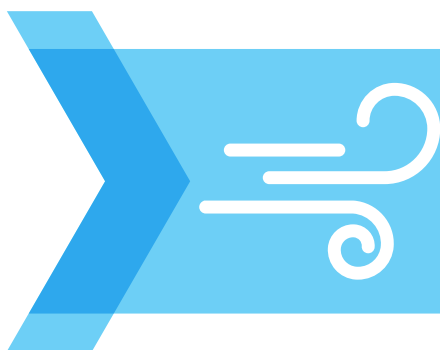
Owner:  
Elliott Green Power

Commissioned:  
2019

**116 MW**



Image: Haughton Solar Farm, Queensland



After overtaking hydro to become Australia's leading renewable energy source in 2019, the wind sector maintained its momentum in 2020, recording its second-straight record-breaking year and adding more than 1 GW of new capacity for the first time.

**10**

wind farms commissioned in 2020

The commissioning of 10 new wind farms around Australia added 1097 MW of wind capacity in 2020, comfortably surpassing the previous record of 837 MW set in 2019. Six of these wind farms were installed in Victoria, which accounted for 658 MW of the new capacity. At the same time, Western Australia added two new projects and Tasmania and South Australia added one new wind farm each. Victoria continued to be the home of the wind sector in Australia in 2020, contributing almost 30 per cent of the nation's total wind generation.

The wind sector was responsible for 35.9 per cent of Australia's total renewable energy generation in 2020, marginally up on the 35.4 per cent it accounted for in 2019. However, wind's percentage of total generation increased by 1.4 percentage points to 9.9 per cent

**1097 MW**

wind capacity installed in 2020

in 2020 as renewables increasingly displaced fossil fuel generation.

The largest completed project in 2020 was the 226 MW stage 1 of the Murra Warra Wind Farm in western Victoria. The second stage of the project is currently under construction, and upon completion will bring the total capacity of the Murra Warra Wind Farm to a massive 429 MW. Other notable projects to reach completion in 2020 include the 184 MW Warradarge Wind Farm in Western Australia and Victoria's 148 MW Cattle Hill Wind Farm.

The wind industry's strong performance over the past two years looks set to continue in 2021, with 21 projects under construction or financially committed at the end of 2020. This represents more than 4 GW of new wind capacity and includes the 530 MW Stockyard

**658 MW**

wind capacity installed in Victoria in 2020

Hill Wind Farm and the 453 MW Coopers Gap Wind Farm, both of which are bigger than Australia's current largest wind farm.

These aren't the only big projects in the pipeline, with ACCIONA planning to build a 1 GW wind farm in Queensland in conjunction with state-owned clean energy generation company CleanCo<sup>97</sup> and Neoen announcing plans to build the massive Goyder South wind, solar and storage project in South Australia, which will feature a 1.2 GW wind farm and a 900 MW/1800 MWh battery.<sup>98</sup> With development also continuing on the 7.5 GW of wind capacity proposed for the Asian Renewable Energy Hub in Western Australia<sup>99</sup> and Victoria's 2.2 GW Star of the South offshore wind farm, the next few years promise to be extremely exciting for the wind sector in Australia.

97 G Parkinson, RenewEconomy, *ACCIONA to build huge 1GW wind farm in Queensland after landing CleanCo deal*, 26 March 2020, [reneweconomy.com.au/acciona-to-build-huge-1gw-wind-farm-in-queensland-after-landing-cleanco-deal-15236](https://reneweconomy.com.au/acciona-to-build-huge-1gw-wind-farm-in-queensland-after-landing-cleanco-deal-15236)

98 G Parkinson, RenewEconomy, *Neoen files plans for \$3bn wind and solar farm with battery 10 times bigger than Hornsdale*, 20 August 2020, [reneweconomy.com.au/neoen-files-plans-for-3bn-wind-and-solar-farm-with-battery-10-times-bigger-than-hornsdale-67395](https://reneweconomy.com.au/neoen-files-plans-for-3bn-wind-and-solar-farm-with-battery-10-times-bigger-than-hornsdale-67395)

99 NS Energy, *Asian Renewable Energy Hub (AREH), Pilbara*, [nenergybusiness.com/projects/asian-renewable-energy-hub-areh-pilbara](https://nenergybusiness.com/projects/asian-renewable-energy-hub-areh-pilbara)





**35.9%**  
of total clean energy  
generated in Australia  
in 2020



**9.9%**  
of total Australian  
electricity generated  
in 2020

## WIND FARMS COMMISSIONED IN 2020<sup>100</sup>

STATE	PROJECT	OWNER	CAPACITY (MW)
VIC	Murra Warra Wind Farm – Stage 1	Partners Group	226
WA	Warradarge Wind Farm	Bright Energy Investments	183.6
VIC	Cattle Hill Wind Farm	Goldwind Australia/Power China Group	148
VIC	Mt Gellibrand Wind Farm – Stage 1	ACCIONA	132
SA	Lincoln Gap Wind Farm – Stage 1	Nexif Energy	126
TAS	Granville Harbour Wind Farm	Palisade Asset Management	111.6
VIC	Lal Lal Wind Farm – Elaine section	Northleaf Capital/InfraRed Capital Partners/ Macquarie Capital	83.6
VIC	Cherry Tree Wind Farm	John Laing	57.6
WA	Agnew Mine Wind and Solar Project	Energy Developments Limited	18
VIC	Ferguson Wind Farm	BayWa r.e.	10.8

## TOP FIVE PLANTS BY SIZE

### MACARTHUR, VIC

Owner:  
HRL Morrison/  
Malakoff Corporation

Commissioned:  
2012

**420 MW**

### SNOWTOWN 2, SA

Owner:  
Tilt Renewables

Commissioned:  
2014

**270 MW**

### SAPPHIRE, NSW

Owner:  
Partners Group/  
CWP Renewables

Commissioned:  
2018

**270 MW**

### ARARAT, VIC

Owner:  
RES

Commissioned:  
2017

**240 MW**

### MURRA WARRA, VIC

Owner:  
Partners Group

Commissioned:  
2020

**226 MW**

TECHNOLOGY PROFILES  
**WIND POWER** (CONTINUED)

**PERCENTAGE OF WIND GENERATION BY STATE<sup>101</sup>**



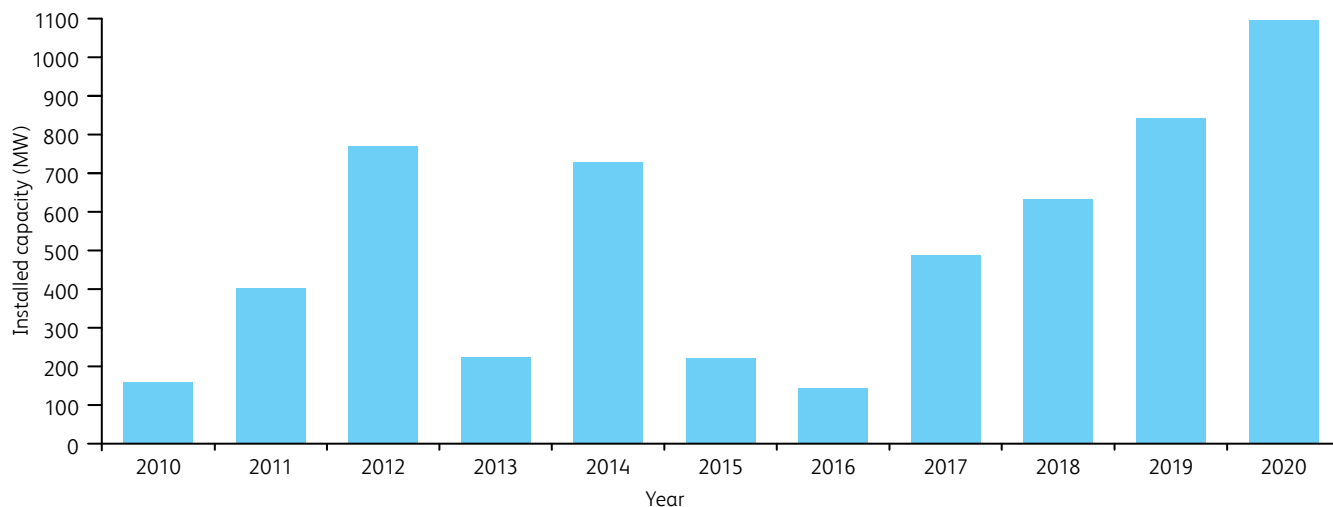


## WIND FARMS UNDER CONSTRUCTION AND COMMITTED AT END OF 2020<sup>101</sup>

STATE	PROJECT	OWNER	CAPACITY (MW)
VIC	Stockyard Hill Wind Farm	Goldwind Australia	530
QLD	Coopers Gap Wind Farm	AGL/Powering Australia Renewables Fund	453
VIC	Dundonnell Wind Farm	Tilt Renewables	336
VIC	Moorabool Wind Farm	Goldwind Australia	321
NSW	Bango Wind Farm	Partners Group/CWP Renewables	244
NSW	Collector Wind Farm	RATCH-Australia	227
VIC	Ryan Corner Wind Farm	Global Power Generation	218
WA	Yandin Wind Farm	Alinta Energy/RATCH-Australia	210
VIC	Murra Warra Wind Farm - Stage 2	Partners Group	203
VIC	Bulgana Green Power Hub	Neoen	194
VIC	Berrybank Wind Farm	Global Power Generation	180
VIC	Mortlake South Wind Farm	ACCIONA	157.5
VIC	Lal Lal Wind Farm	Northleaf Capital/InfraRed Capital Partners/Macquarie Capital	144.4
NSW	Crudine Ridge Wind Farm	Partners Group/CWP Renewables	134.3
NSW	Biala Wind Farm	BJCE Australia	110
VIC	Berrybank Wind Farm - Stage 2	Global Power Generation	109.2
VIC	Hawkesdale Wind Farm	Global Power Generation	96.6
SA	Lincoln Gap Wind Farm - Stage 2	Nexif Energy	86
QLD	Kennedy Energy Park - Wind	Windlab/Eurus	43.2
WA	Beros Road Wind Farm	Indian Ocean Farms	9.5
VIC	Diapur Wind Farm	BayWa r.e.	8.4

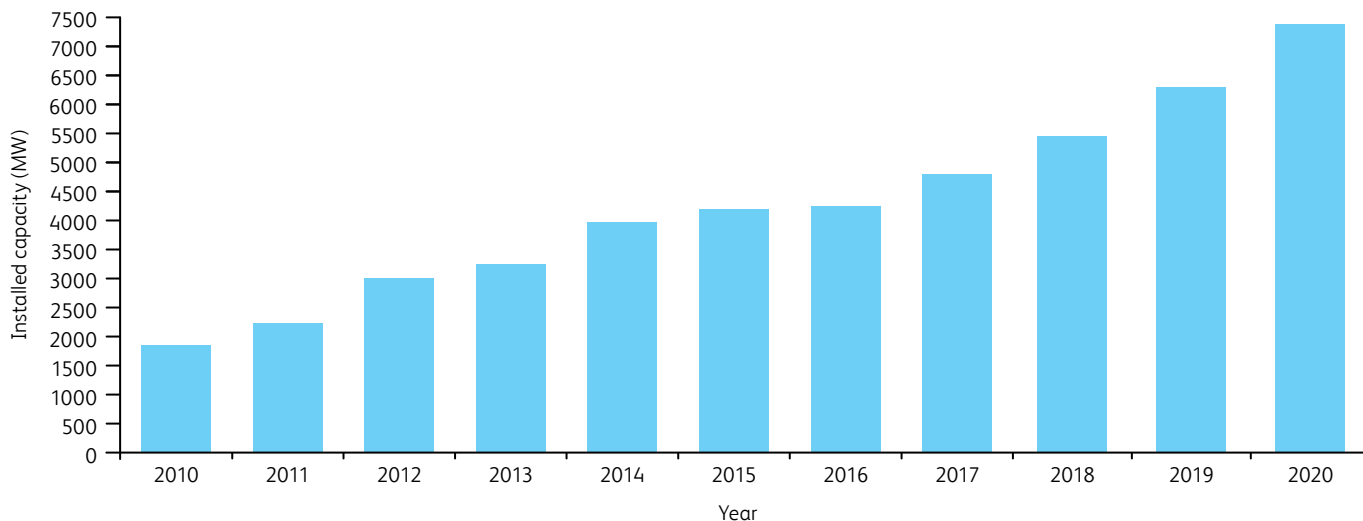
TECHNOLOGY PROFILES  
**WIND POWER** (CONTINUED)

**ANNUAL INSTALLED WIND CAPACITY IN AUSTRALIA<sup>102</sup>**



YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ANNUAL INSTALLED CAPACITY (MW)	159	401	768	225	728	220	41	590	631	837	1097

**CUMULATIVE INSTALLED WIND CAPACITY IN AUSTRALIA<sup>102</sup>**



YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CUMULATIVE INSTALLED CAPACITY (MW)	1840	2241	3009	3234	3962	4181	4222	4811	5442	6279	7376

<sup>102</sup> Green Energy Markets



Image: Dundonnell Wind Farm, Victoria

## CASE STUDY

### DUNDONNELL WIND FARM CREATING A LASTING LEGACY FOR LOCAL COMMUNITIES

In recent years, the Australian wind industry has learned that community engagement is just as critical when designing a new wind farm as turbine location or wind modelling. Ensuring that the local community supports a new wind farm and shares in its benefits often plays a key role in the successful development of a project.

A striking example of this theory being put into practice comes from the Dundonnell Wind Farm in western Victoria, where Tilt Renewables implemented an extensive benefit-sharing plan to create an enduring positive legacy in the local community surrounding the wind farm.

The plan included the installation of a community mini-grid, a fund to improve road safety, support for local not-for-profit organisations, community groups and mental health providers, a major contribution towards safe housing for women fleeing domestic violence, and education funding for residents.

The benefit-sharing plan was a result of extensive consultation with the local community, which identified a number of key local challenges, including mental health, an ageing population, sustainable local employment and the accessibility of education.

The resulting plan was extremely successful as it took a considered approach to ensure that it addressed the chief concerns raised by the local community. In addition to maintaining the wind farm's social licence in the region, the benefit-sharing plan will create a lasting legacy by helping to prevent suicide, support vulnerable communities and create education opportunities for local residents.

The outstanding work done by Tilt Renewables at the Dundonnell Wind Farm was recognised with the Community Engagement Award at the 2020 Clean Energy Council Awards.





Image: Lake Bonney Wind Farm, South Australia





Image: White Rock Wind Farm, New South Wales



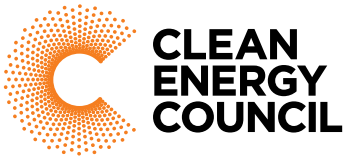
The Clean Energy Council would like to thank the Business Renewables Centre Australia and Bioenergy Australia for their contributions to this year's report and the following members and industry stakeholders for providing the photographs:

- Autonomous Energy
- Coffs Solar Energy
- CPS National
- GEM Energy
- Goldwind Australia
- Infigen
- Neoen
- Pacific Hydro
- Palisade Investment Partners
- RATCH-Australia
- RES Australia
- Tilt Renewables – University of Queensland



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Design by indium design / [indiumdesign@gmail.com](mailto:indiumdesign@gmail.com)



Phone  
**+61 3 9929 4100**

Email  
**info@cleanenergycouncil.org.au**

Web  
**cleanenergycouncil.org.au**

Find us on

