

POWERING PROGRESS: STATES RENEWABLE ENERGY RACE



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Preface

The renewable energy boom is accelerating in Australia, and across the world. State and territory governments are leading Australia's electricity transition from fossil fuels to renewable energy and storage.

Every year the Climate Council tracks the relative progress of Australian states and territories based on their performance across a range of renewable energy metrics: percentage of renewable electricity; proportion of households with solar; large-scale wind and solar capacity per capita; and targets or policies in place for renewable energy. We also outline progress for each state and territory government over the last twelve months in terms of renewable energy growth and policy, as well as their position on fossil fuels. This report is the Climate Council's fourth scorecard evaluating state and territory progress on renewable energy. This report follows on from previous state and territory renewable energy updates in 2014, 2016 and 2017.

We would like to thank Tim Buckley and Renate Egan for kindly reviewing the report. We also appreciate the assistance of Huw Jones in its preparation. We would also like to thank the relevant state and territory departments for reviewing and providing feedback on each state or territory profile.

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Key Findings

1

Tasmania, ACT and SA are equal winners of this year's renewables race. WA and the NT are lagging at the back of the pack.

- › The Climate Council's 2018 renewable energy scorecard finds Tasmania, the Australian Capital Territory (ACT) and South Australia are leading the other states and territories across a range of renewable energy measures – based on each state's proportion of renewable energy, wind and solar capacity per capita, proportion of households with solar, and renewable energy targets and policies.
- › Western Australia, the Northern Territory and New South Wales are lagging behind the other states and territories. Western Australia's share of renewable energy is low, however the state has the third highest proportion of households with rooftop solar. The Northern Territory has a low share of renewable electricity and solar households, but is set to implement its plan to reach 50% renewable energy by 2030. New South Wales does not have a renewable energy target and has no plan to replace its ageing and unreliable coal power stations.

2

States and territories continue to lead the way on renewable energy in the ongoing absence of credible national climate policy.

- › Australia is already experiencing the devastating impacts of climate change, such as worsening extreme weather events. To effectively tackle climate change we must accelerate the transition to renewables and storage technologies.
- › With the exception of Western Australia, all states and territories have committed to renewable energy targets and/or net zero emissions targets.
- › Tasmania, the ACT and South Australia have the highest proportion of renewable electricity.
- › South Australia continues to have the largest amount of installed wind and solar capacity (1,831MW), closely followed by New South Wales (1,759MW) and Victoria (1,634MW). On a per capita basis, South Australia, the ACT and Tasmania are the leaders.
- › Queensland and South Australia have the highest proportion of households with rooftop solar, at 32.9% and 32.3% respectively. Western Australia is in third place with 26.7% of households with rooftop solar.

3

Queensland has more renewable energy projects under construction than any other state.

- › Almost 10,000 jobs are being created in the renewable energy industry across Australia with 69 wind and solar plants under construction.
- › Queensland, Victoria and New South Wales are home to the vast majority of these projects.
- › Queensland and Victoria have ambitious renewable energy targets and policies to increase the amount of renewable energy.
- › South Australia has at least eight new projects under construction and is on track for 73% renewable electricity in just two years.

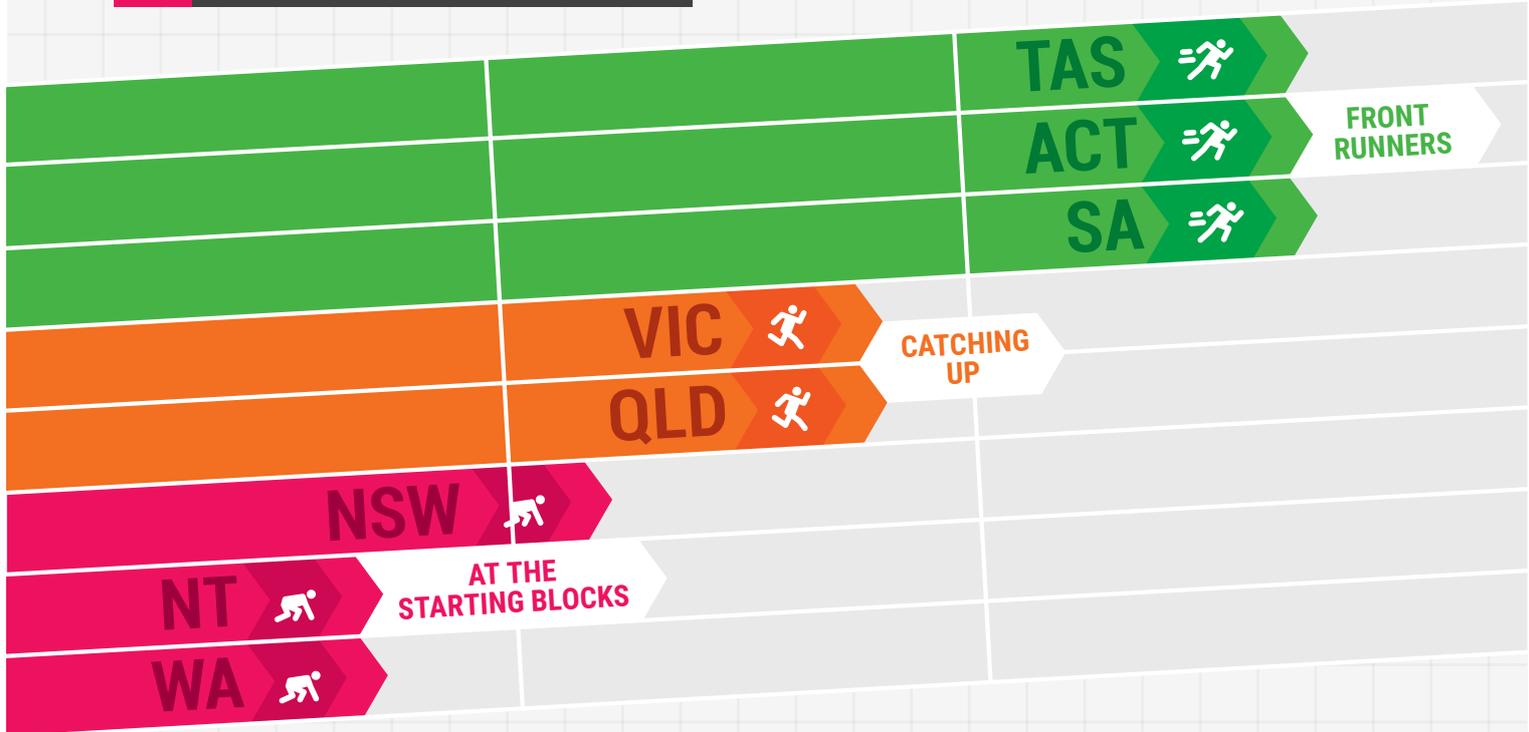
4

More solar PV capacity was added around the world than coal, natural gas and nuclear combined.

- › Almost three-quarters of new energy generation capacity added globally was renewable in 2017.
- › Electricity generation from coal and gas fell for the fifth consecutive year.
- › Approximately 17 countries generated more than 90% of their electricity with renewable energy in 2017. Australia was not one of them.

THE AUSTRALIAN RENEWABLE ENERGY RACE:

2018 SCORE CARD



	% Renewable energy (2017)	Capacity per cap (kw/cap)	% solar households	Renewable energy targets	Net zero emissions targets	Highlights
TAS (A)	87.4	0.7	14	100% by 2022	Net zero by 2050	Highest proportion of renewable electricity. Achieved net zero emissions.
ACT (A)	46.2	1.1	14	100% by 2020	Net zero by 2050	On track to meet renewable energy target.
SA (A)	43.4	1.1	32	-	Net zero by 2050	On track for 73% renewables by 2020.
VIC (B)	13.6	0.3	16	25% by 2020 40% by 2025	Net zero by 2050	Completed Australia's largest renewable energy reverse auction.
QLD (B)	7.1	0.1	33	50% by 2030	Net zero by 2050	Highest proportion of solar households. Largest number of projects under construction.
NSW (C)	12.6	0.2	18	-	Net zero by 2050	Strong pipeline of renewable energy projects with planning approval.
NT (C)	3.0	0.1	14	50% by 2030	-	50% renewable energy target by 2030.
WA (C)	7.5	0.2	27	-	-	Only state with no renewable energy target or net zero emissions target.

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1. Introduction

Every year the Climate Council tracks the relative progress of Australian states and territories based on their performance across a range of renewable energy metrics: percentage of renewable electricity; proportion of households with solar; large-scale wind and solar capacity per capita; and targets or policies in place for renewable energy. This report is the Climate Council's fourth scorecard evaluating state and territory progress on renewable energy.

Over the past year, with the ongoing absence of credible climate and energy policy at the federal level, states and territories have continued leading the charge on renewable energy. Along with the national Renewable Energy Target, state and territory policy support is driving the continued uptake of renewable energy across the country.

Discussion surrounding the Federal Government's now abandoned National Energy Guarantee (NEG) appeared to slow the pace of proactive state and territory policy announcements and implementation throughout 2018. Shortly after the Federal Government abandoned its proposed NEG (The Guardian 2018), states and territories again stepped in to partly fill the policy vacuum with the Victorian Government announcing the outcome of its renewable energy auction and new support for household solar and storage (Victorian Government 2018b) and the South Australian Government outlining the details of its home battery scheme (Government of South Australia 2018a).

Looking ahead, state and territory leadership will continue to be critical for investment in new large-scale wind, solar and storage projects in Australia in the absence of any credible national climate and energy policy to succeed the Renewable Energy Target from 2020.

Strong state and territory government policies are vital if Australia is to increase the uptake of renewable energy and reduce greenhouse gas pollution.

If other countries adopted similar climate policies to Australia, then global average temperature rise could reach over 3°C.

Reflecting the ongoing absence of any credible national climate policy, Australia's greenhouse gas pollution increased for the third consecutive year in 2017, despite a fall in emissions in the electricity sector (Australian Government 2018). Greenhouse gas pollution from the electricity sector fell largely due to reduced electricity demand and reduced generation from brown coal following the closure of the polluting, end-of-life Hazelwood Power Station in March 2017. Nationally, the proportion of renewable electricity generation declined by a percentage point (from 16% in 2016 to 15% in 2017) (Department of the Environment and Energy 2018a). This was in large part due to a 23% drop in hydro generation due to reduced rainfall (Clean Energy Council 2018; Department of the Environment and Energy 2018a). In contrast, combined solar and wind generation increased by 5% (Department of the Environment and Energy 2018a).

Australia is not on track to achieve even its weak 2030 emissions reduction target of 26-28% by 2030 below 2005 levels, as greenhouse gas pollution is going up. Even this target falls significantly short of what is required for Australia to do its fair share to tackle climate change. The Climate Change Authority recommended a 45-65% emissions reduction target for 2030 below 2005 levels, based on scientific evidence, what comparable countries are doing and what is in the best interests of Australia (Climate Change Authority 2015). In order to achieve the Climate Change Authority's recommended economy-wide emissions reduction target of 45-65% below 2005 levels

by 2030, the electricity sector should reduce its greenhouse gas pollution levels by 60% by 2030 (ClimateWorks 2017).

If all other countries were to have similar climate policies to Australia, then global average temperature could reach over 3°C and up to 4°C above pre-industrial levels (Climate Action Tracker 2018). A four-degree world would make it very difficult for human civilisation to cope, putting billions of lives in danger (New et al. 2011).

Increasing global temperatures - driven primarily by higher carbon dioxide levels from the burning of fossil fuels like coal and gas - are exacerbating extreme weather events around the globe and in Australia. The world has just experienced the hottest five-year period (2013-2017) ever recorded. This record is part of a sharp, long-term upswing in global temperatures, with 17 of the 18 hottest years on record all occurring in this century (NOAA 2018).

In Australia, climate change is influencing many extreme weather events: hotter, longer and more frequent heat waves; more intense and damaging storms; increased bushfire risk; and rising ocean temperatures which are triggering coral bleaching events on the Great Barrier Reef (Climate Council 2017).

Australia's electricity sector is the nation's largest polluter accounting for a third of our emissions, but is also the sector with the lowest cost and technically feasible opportunities to reduce emissions while maintaining reliability.

More solar PV capacity was added globally in 2017 than coal, natural gas and nuclear combined.

Table 1: The top 10 countries with the most wind and solar electricity generation.

Country	% wind and solar electricity generation
Denmark	Over 50%
Uruguay	Over 30%
Germany	Over 20%
Ireland	Over 20%
Portugal	Over 20%
Spain	Over 20%
United Kingdom	Over 15%
Greece	Over 15%
Honduras	Over 15%
Nicaragua	Over 15%

Source: REN21 (2018).

Globally, 2017 was a record year for renewable energy, with more renewable energy capacity added than any other year, up 9% from 2016 (REN21 2018). Over half (55%) of this new renewable energy capacity was solar photovoltaic (PV) power, 29% was wind power and 11% was hydro (REN21 2018).

More solar PV capacity was added around the world than coal, natural gas and nuclear combined, with global solar capacity increasing by one third to 402GW (REN21 2018). Wind energy capacity increased by 52GW to 539GW – the third strongest year ever for wind energy. This was driven by record years for wind in Europe and India (REN21 2018).

Countries around the world are integrating an increasingly large amount of renewable energy into their electricity grids.

Approximately 17 countries generated more than 90% of their electricity with renewable energy in 2017 (REN21 2018). Meanwhile, thirteen countries generated 10% or more of their power from wind energy in 2017, while at least ten countries including the United Kingdom generated 15% or more of their electricity from solar PV and wind power in 2017. Ireland generated more than 20% of their electricity from solar and wind (Table 1; REN21 2018).

Following this introduction, section two of this report profiles renewable energy and storage progress, developments and policies across states and territories over the past twelve months. Section three tracks state and territory performance across a range of renewable energy metrics: percentage of renewable electricity; proportion of households with solar; large-scale wind and solar capacity per capita; and targets or policies in place for renewable energy. Section four then profiles each of the eight states and territories, from leaders like the ACT to those states still stuck at the starting blocks like New South Wales and Western Australia. The report concludes with Section five highlighting the ongoing importance of state and territory government policies, particularly in light of the continuing absence of a credible long-term policy to tackle climate change from the Federal Government.

More than ten countries
already generate 15% of
their electricity from
wind and solar.

2. States and Territories stepping in to tackle climate change

In the continuing absence of credible national climate and energy policy, state and territory government renewable energy targets and policies are crucial to reducing Australia's greenhouse gas pollution levels.

In the past year, states and territories have continued to push ahead with the transition from fossil fuels to a renewable powered future:

- › Having contracted enough wind and solar projects to reach its 100% renewable energy target by 2020, the Australian Capital Territory (ACT) has almost half of its electricity coming from renewable energy, a proportion that will continue to grow as more of the ACT's contracted projects come online. The ACT is supporting the rollout of 5,000 household batteries.
- › There was a change of government in South Australia following the state election in March 2018. While the incoming Liberal government pledged to drop the state's renewable energy target, the new government's first budget maintained support for pre-existing renewable energy and storage policies as well as announcing new funding for grid scale and household battery storage and demand response (Solar Quotes 2018a). The most powerful battery in the world (to-date) began operating in South Australia, saving consumers millions of dollars. Several more grid-scale batteries are now being installed in the state, and the state government is implementing policies to support thousands of households to install their own battery.

- › Victoria legislated its renewable energy target of 25% by 2020 and 40% by 2025. In September the state also announced the results of Australia's largest reverse auction (to date) for 650MW of renewable energy. A reverse auction is a process to contract power from the lowest priced renewable energy projects, locking in low prices for consumers and a fixed long-term price for new renewable energy projects. The Victorian Government's announcement ensures three new wind farms and three new solar farms, totalling 928MW, will proceed to construction (Victorian Government 2018b). Victoria supported the construction of three large-scale batteries and announced new programs to support household solar, battery storage and solar hot water.
- › The Northern Territory has given in-principle support to all recommendations made by an expert panel into how the territory can meet its commitment to source 50% of the territory's power from renewable energy by 2030. The Northern Territory has announced a tender for battery storage and is building a large-scale battery in Alice Springs.
- › Tasmania has become the first state to achieve net zero emissions in 2015-16 as a result of the protection of Tasmania's extensive native forests that act as a carbon sink – cancelling out the state's emissions from energy and transport. Originally, Tasmania had a policy to achieve net zero emissions by 2050. Tasmania has also commenced construction of two new wind farms to help the state reach its target of 100% renewable energy by 2022.
- › Queensland has created a state owned renewable energy company, CleanCo, which includes hydro and pumped hydro generators. It will eventually grow to include wind and solar projects.
- › Western Australia remains the only state without a renewable energy or net zero emissions target. The state closed its oldest coal power station (albeit after an expensive, failed retrofit) and has begun modest investments in renewable energy.
- › In New South Wales, AGL Energy has taken the lead in progressing a detailed multi-billion dollar lower emissions investment program to replace the end-of-life Liddell Power coal power plant in the Hunter Valley, despite Federal Government resistance to this transformative proposal.
- › Five states and territories have strong renewable energy targets in place. Apart from Western Australia and the Northern Territory, all states and territories in Australia now have economy wide net zero emissions targets in place.

3. State and Territory Renewable Energy Scorecard 2018

The Climate Council tracks the relative progress of Australian states and territories based on their performance across a range of renewable energy metrics: percentage of renewable electricity, proportion of households with solar, large-scale wind and solar capacity per capita and targets or policies in place for renewable energy.

ACT, Tasmania and South Australia continue to lead the charge on renewable energy, with Victoria and Queensland catching up. Despite some positive steps, Western Australia, New South Wales and the Northern Territory lag behind the other states and territories when measured against the renewable energy scorecard criteria.

3.1 Percentage renewable electricity

Tasmania, the ACT and South Australia continued to lead with the largest shares of renewable energy out of all the states and territories (Table 2).

In 2017, the proportion of renewable energy increased in five states and territories - the ACT, Victoria, Queensland, the Northern Territory and Western Australia. Meanwhile the share of renewable energy decreased in

Tasmania, South Australia and New South Wales. In Tasmania and New South Wales this was due to a substantial drop in hydro generation, while in South Australia this was due to substantially higher gas generation as a result of the closure of the Northern coal power station in May 2016 and higher electricity demand (Department of the Environment and Energy 2018a).

Table 2: State and territory percentage of renewable energy. Tasmania is leading with 87.4%, while the Northern Territory is in last place with just 3%.

State/Territory	% of renewable energy in 2017 (including hydro)	% wind and solar electricity generation in 2017
TAS	87.4	11.2
ACT	46.2 ¹	43.1
SA	43.4	42.7
VIC	13.6	10.4
NSW	12.6	6
WA	7.5	6.5
QLD	7.1	3.7
NT	3	3

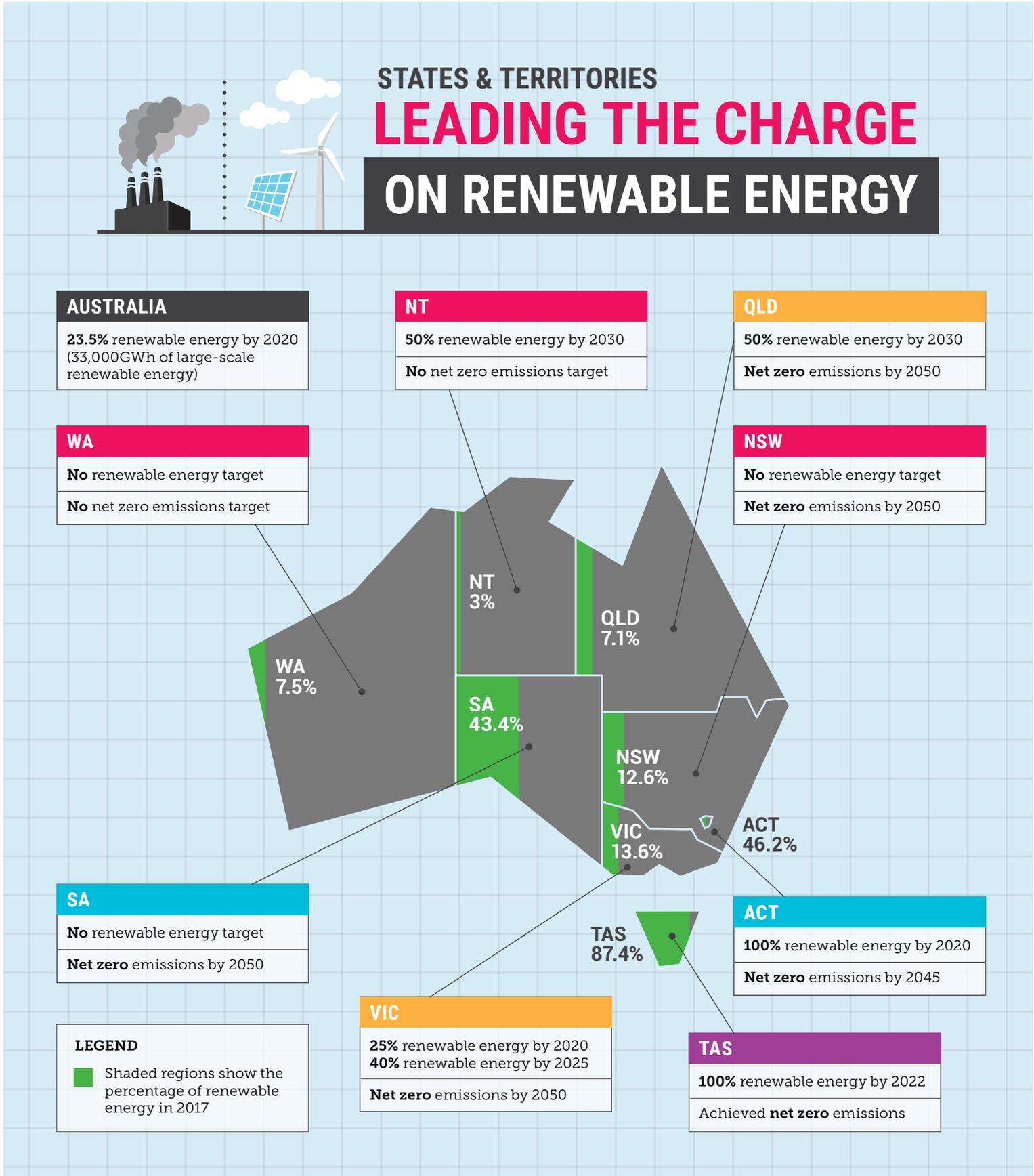
Source: Department of the Environment and Energy (2018a).

¹ % of renewable energy consumed over 2017 (ACT Government 2018)

Note: Federal Government energy statistics are used here to provide a consistent means of comparing the states and territories. Individual states and territories may publish different renewable percentage figures based on different assumptions and data sources. The ACT is an exception, as the Federal Government does not report separately on the ACT and it sources renewable energy from outside the ACT to meet its target.

South Australia (48.9%), NSW (14.6%), Queensland (8.4%) and Victoria (18.8%) all report higher percentage figures for their individual state than Federal Government figures. For example, Victorian Government figures for the proportion of renewable energy are significantly higher as these include the Murray hydroelectric station (located in NSW, but in Victoria's National Electricity Market region) in Victoria's total.

Figure 1: Some states and territories, like Tasmania and the ACT, are continuing to lead the charge by investing in wind and solar. Other states, like Western Australia and the Northern Territory, are at the back of the pack.



3.2 Wind and solar capacity per person

South Australia, the ACT (see Figure 2) and Tasmania have more wind and solar capacity per person than the other states and territories (Table 3).

In terms of total large-scale wind and solar, South Australia continues to have the largest amount of installed wind and solar capacity (1,831MW), closely followed by New South Wales (1,759MW) and Victoria (1,634MW) (AEMO 2018c; Table 3).

While Queensland has just 377MW of wind and solar capacity (and lags behind the other states in terms of capacity per capita), this number is expected to increase significantly over the next few years as the state has over 3,000MW of wind and solar projects under construction (Clean Energy Council 2018a).

Figure 2: The Mount Majura solar farm, which opened in 2016, was supported by the ACT Government with a power purchase agreement.



South Australia and the ACT have the highest amount of wind and solar capacity per person.

Table 3: State and territory large scale solar and wind capacity per person in 2018 (small scale solar excluded).

State/Territory	Population (in millions) ¹	Wind and solar installed capacity (MW) ²	Wind and solar capacity per capita (kW/pop)
SA	1.728	1,831	1.1
ACT	0.416	449 ³	1.1
TAS	0.525	373	0.7
VIC	6.386	1,634	0.3
NSW	7.915	1,759	0.2
WA	2.585	488 ⁴	0.2
QLD	4.965	377	0.1
NT	0.247	13 ⁵	0.1

Sources: ¹ ABS (2018). ² AEMO (2018c). ³ ACT Government (2018). ⁴ AEMO (2018b). ⁵ APVI (2018).

3.3 Proportion of households with solar

Australian households and businesses have continued to install rooftop solar in record numbers. In 2017, Australians installed 1.25GW of solar PV and 2018 is on track to be a new record year, with over 1GW of rooftop solar already installed by the end of September (SunWiz 2018a; 2018b). This rapid increase has been partly driven by a large increase in commercial and industrial businesses installing large rooftop solar systems to reduce their energy bills (Climate Council 2018; SunWiz 2018b).

Queensland (32.9%), South Australia (32.3%) and Western Australia (26.7%) continued to have the highest proportion of households with rooftop solar (APVI 2018; Figure 3).

There are now 26 Australian suburbs where over 50% of dwellings have installed rooftop solar, up from 22 in last year's report (APVI 2018). 19 of these suburbs are in Queensland (Table 4) with four in South Australia. The best performing postcodes in each state are listed in Table 5.

There are now 26 Australian suburbs and towns where over half of all households have rooftop solar.

Figure 3: Queensland leads the nation in the proportion of households with rooftop solar.



There is a range of programs being pursued by state and territory governments to encourage the uptake of rooftop solar and battery storage to reduce energy bills:

- › Northern Territory is providing grants of up to \$1,000 for households to install rooftop solar on their homes.
- › South Australia has two programs to roll out battery storage. The first includes grants of up to \$6,000 for 40,000 households to install batteries. The second program involves the construction of a virtual power plant, with 100 batteries already rolled out to low income households with the potential to upscale this program to 50,000 households. The virtual power plant’s solar and battery storage systems will be owned by an electricity retailer and controlled by the same software. This enables the generation, charge and discharge of energy to be coordinated, so that all the systems

effectively operate as one power station – hence the name, virtual power plant.

- › Victoria have announced a new program to reduce the upfront cost of rooftop solar for households by paying for half the cost of the solar panels and providing an interest-free loan to cover the other half of the cost to be paid back over four years.
- › The ACT is rolling out 5,000 batteries to households and businesses with rooftop solar.

All homes that are part of the residential development of Alkimos Beach in Western Australia (Figure 4) have solar panels on their rooftops. The development is also the first to trial community-scale battery storage (1.1MWh) to store solar power from the residents at Alkimos Beach, reducing the community’s dependence on electricity from the grid (Lend Lease 2018).

Table 4: Percentage of rooftop solar penetration by state and territory. Queensland and South Australia continue to lead the nation.

State/Territory	% of rooftop solar penetration by state and territory	Number of postcodes where over 50% of dwellings have rooftop solar (excluding postcodes with under 1,000 dwellings)
QLD	32.9	19
SA	32.3	4
WA	26.7	1
NSW	17.6	2
VIC	15.9	-
ACT	14.2	-
TAS	14.2	-
NT	13.8	-

Source: APVI (2018).



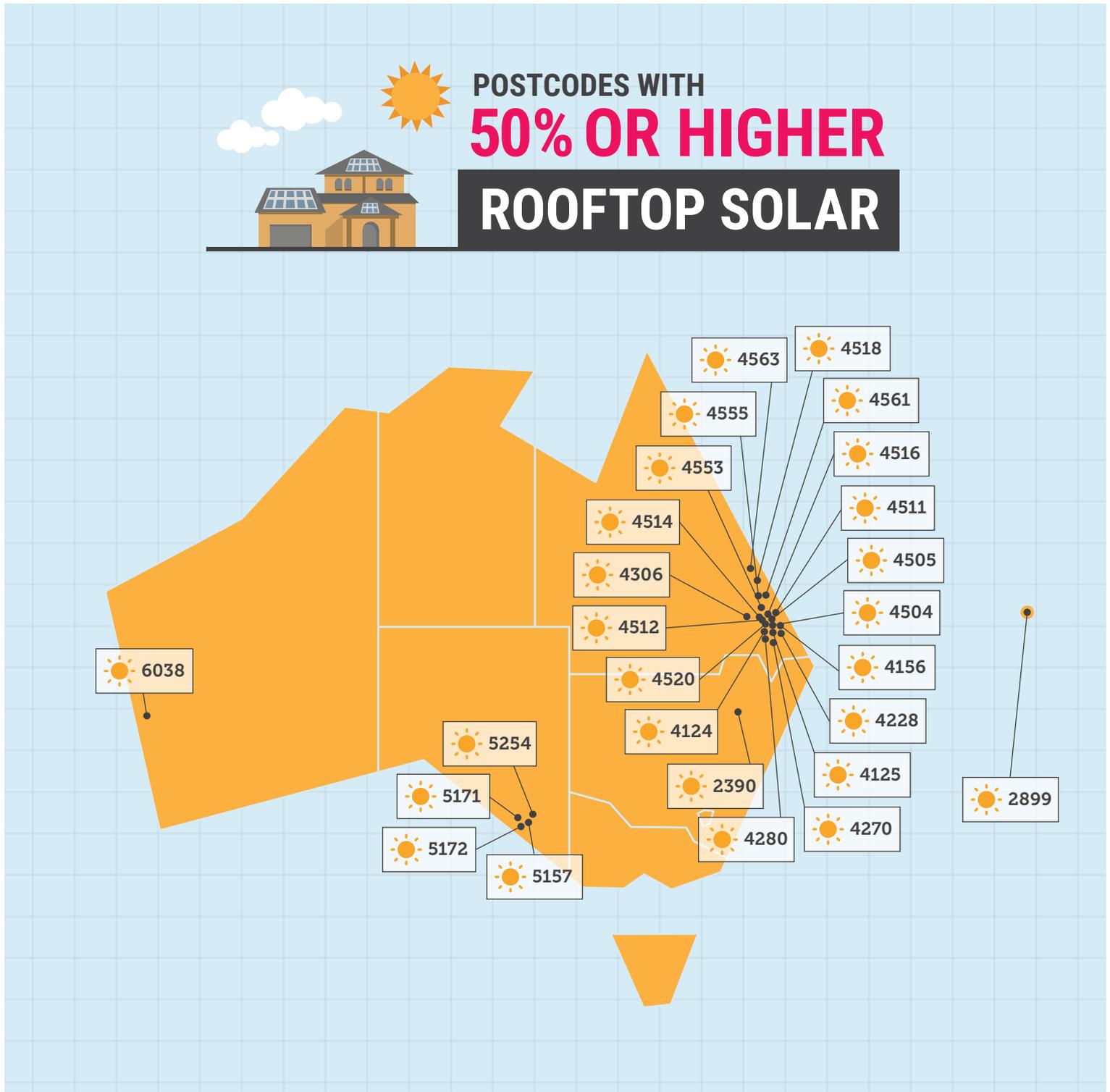
Figure 4: Homes in the Alkimos Beach residential development in Western Australia have rooftop solar.

Table 5: The top postcode in each state or territory for residential uptake of rooftop solar. Only suburbs with more than 1,000 dwellings are included.

State	Postcode	Suburbs	Rooftop solar installations	% of households with rooftop solar
QLD	4516	Elimbah	868	68.5
SA	5172	Wilunga, Hope Forest, Dingabledinga, Pages Flat, Yundi	872	54.1
NSW	2390	Baan Baa, Bohena Creek, Bullawa Creek, Couradda, Edgeroi, Eulah Creek, Harparary, Jacks Creek, Kaputar, Narrabi, Narrabi West, Tarriaro, Turrawan	1865	52.4
WA	6038	Alkimos	1298	50.2
VIC	3678	Towns around Wangaratta, including Peechelba, Milawa and Everton	981	36.3
TAS	7017	Grasstree Hill, Honeywood, Old Beach, Otago, Risdon, Tea Tree	519	24.8
NT	870	Alice Springs	1882	23.4
ACT	2611	Brindabella, Bimberi, Coombs	1912	20.7

Source: APVI (2018).

Figure 5: Queensland is leading Australia with over 50% of households in 19 postcodes having installed rooftop solar. South Australia has the second most with four.



3.4 Renewable energy targets and policies

With the exception of Western Australia, all states and territories have committed to renewable energy targets and/or net zero emissions targets (Table 6).

In the past year, the ACT brought forward its net zero emissions target from 2050 to 2045 (ACT Government 2018). The incoming South Australian government have dropped the state's renewable energy target (which was not legislated).

Table 6: State and territory renewable energy targets and net zero emissions targets.

	ACT	VIC	QLD	TAS	NT	SA	NSW	WA
Renewable electricity targets	100% by 2020	25% by 2020 40% by 2025	50% by 2030	100% by 2022	50% by 2030	-	-	-
Net zero emissions target	By 2045	By 2050	By 2050	By 2050	-	By 2050	By 2050	-

Source: ACT Government 2018; New South Wales Government 2016; Northern Territory Government 2018; Queensland Government 2017; Tasmanian Government 2017a; Tasmanian Government 2017b; Victoria State Government 2017.

All states and territories have renewable energy targets or net zero emissions targets, except Western Australia.

3.5 Powering forward: the renewable energy construction boom

Australia's renewable energy boom that re-started in 2017 has continued, with 30 projects finished in 2018 so far and another 69 projects under construction or about to start construction (as of 21 September) (Clean Energy Council 2018a). Investment in large-scale renewable energy in Australia fell to the lowest levels in ten years in 2014 and 2015. This was due to uncertainty caused by the abolition of the Carbon Pricing Mechanism, multiple Federal Government reviews of, and the eventual cut to the Renewable Energy Target (SMH 2016).

The renewables construction boom is creating 9,269 jobs and adding 10,979MW of renewable energy capacity to Australia's

electricity grid (Clean Energy Council 2018a). This is similar to the capacity of New South Wales' entire coal power station fleet. These projects are also creating over \$15.6 billion of investment throughout the country (Clean Energy Council 2018a).

These projects are not spread evenly across all states and territories. Queensland is attracting the largest amount of new capacity and investment, while Victoria and New South Wales are also attracting large amounts of new capacity and investment (Clean Energy Council 2018a). In the case of Western Australia, just 70MW of new capacity is under construction, the lowest of any state (Clean Energy Council 2018a) (Table 7).

Australia's current renewable energy construction boom is creating almost 10,000 jobs and adding over 10,000MW in new wind and solar capacity.

Table 7: The number of wind and solar projects under construction or about to start construction by state or territory, along with the investment and jobs numbers that these projects are driving. Queensland is attracting the bulk of these projects.

State	Number of renewable energy projects under construction or about to start	Capacity of these projects (MW)	% of new national renewable energy capacity by state	Investment (AU\$M)	Jobs	% of national renewable energy jobs by state
Total	69	10,979	100%	15,600	9,269	100%
QLD	20	3,287	30	4,344	3,006	32
VIC	19	3,181	29	4,479	3,040	33
NSW	18	2,648	24	3,709	1,505	16
SA	8	1,681	15	2,638	1,280	14
TAS	1	112	1	280	208	2
WA	3	70	1	150	230	3

Source: Clean Energy Council (2018a).

Almost three times as many renewable energy projects have been completed so far in 2018 compared to the entire total for 2017, when just twelve projects reached completion (Clean Energy Council 2018a).

There are still 69 renewable energy projects under construction or about to start in Australia, even though there is an absence of Federal Government climate and energy policy to drive investment in new energy generation after 2020 when the Federal Renewable Energy target ends. So far in 2018, a further 29 renewable energy projects have reached financial close, compared to 42 in 2017 (Clean Energy Council 2018a). State and territory policies will continue to be critical to supporting new investment in renewable energy after 2020.

Queensland and Victoria are home to 65% of all renewable energy jobs being created in Australia.

4. State and Territory by Renewable Energy Progress

4.1 Front Runners

AUSTRALIAN CAPITAL TERRITORY

The ACT has a renewable electricity target for 100% renewable energy by 2020 (to meet the ACT's electricity needs). The territory will reach this goal as it has contracted wind and solar farms under its nation-leading reverse auction process driving investment in 600MW of wind power and 40MW of large-scale solar (ACT Government 2018). These projects are all expected to be operational by 2020.

The ACT's 100% renewable energy target and reverse auction process has contributed a significant proportion of new renewable electricity capacity added across Australia over the past two years (Clean Energy Council 2018a). Nationally, the ACT's reverse auction program made up: 54% of all new renewable energy capacity added across Australia in 2016 and 40% in 2017. A further 14% of projects under construction in December 2017 were supported under the ACT reverse auction scheme - the 270MW Sapphire Wind Farm and 91MW Crookwell 2 Wind Farm. Projects completed in 2017 under the ACT target included the Ararat Wind Farm (80.5MW) and stages 2 and 3 of the Hornsdale wind farm (209MW) (Clean Energy Council 2018a).

BOX 1: FAST FACTS

Percentage renewable power:

The ACT consumed 46.2% renewable electricity in 2017, the second highest amount of any state or territory. The territory is on track to achieve 100% renewable electricity by 2020.

Households:

14.2% of ACT households have rooftop solar.

Policy

- › On track to hit 100% renewable energy in 2020, after completion of the ACT's reverse auction program, supporting over 600MW of wind and solar projects.
- › Household battery grants, aiming to support the rollout of 5,000 batteries by 2020.
- › Brought forward net zero emissions target for 2045.

Source: ACT Government 2018; ActSmart 2018; APVI 2018; Department of the Environment and Energy 2018a.

The ACT is on track for 100% renewable electricity by 2020.

The ACT now gets 46.2% of its electricity from renewable energy, the second highest amount of any state or territory in Australia after Tasmania (Department of the Environment and Energy 2018a). 14.2% of ACT households now have rooftop solar (APVI 2018).

The ACT is embracing energy storage with an ambitious plan to roll out 5,000 battery storage systems across ACT households and businesses by 2020 (ActSmart 2018). Under the Next Generation Energy Storage

grants program, a typical household with 5kW of rooftop solar is eligible for around \$4,000 to help install a battery (ActSmart 2018). The combined capacity of the batteries is expected to be around 36MW (ActSmart 2018).

The ACT has brought forward its net zero emissions target from 2050 to 2045 (ACT Government 2018). The ACT government are currently developing a new strategy to achieve this goal.

The ACT now generates almost half of its electricity from renewable energy.

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For more information on the ACT's renewable energy leadership, read the Climate Council's report:



'Territory Trailblazer: How the ACT became the renewable capital of Australia'

Figure 6: The three stages of the Hornsdale Wind Farm in South Australia (below) put forward winning bids under the ACT's reverse auction process. Stages 2 and 3 of the project set record low prices for wind energy in Australia at the time.



TASMANIA

Tasmania's renewable energy generation fell in 2017 to 87.4% due to lower hydro generation and higher gas generation (Department of the Environment and Energy 2018a). In 2017, the state set a 100% renewable energy target for 2022 and to achieve this goal, the state government are supporting the construction of two new wind farms (ABC News 2017b). The 144MW Cattle Hill wind farm and the 112MW Granville Harbour wind farm are both under construction or about to begin construction (RenewEconomy 2018c; 2018d).

The Tasmanian Government is funding a feasibility study into the expansion of Tasmania's hydro scheme to provide the National Electricity Market with pumped hydro energy storage. Pumped hydro is not renewable energy but it can help store renewable energy which can then be used when needed. There are 14 sites in Tasmania with high pumped hydro potential, which have a combined capacity of 4,800MW (RenewEconomy 2018e). For the project to come to fruition, a new interconnector between Tasmania and Victoria will be required (RenewEconomy 2018e). The feasibility study is being funded by the Tasmanian Government and the Australian Renewable Energy Agency.

BOX 2: FAST FACTS

Percentage renewable power:

Tasmania had 87.4% renewable energy in 2017 (down from 92% in 2016).

Households:

14.2% of households have rooftop solar

Policy

- › 100% renewable energy by 2022.
- › Net zero emissions target by 2050 (already achieved).
- › Funding for feasibility study of 'Battery of the Nation' pumped hydro project.

Source: APVI 2018; Clean Energy Council 2018a; Department of the Environment and Energy 2018a; Premier of Tasmania 2018; RenewEconomy 2018e.

Tasmania has a 100% renewable energy target by 2022.

Tasmania became the first state to achieve net zero emissions in 2015-16. The state's emissions in 2015-16 had declined 100% from 1989-90, largely due to the state's extensive forests that act as a carbon sink for emissions in other sectors (Premier of Tasmania 2018). However, achieving net zero emissions through land-based measures can be risky and potentially short-lived, because carbon stored on land is vulnerable to being returned to the atmosphere, for example, through bushfires, insect plagues and changes in land clearing policies. Tasmania has a net zero emissions target for 2050.

Figure 7: Tasmania's Woolnorth Wind Farm.



SOUTH AUSTRALIA

South Australia has been leading Australia in the uptake of renewable energy and storage over the past decade. The Climate Council's renewable energy scorecards have consistently placed South Australia as a front-runner in renewable energy, with supportive policies and targets, high household uptake of solar and high quality wind and solar resources. The incoming state government, elected in March 2018, has since dropped South Australia's renewable energy target. This has led to a fall in South Australia's ranking.

South Australia is aiming towards net zero emissions by 2050. The state has an emissions reduction target set in legislation to reduce greenhouse gas emissions by at least 60% below 1990 levels. A Climate Change Strategy is also being developed by the Premier's Climate Change Council at the request of the state government (Government of South Australia 2018c).

BOX 3: FAST FACTS

Percentage renewable power:

Renewable energy generation fell slightly in South Australia in 2017 to 43.4% (from 46.6% in 2016). The state is on track for 73% renewable energy generation by 2020-21.

Households:

South Australia has the second highest proportion of solar PV households (32.3%).

Policy

- › South Australia now has no target to increase renewable energy.
- › South Australia is aiming towards net zero emissions by 2050. The state is also developing a Climate Change Strategy.
- › The world's most powerful battery began operating at the Hornsdale Wind Farm in December, with more grid-scale batteries to open soon.
- › Two programs to roll out battery storage: grants of up to \$6,000 for 40,000 households to install batteries; and 100 household batteries already rolled out to low income households as part of a virtual power plant, with potential to upscale this program to 50,000 households.

Source: AEMO 2017; 2018a; APVI 2018; Clean Energy Council 2018a; Department of the Environment and Energy 2018a; Government of South Australia 2018a; 2018b; 2018c.

South Australia has abolished its renewable energy target.

South Australia's proportion of renewable electricity generation fell in 2017 from 47% to 43.4%. This was mainly due to substantially higher gas generation in the aftermath of the closure of the Northern coal power station in May 2016, as well as higher electricity demand (Department of the Environment and Energy 2018a). This occurred despite absolute wind and solar generation increasing by 7% in 2017. In fact, South Australia experienced the second highest percentage increase in renewable energy generation of any state in the National Electricity Market (behind Queensland) (Department of the Environment and Energy 2018a).

The increase in wind generation could have been higher but the region experienced unusually low levels of wind in 2017, resulting in lower capacity factors at many wind farms (Department of the Environment and Energy 2018a; ABC News 2017a). This was particularly an issue in winter 2017, with some wind farms reporting wind generation at 30% below the historical average during that time (ABC News 2017a).

South Australia has a number of wind and solar projects under construction which are expected to increase renewable energy generation further in coming years, projected to reach 73% renewable electricity as soon as 2020-21 (AEMO 2017). These include the Lincoln Gap wind farm and battery, the Willogoleche wind farm, and the Bungala and Tailern Bend solar farms (Engie 2017; Lincoln Gap Wind Farm 2018; RenewEconomy 2018a; Power Technology 2018).

A solar thermal plant is also planned in Port Augusta. If it is built it will be Australia's largest solar thermal plant and will provide 100% of the South Australian government's electricity needs (Government of South Australia 2017). The 150MW plant will be able to generate a clean and reliable supply of electricity 24/7 (Government of South Australia 2017).

In December 2017, the world's most powerful lithium ion battery began discharging into the grid, improving the security of the electricity grid and significantly reducing costs for consumers. It is estimated that during one instance on the 14th of January, the battery reduced costs to consumers by \$3.5 million over a five-hour period (AEMO 2018a).

South Australia is expected to have 73% renewable electricity in just two years.

Other grid-scale batteries are also being built in South Australia. South Australia's second 'big battery', the Dalrymple North battery on the Yorke Peninsula is currently undergoing commissioning. The 30MW/8MWh battery has already demonstrated that it can support the local grid when it is disconnected from the rest of the distribution and transmission network (RenewEconomy 2018l). The state will soon be home to two more batteries, with a 10MW/10MWh battery at the Lincoln Gap wind farm about to begin construction and a 21MW/26MWh battery planned near the Snowtown wind farm (RenewEconomy 2017m).

South Australia is investing heavily in household batteries. The newly elected South Australian government announced in September that they would provide \$100 million in grants and \$100 million in loans to enable 40,000 households to install their own batteries. These batteries can store solar energy and will help to reduce consumers power bills. The grants are available to all households at \$500 per kWh with lower income households who are Energy Concession Holders able to access a higher subsidy of \$600 per kWh (Government of South Australia 2018a). Grants are capped at \$6,000 per battery. All batteries under this program will be capable of being part of a virtual power plant, although individual households will be able to decide whether they join one. As part of this program, households will also be able to apply for finance from the Clean Energy Finance Corporation to install rooftop solar (Government of South Australia 2018a).

The state government is continuing with the previous government's program to create a virtual power plant, with one hundred 13.5kWh batteries rolled out at low income Housing SA homes (Government of South Australia 2018b). Another 1,000 homes will soon follow, with the potential to scale up the program to 50,000 Housing SA and low income homes (Government of South Australia 2018b). The virtual power plant's solar and battery storage systems will be owned by an electricity retailer and controlled by the same software. This enables the generation, charge and discharge of energy to be coordinated, so that all the systems effectively operate as one power station – hence the name, "virtual power plant".

Figure 8: This solar thermal plant provides around 90% of the electricity needs of tomato growers Sundrop Farms in Port Augusta, South Australia.



4.2 Catching up

VICTORIA

Victoria is rapidly transforming its electricity grid with the state home to ambitious renewable energy policies and a large number of renewable energy projects.

Victoria currently generates 13.6% of its electricity from renewable energy but this is likely to rise rapidly in the next few years. Renewable energy generation may provide as much as 39.4% of the state's consumption by 2020 (Green Energy Markets 2018).

Victoria succeeded in legislating its two-stage renewable energy target in 2017 and shortly thereafter launched its first reverse auction for 650MW of wind and solar capacity (Victorian Government 2018b). In September 2018, the Victorian Government announced that six renewable energy projects with a combined capacity of 928 MW had been successful in the auction. This has been the largest reverse auction for renewable energy in Australia and will help the state meet targets of 25% renewable energy by 2020 and 40% renewable energy by 2025 (Victorian Government 2018a).

Victoria has held Australia's largest ever auction for renewable energy.

BOX 4: FAST FACTS

Percentage renewable power:

Victoria had 13.6% renewable electricity in 2017, up from 12.1% in 2016.

Households:

15.9% of households have solar PV.

Policy

- › Renewable energy target of 25% by 2020 and 40% by 2025.
- › Australia's single largest reverse auction for 928MW of wind and solar capacity.
- › Support for the construction of three large-scale batteries in Ballarat, at the Gannawarra solar farm and at the Bulgana wind farm.
- › New policies to encourage the uptake of rooftop solar and battery storage.
- › A commitment to reduce Victoria's greenhouse gas emissions by 15-20 per cent below 2005 levels by 2020.
- › A net zero emissions target by 2050.

Source: ACT Government 2018; ActSmart 2018; APVI 2018; Department of the Environment and Energy 2018a.

Victoria's tram network will soon be powered by 100% renewable energy.

Victoria has been very supportive of energy storage. In early 2018, the Victorian Government announced two winners of a tender for 55MW/80MWh of battery storage. A 30MW/30MWh battery will be built at a terminal station in Ballarat and a 25MW/50MWh battery will be co-located with the 60MW Gannawarra solar farm, which is also under construction (ARENA 2018a). These large-scale batteries are expected to be operational by summer 2018-19.

The Victorian Government has also supported an integrated wind farm and battery storage project. The 194MW Bulgana wind farm will be backed up by a 20MW/34MWh battery to power Nectar Farms' greenhouses in Stawell (Premier of

Victoria 2018a). The project will be complete in 2019 and provide clean, affordable and reliable power 24/7.

The Victorian Government is also building wind and solar plants to power the state's iconic tram network with 100% renewable energy. This includes 34MW of the Numurkah solar farm (the solar farm will be 100MW in total) and the 88MW Bannerton solar park (Victorian Government 2018c).

The state government has announced a new program to reduce the upfront cost of rooftop solar for households by paying up to half the cost of the solar panels. This \$1.24 billion program will see solar panels installed on 650,000 more homes over ten years (Premier of Victoria 2018b). Currently, 15.9% of Victorian households have rooftop solar (APVI 2018). As part of this program, the government will also provide half price solar batteries for 10,000 Victorian households that already have solar panels. The government will also provide \$40 million to households to install batteries in their homes. 10,000 households will be provided with up to \$4,838 depending on battery size, to cover part of the cost of the battery (RenewEconomy 2018k).

There is a proposal to build Australia's first offshore wind farm off the coast of South Gippsland in Victoria (a 2,000MW project) (RenewEconomy 2017a). The eight billion dollar 'Star of the South' proposal would include 250 turbines and be located 10-25km off the Gippsland coast in the Bass Strait (RenewEconomy 2017a). The project could produce enough electricity to power 1.2 million homes (RenewEconomy 2017a).

Figure 9: The Mount Gellibrand wind farm in Victoria, completed in 2018. The wind farm was supported by a 2015 Victorian Government tender for 100MW of renewable energy.



 BOX 5: COAL CLOSURES IN 2017

In March 2017, Victoria’s Hazelwood coal power station was officially retired. The 1,600MW power station was 53 years old and becoming an increasingly unsafe workplace. Since the closure of the power station, much of its capacity has been replaced by wind and solar (ABC News 2016).

In September 2017, Western Australia’s Muja AB coal power station located in Collie south of Perth also closed (The West Australian 2017). The 220MW power station was 53 years old and had been initially closed in 2007, but the state government undertook an expensive and controversial \$300 million dollar refurbishment in 2008. After returning to service, the power station struggled to generate electricity and became increasingly unreliable. In 2016, the Western Australian Government announced they would be shutting it down, just eight years after the redevelopment began (The West Australian 2017).

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For more information on coal-fired power stations in Australia, read the Climate Council’s report:



[‘End of the Line: Coal in Australia’](#)

QUEENSLAND

In 2017 and 2018, Queensland has continued to lead Australia in the construction of new renewable energy projects, with 20 renewable energy projects totaling 3,287MW under construction. While the national Renewable Energy Target is a key driver of many of these projects, Queensland's excellent renewable energy resources and strong state government support have also been important in making Queensland home to the largest amount of renewable energy construction of any state or territory in Australia (Clean Energy Council 2018a).

Although Queensland only generated 7.1% of its electricity from renewable energy in 2017, twelve wind and solar farms have already opened in 2018 with another 20 under construction or about to start (Department of the Environment and Energy 2018a; Clean Energy Council 2018a). These projects should propel Queensland forward to a much higher level of renewable energy generation in the next few years.

Along with their net zero emissions target, Queensland has committed to a 50% renewable energy target by 2030, and to help achieve this the state government has announced a tender for 400MW of renewable energy capacity, including 100MW of energy storage. Although the tender closed in September 2017, the winners are yet to be announced (Queensland Government 2018a). The 100MW energy storage reverse auction is one of the largest auctions for energy storage in Australia.

BOX 6: FAST FACTS

Percentage renewable power:
Queensland had a 7.1% share of renewable energy in 2017 up from 6.5% in 2016.

Households:
Queensland has the highest proportion of households with solar PV (32.9%).

Policy

- › 50% renewable energy target by 2030.
- › Reverse auction announced for 400MW of renewable energy and storage.
- › A net zero emissions target by 2050.

Source: APVI 2018; Clean Energy Council 2018a; Department of the Environment and Energy 2018a; Premier of Tasmania 2018; RenewEconomy 2018e.

Queensland has more renewable energy projects under construction than any other state or territory.

The state government is also setting up a new state owned renewable energy generator called CleanCo. It will initially include the existing Barron Gorge, Kareeya and Koombooloomba hydro power stations and the Wivenhoe pumped hydro energy storage facility (RenewEconomy 2018j). However it will also include the polluting Swanbank E gas power station. The organisation will have \$250 million to invest in new generation, like wind and solar. CleanCo is expected to begin trading in mid-2019 (RenewEconomy 2018j).

Queensland continues to lead Australia in rooftop solar. Almost one third of households (32.9%) have now installed solar PV, more than any other state or territory (APVI 2018). The Queensland Government has also installed solar in the remote community of Lockhart River in far north Queensland. 750 solar panels have been installed on the roofs of government buildings, such as schools, and the electricity produced by these panels can be used by the whole community. Solar can provide about 10% of the community's energy needs, helping to reduce Lockhart River's reliance on expensive and polluting diesel (Queensland Government 2018b).

Figure 10: 750 solar panels have been installed in Lockhart River (below) to help reduce the community's energy bills.



4.3 At the starting blocks

NEW SOUTH WALES

New South Wales generated 12.6% of its electricity from renewable energy in 2017 and this is predominantly made up of large hydro generators and both large and small scale solar PV (Department of the Environment and Energy 2018a).

There is over 1,000MW of wind and solar projects under construction in New South Wales, largely due to the Federal Government's Renewable Energy Target and changes to planning regulations for wind and solar farms in the state (Clean Energy Council 2018a). NSW has a strong pipeline of over 40 renewable energy projects with planning approval, totaling 5,700MW.

BOX 7: FAST FACTS

Percentage renewable power:
NSW had 12.6% renewable electricity in 2017 consisting mainly of large hydro, decreasing from 17.5% in 2016.

Households:
17.6% of households in NSW have rooftop solar.

Policy

- › Net zero emissions target by 2050.
- › Renewable Energy Action Plan in place since 2013.
- › No renewable energy target.

Source: APVI 2018; Clean Energy Council 2018a; Department of the Environment and Energy 2018a; New South Wales Government 2016.

New South Wales has limited policies to encourage renewable energy, despite having Australia's oldest fleet of coal power stations.

The NSW Government's main renewable energy policy is its Renewable Energy Action Plan, which was first released in 2013. The Renewable Energy Action Plan has three goals to support the sector by attracting investment, building community support and growing expertise. Through the Plan, the NSW Government has supported the growth of renewable energy with initiatives such as signing a deal to buy power from the 24MW Dubbo Solar Hub, which underpinned the project reaching financial close and beginning construction.

The state government recently announced it has signed a power purchase agreement with the 87MW Beryl solar farm to power a new train line (RenewEconomy 2018h). The 15-year agreement involves the purchase of 69% of the project's output to power the north-west line. It is expected to be operational by mid-2019 (RenewEconomy 2018h).

New South Wales has set a net zero emissions target by 2050 in its Climate Change Policy Framework (New South Wales Government 2016). The NSW Government has also announced it is preparing a Transmission Infrastructure Strategy, to access low cost electricity generation from three potential priority energy zones in the New England, Central-West and South-West regions.

In August 2018, the NSW Government announced a \$30 million Regional Community Energy Program, which will support community energy projects, community energy hubs (for advice and bulk buys) and provide support for regional and remote communities.

Figure 11: The Griffith Solar Farm is one of a number of large-scale solar farms commissioned in NSW in 2018.



NORTHERN TERRITORY

The Northern Territory has a very low proportion of renewable electricity at just 3% but it has adopted an ambitious target of 50% renewable energy by 2030 (Department of the Environment and Energy 2018a; Northern Territory Government 2018).

The Northern Territory Government commissioned a Roadmap to Renewables report that outlined how the territory can achieve their 50% renewable energy target. The report's 11 recommendations, have all been given in-principle support by the state government (Langworthy et al 2017). The plan requires the Northern Territory to increase the amount of renewable energy capacity from 36MW to 450MW by 2030 (RenewEconomy 2017b).

The government has recently released the first stage of their Implementation Plan for transitioning to 50% renewable energy (Solar Quotes 2018b). The government have also signed a power purchase agreement to buy the output of the 25MW Katherine solar farm (Solar Quotes 2018b).

The Northern Territory Government through the Power and Water Corporation has partnered with the Australian Renewable Energy Agency (ARENA) to bring solar to remote Territory communities. Power and Water's SETuP program is delivering a wide-scale rollout of 10MW of solar systems across 25 remote Indigenous communities (ARENA 2014). The \$59 million program, funded by ARENA and the Northern Territory Government, is nearing completion with construction expected to finish by the end of 2018. A 0.8MW battery has also been installed in the Daly River remote community to help the area achieve 50% renewable energy (ARENA 2014).

BOX 8: FAST FACTS

Percentage renewable power:

The Northern Territory had 3% renewable electricity in 2017, increasing from 2.3% in 2016.

Households:

13.8% of Northern Territory households have rooftop solar.

Policy

- › 50% renewable energy target by 2030.
- › Release of the first stage of an Implementation Plan for transitioning to 50% renewable energy.
- › Expression of interest for 25-45MW of battery storage with between 30 and 90 minutes of storage.
- › Have signed a PPA to support a 25MW solar farm.

Source: APVI 2018; Clean Energy Council 2018a; Department of the Environment and Energy 2018a; Northern Territory Government 2018; RenewEconomy 2018f; Solar Quotes 2018b.

The Northern Territory has a 50% renewable energy target by 2030.

The state owned generator, Territory Generation, has released an expression of interest for 25-45MW of battery storage with a storage capacity between 30 and 90 minutes on the Darwin-Katherine grid. Proposals from companies were due by the end of September this year, with the battery potentially operating by mid-2019 (RenewEconomy 2018f).

The Darwin-Katherine grid has demand ranging from 100MW to nearly 300MW with an average of 195MW. A 45MW battery could support one quarter of this electricity grid during a period of average demand (RenewEconomy 2018f).

The Northern Territory has three main separate grids (Darwin-Katherine, Tennant Creek and Alice Springs) and a range of smaller grids. In November 2017, construction began on a 5MW battery in Alice Springs' electricity grid, representing about 10% of total electricity demand (Territory Generation 2017).

The Alice Springs grid has a very high penetration of solar and in 2016, solar generation contributed 40% of demand (RenewEconomy 2018g). With 10.6MW of solar capacity, the 5MW battery will go a long way towards maintaining the security of the electricity grid as the amount of solar increases even further (RenewEconomy 2018g).

The government has introduced a \$4.5 million program to provide households with \$1,000 grants to install rooftop solar, batteries or fund other energy efficiency improvements (RenewEconomy 2017b). 13.8% of households in the Northern Territory have already installed rooftop solar (APVI 2018).

Three new solar farms and a grid-scale battery are being built to power airports in the Northern Territory. This includes a 40MW solar farm at the Darwin International Airport, a 10MW solar farm at the Alice Springs Airport and another solar farm at Tennant Creek (One Step Off the Grid 2018). A battery will also be built outside Darwin. These projects will significantly expand the amount of solar at the Darwin and Alice Springs airports which already have smaller solar systems. These projects are co-funded by the Northern Australia Infrastructure Fund (NAIF) (One Step Off the Grid 2018).

Figure 12: Solar panels on a hotel roof near Uluru, Northern Territory. 13.8% of households in the Territory have installed rooftop solar.



WESTERN AUSTRALIA

Western Australia remains the only state or territory in Australia without a target to increase renewable energy or achieve net zero emissions by 2050. Western Australia generates 7.5% of its electricity from renewable energy (Department of the Environment and Energy 2018a). Over a quarter of households (26.7%) in the state have installed a rooftop solar system (APVI 2018). The state has just three renewable energy projects under construction totaling 70MW – the lowest amount of new capacity under construction of any state or territory (Clean Energy Council 2018a).

Western Australia does not have a renewable energy target or an emissions reduction target. However the state is working on policies and regulatory reform to address network access constraints that are restraining the growth of new renewable energy (Government of Western Australia 2018a).

A number of renewable energy projects are being developed in Western Australia to meet obligations under the Federal Government's renewable energy target. This includes the expansion of the Greenough River solar farm from 10MW to 40MW, preparatory work for the 180MW Warradarge wind farm and refurbishment of the Albany Grasmere wind farm (Government of Western Australia 2018b).

BOX 9: FAST FACTS

Percentage renewable power:
Renewable energy generation in Western Australia has increased slightly from 7% in 2016 to 7.5% in 2017.

Households:
Western Australia has the third highest proportion of solar households (26.7%).

Policy

- › Western Australia has no target to increase renewable energy or achieve net zero emissions by 2050.
- › State owned generator Synergy to build 210 MW of renewable energy.

Source: APVI 2018; Clean Energy Council 2018a; Government of Western Australia 2018a; Department of the Environment and Energy 2018a.

Western Australia is supporting a small amount of renewable energy but could be doing much more.

The 20MW Emu Downs solar farm was completed in early 2018, making it the largest solar farm in the state. The solar farm is co-located with an 80MW wind farm (Figure 13). The 130MW Badgingarra wind farm is planned to begin construction on the same site in the near future (RenewEconomy 2018i).

There are a number of large-scale energy storage projects operating throughout Western Australia, particularly in remote and off-grid locations. These include large-

scale battery storage at the Newman Power Station (Alinta Energy 2018), the DeGrussa copper-gold mine (ARENA 2016) and proposed as part of the Kalbarri microgrid project (Western Power 2018).

In 2017, the state government brought forward the closure of Western Australia's oldest and dirtiest coal power station, the Muja AB power station, after an expensive (\$300 million), failed attempt at refurbishing the 53 year-old power station (The West Australian 2017; Box 5).

Figure 13: The Emu Downs wind farm in Western Australia is co-located with the a 20MW solar farm that was completed earlier this year.



5. Vacating the Field: The NEG and Federal Government inaction

The Federal Government has not yet developed a credible national climate and energy policy to reduce greenhouse gas pollution and encourage renewable energy after the Renewable Energy Target expires in 2020.

Australia's Renewable Energy Target, which has been in place for well over a decade, has been an important driver of investment in clean, affordable and reliable renewable energy over the past two years, with the policy expected to result in 23.5% of Australia's electricity coming from renewable energy in 2020, up from just 15% in 2017 (Department of the Environment and Energy 2018a). Excluding hydro, wind and solar contributed 8.3% of Australia's electricity in 2017 (Department of the Environment and Energy 2018a).

The Federal Government's abandoned National Energy Guarantee proposal, planned to reduce emissions from the National Electricity Market by just 2% between 2021 and 2030. This target is woefully inadequate. Australia would not meet its commitment to reduce emissions in line with keeping global temperature rise to under 2°C if a 26% emissions reduction target by 2030 is applied to the electricity sector (COAG Energy Council 2018).



Figure 14: Lake Jindabyne is part of the Snowy Mountains Hydroelectricity Scheme. The Federal Government's Snowy 2.0 pumped hydro project would significantly increase the amount of pumped hydro storage.

The Federal Government's abandoned plan to reduce greenhouse gas pollution from electricity by 2% between 2021 and 2030 was woefully inadequate.

Australia is currently not on track to achieve its economy-wide 2030 emissions reduction target of 26–28% below 2005 levels by 2030 and even this target falls significantly short of what is required for Australia to do its fair share to tackle climate change. The Climate Change Authority recommended a 45–65% emissions reduction target for 2030 below 2005 levels, based on scientific evidence, what comparable countries are doing and what is in the best interests of Australia (Climate Change Authority 2015).

All state and territories except Western Australia now have renewable energy targets or emissions reduction targets that are more ambitious than the Federal Government.

The Federal Government is supporting investments in energy storage such as Snowy Hydro 2.0, which will add 2,00MW of pumped hydro capacity and 175 hours of storage, and the expansion of Tasmania's pumped hydro scheme (Snowy Hydro 2018; Hydro Tasmania 2018; e.g. Figure 14). However, these projects will likely increase greenhouse gas pollution if they are not accompanied by significant investment in new renewable energy generation. The Federal Government has also supported renewable energy and storage through the Northern Australia Infrastructure Fund, which has provided funding for three solar farms and a battery in the Northern Territory, as well as a solar and pumped hydro project in Queensland (One Step Off the Grid 2018; RenewEconomy 2018b).

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For more analysis of the NEG, read the Climate Council's report:



'Clean & Reliable: Roadmap to a Renewable Future'.

The Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation continue to invest in renewable energy and storage technology, although funding for ARENA will finish in 2022 (ARENA 2018b).

State and territory leadership is critical if Australia is to do its fair share to reduce greenhouse gas pollution.

References

- ABC News (2016) Worksafe notices detail extent of repairs needed at Hazelwood power station. 1 December 2016. Accessed at: <http://www.abc.net.au/news/2016-12-01/worksafe-notices-detail-extent-of-repairs-needed-at-hazelwood/8082318>
- ABC News (2017a) Lack of wind a big blow for Infigen and power prices. 24 June 2017. Accessed at: <http://www.abc.net.au/news/2017-06-24/lack-of-wind-a-big-blow-for-infigen-and-consumers/8646894>
- ABC News (2017b) Tasmania's eye on full renewable energy by 2022, but work still to be done on securing supply. 16 August 2017. Accessed at: <http://www.abc.net.au/news/2017-08-16/recommendations-from-tas-energy-security-taskforce/8814220>
- ABS (Australian Bureau of Statistics) (2018) 3101.0 – Australian Demographic Statistics, Dec 2017. 21 June 2018. Accessed at: <http://www.abs.gov.au/ausstats/abs@.nsf/0/D56C4A3E41586764CA2581A70015893E?OpenDocument>
- ACT Government (2015) Environment and Planning Directorate – Environment Energy. Accessed at: <http://www.environment.act.gov.au/energy>
- ACT Government (2018) What is Government doing? Accessed at: <https://www.environment.act.gov.au/cc/what-government-is-doing>
- ActSmart (2018) Household Battery Storage. Accessed at: <https://www.actsmart.act.gov.au/what-can-i-do/homes/discounted-battery-storage>
- AEMO (Australian Energy Market Operator) (2017) South Australian Generation Forecasts. 15 December 2017. Accessed at: http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2017/2017-South-Australian-Generation-Forecast.pdf
- AEMO (2018a) Quarterly Energy Dynamics: Q1 2018. Accessed at: http://www.aemo.com.au/-/media/Files/Media_Centre/2018/QED-Q1-2018.pdf
- AEMO (2018b) Electricity Statement of Opportunities: Wholesale Electricity Market. Accessed at: https://www.aemo.com.au/-/media/Files/Electricity/WEM/Planning_and_Forecasting/ESOO/2018/2018-WEM-ESOO-Report.pdf
- AEMO (2018c) Generation Information. 31 July 2018. Accessed at: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information>
- Alinta Energy (2018) Alinta Energy switches on big Pilbara battery. Accessed at: <https://www.alintaenergy.com.au/about-us/news/alinta-energy-switches-on-big-pilbara-battery>
- APVI (Australian PV Institute) (2018) Mapping Australian Photovoltaic Installations. Accessed at: <http://pv-map.apvi.org.au/historical#9/-35.1738/138.7326>
- ARENA (Australian Renewable Energy Agency) (2014) Northern Territory Solar Energy Transformation Program. Accessed at: <https://arena.gov.au/projects/northern-territory-solar-energy-transformation-program/>
- ARENA (2016) Mining success marks turning point for off-grid renewables. Accessed at: <https://arena.gov.au/news/mining-success-marks-turning-point-for-off-grid-renewables/>
- ARENA (2018a) ARENA to provide \$25 million to jointly fund Victoria's first large-scale, grid-connected batteries. 22 March 2018. Accessed at: <https://arena.gov.au/news/arena-provide-25-million-jointly-fund-victorias-first-large-scale-grid-connected-batteries/>
- ARENA (2018b) How we are funded. Accessed at: <https://arena.gov.au/about/how-we-are-funded/>
- Australian Government (2018) Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2018. Accessed at: <https://www.environment.gov.au/system/files/resources/63391569-7ffa-4395-b245-e53893158566/files/nggi-quarterly-update-mar-2018.pdf>
- Clean Energy Council (2018a) Jobs and investment in large-scale renewables. 21 September 2018. Accessed at: <https://www.cleanenergycouncil.org.au/cec/policy-advocacy/jobs-and-investment>
- Clean Energy Council (2018b) Clean Energy Australia: Report 2018. Accessed at: <https://www.cleanenergycouncil.org.au/policy-advocacy/reports/clean-energy-australia-report.html>
- Climate Action Tracker (2018) Australia: current policy projections. Updated 30 April 2018. Accessed at: <https://climateactiontracker.org/countries/australia/current-policy-projections/>
- Climate Change Authority (2015) Final Report on Australia's Future Emissions Reduction Targets. 2 July 2015. Accessed at: <http://climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/Final-report-Australias-future-emissions-reduction-targets.pdf>
- Climate Council (2017) Critical Decade 2017: Accelerating Climate Action. Accessed at <https://www.climatecouncil.org.au/resources/critical-decade-2017/>.
- Climate Council (2018) Renewables & Business: Cutting Prices and Pollution. Accessed at <https://www.climatecouncil.org.au/resources/renewables-business-cutting-prices-and-pollution/>
- ClimateWorks (2017) Power Up: Australia's electricity sector can and should do more to deliver on our climate commitments. Accessed at: https://climateworks.com.au/sites/default/files/documents/publications/cwa_power_up_report_final_12_jul.pdf

- COAG Energy Council (2018) Energy Security Board National Energy Guarantee: Final Detailed Design. 1 August 2018. Accessed at: http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Final%20Detailed%20Design%20-%20National%20Energy%20Guarantee_1.pdf
- Department of the Environment and Energy (2015) Australia's 2030 climate change target. Accessed at: <http://www.environment.gov.au/climate-change/publications/factsheet-australias-2030-climate-change-target>
- Department of the Environment and Energy (2018a) Australian Energy Statistics, Table O, Australian electricity generation, by fuel type, physical units. April 2018. Accessed at: https://www.energy.gov.au/sites/g/files/net3411/f/aes-table-o-2016-17_2017.pdf
- Department of the Environment and Energy (2018b) State and Territory Greenhouse Gas Inventories 2016. February 2018. Accessed at: <http://www.environment.gov.au/system/files/resources/a97b89a6-d103-4355-8044-3b1123e8bab6/files/state-territory-inventories-2016.pdf>
- Engie (2017) Willogoleche Wind Farm. Accessed at: <http://www.gdfsuezau.com/about-us/asset/Willogoleche-Wind-Farm>
- Government of South Australia (2017) New solar thermal to boost competition and create jobs. 14 August 2017. Accessed at: <https://newsouthaustralia.com/news/new-solar-thermal-boost-competition-create-jobs/>
- Government of South Australia (2018a) Home Battery Scheme. Accessed at: http://www.energymining.sa.gov.au/energy_implementation/home_battery_scheme
- Government of South Australia (2018b) South Australia's Virtual Power Plant. Accessed at: <https://virtualpowerplant.sa.gov.au/virtual-power-plant>
- Government of South Australia (2018c) Premier's Climate Change Council. Accessed at: <https://www.environment.sa.gov.au/topics/climate-change/premiers-climate-change-council>
- Government of Western Australia (2018a) Improving access to Western Power's network – Implementing Constrained Access. Accessed at: <http://www.treasury.wa.gov.au/Public-Utilities-Office/Industry-reform/Constrained-Network-Access-Reform/>
- Government of Western Australia (2018b) New renewables projects in WA given 'green light'. 10 April 2018. Accessed at: <https://www.mediastatements.wa.gov.au/Pages/McGowan/2018/04/New-renewables-projects-in-WA-given-green-light.aspx>
- Green Energy Markets (2018) Renewable Energy Index – June 2018. 26 July 2018. Accessed at: <http://greenmarkets.com.au/news-events/renewable-energy-index-june-2018>
- Hydro Tasmania (2018) Battery of the Nation. Accessed at: <https://www.hydro.com.au/clean-energy/battery-of-the-nation>
- Langworthy A, Bourne G, Frearson L, Howard K, McKenzie A, Peake O (2017) Northern Territory Roadmap to Renewables: Fifty per cent by 2030. Accessed at: <https://roadmaprenewables.nt.gov.au/?a=460760>
- Lend Lease (2018) Alkimos Beach's Ground-Breaking Energy Trial. Accessed at: <https://www.lendlease.com/articles/2017/02/21/04/56/20170223-alkimos-beach-energy-trial/>
- Lincoln Gap Wind Farm (2018) About the Project. Accessed at: <http://lincolngapwindfarm.com.au/about-the-project/>
- New MG, Liverman DM, Betts RA, Anderson KL, West CC (2011) Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications. The Royal Society Publishing, 369:1934.
- New South Wales Government (2016) Factsheet: achieving net-zero emissions by 2050. Accessed at: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Climate-change/achieving-net-zero-emissions-by-2050-fact-sheet-160604.pdf>
- NOAA (National Oceanic and Atmospheric Administration) (2018) Global Analysis – Global Climate Report – Annual 2017. Accessed at: <https://www.ncdc.noaa.gov/sotc/>
- Northern Territory Government (2018) Roadmap to Renewables. Accessed at: <https://roadmaprenewables.nt.gov.au/>
- One Step off the Grid (2018) Three new solar farms and battery storage system to power NT airports. 7 September 2018. Accessed at: <https://onestepoffthegrid.com.au/three-new-solar-farms-battery-storage-system-power-nt-airports/>
- Power Technology (2018) Bungala Solar PV Plant, Port Augusta. Accessed at: <https://www.power-technology.com/projects/bungala-solar-pv-plant-port-augusta/>
- Premier of Tasmania (2018) Tasmania achieves net zero emissions for the first time. 27 April 2017. Accessed at: http://www.premier.tas.gov.au/releases/tasmania_achieves_zero_net_emissions_for_the_first_time
- Premier of Victoria (2018a) Construction Begins on Bulgana Green Power Hub. 16 May 2018. Accessed at: <https://www.premier.vic.gov.au/construction-begins-on-bulgana-green-power-hub/>
- Premier of Victoria (2018b) Cutting power bills with solar panels for 650,000 homes. 19 August 2018. Accessed at: <https://www.premier.vic.gov.au/cutting-power-bills-with-solar-panels-for-650000-homes/>

Premier of Victoria (2018c) Emissions target kicks off more climate change action. 29 January 2017. Accessed at: <https://www.premier.vic.gov.au/emissions-target-kicks-off-more-climate-change-action>

Queensland Government (2017) Pathways to a clean growth economy Queensland Climate Transition Strategy. Accessed at: <https://www.qld.gov.au/environment/assets/documents/climate/qld-climate-transition-strategy.pdf>

Queensland Government (2018a) Renewables 400. Accessed at: <https://www.business.qld.gov.au/industries/mining-energy-water/energy/renewable/projects-queensland/renewables-400>

Queensland Government (2018b) Lockhart River solar power trial. Accessed at: <https://www.qld.gov.au/housing/public-community-housing/public-housing-tenants/solar-lockhart-river>

REN21 (2018) Renewables 2018: Global Status Report. Accessed at: <http://www.ren21.net/status-of-renewables/global-status-report/>

RenewEconomy (2017a) Plans for Australia's first offshore wind farm gather pace. 1 December 2017. Accessed at: <https://reneweconomy.com.au/plans-australias-first-offshore-wind-farm-gather-pace-49478/>

RenewEconomy (2017b) NT backs 50% renewables plan, to boost home solar and batteries. 28 November 2017. Accessed at: <https://reneweconomy.com.au/nt-backs-50-renewables-plan-to-boost-home-solar-and-batteries-64285/>

RenewEconomy (2018a) Equis gets finance for 127MW solar farm in South Australia. 14 February 2018. Accessed at: <https://reneweconomy.com.au/equis-gets-finance-127mw-solar-farm-south-australia-55308/>

RenewEconomy (2018b) Genex lands \$516m NAIF loan for solar and storage project. 20 June 2018. Accessed at: <https://reneweconomy.com.au/genex-lands-516m-naif-loan-for-solar-and-storage-project-33669/>

RenewEconomy (2018c) Goldwind begins construction of 144MW Tasmania wind farm. 22 May 2018. Accessed at: <https://reneweconomy.com.au/goldwind-begins-construction-144mw-tasmania-wind-farm-10584/>

RenewEconomy (2018d) Tasmania's Granville Harbour wind farm reaches financial close. 12 July 2018. Accessed at: <https://reneweconomy.com.au/tasmanias-granville-harbour-wind-farm-reaches-financial-close-18064/>

RenewEconomy (2018e) Tasmania touts its "Battery of the Nation" – half the cost of Snowy 2.0. 6 June 2018. Accessed at: <https://reneweconomy.com.au/tasmania-touts-its-battery-of-the-nation-half-the-cost-of-snowy-2-0-55880/>

RenewEconomy (2018f) Northern Territory launches tender for up to 45MW grid-scale battery storage. 15 January 2018. Accessed at: <https://reneweconomy.com.au/northern-territory-launches-tender-for-up-to-45mw-grid-scale-battery-storage-10162/>

RenewEconomy (2018g) Putting the Northern Territory on Australia's energy map. 9 July 2018. Accessed at: <https://reneweconomy.com.au/putting-northern-territory-australias-energy-map-82992/>

RenewEconomy (2018h) Beryl solar farm to power NSW trains, may add battery storage. 24 July 2018. Accessed at: <https://reneweconomy.com.au/beryl-solar-farm-power-nsw-trains-may-add-battery-storage-25337/>

RenewEconomy (2018i) WA's largest solar farm – Emu Downs – opens for business. 5 March 2018. Accessed at: <https://reneweconomy.com.au/w-a-s-largest-solar-farm-emu-downs-opens-for-business-69933/>

RenewEconomy (2018j) Queensland says wind, solar key to lower power bills, creates new renewables generation company. 30 August 2018. Accessed at: <https://reneweconomy.com.au/queensland-says-wind-solar-key-to-lower-power-bills-creates-new-renewables-generation-company-52072/>

RenewEconomy (2018k) Victoria government offers \$5,000 grants for household batteries. 11 September 2018. Accessed at: <https://reneweconomy.com.au/victoria-government-offers-5000-grants-for-household-batteries-17966/>

RenewEconomy (2018l) South Australia's second big battery takes peninsula off grid, as tests continue. 20 September 2018. Accessed at: <https://reneweconomy.com.au/south-australias-second-big-battery-takes-peninsula-off-grid-as-tests-continue-83320/>

RenewEconomy (2018m) South Australia's second big battery charges into action. 26 June 2018. Accessed at: <https://reneweconomy.com.au/south-australias-second-big-battery-charges-into-action-79148/>

SMH (Sydney Morning Herald) (2016) Confidence in renewable energy sector 'evaporated' after Abbott cut: Bloomberg. Accessed at <https://www.smh.com.au/environment/climate-change/confidence-in-renewable-energy-sector-evaporated-after-abbott-cut-bloomberg-20160114-gm5qbo.html>

Snowy Hydro (2018) Snowy 2.0. Accessed at: <https://www.snowyhydro.com.au/our-scheme/snowy20/>

Solar Quotes (2018a) State Budget 2018-19. Accessed at: <https://www.solarquotes.com.au/blog/sa-budget-energy-mb0732/>

Solar Quotes (2018b) NT Renewable Energy Target – Movement at the Station. 9 October 2018. Accessed at: <https://www.solarquotes.com.au/blog/nt-renewable-energy-target-mb0776/>

SunWiz (2018a) Highlights of Australia's 1.25GW of PV installations in 2017. 17 January 2018. Accessed at: <http://www.sunwiz.com.au/index.php/more/news.html>

SunWiz (2018b) Australia rooftop solar charts another record month, even as prices edge up. 5 September 2018. Accessed at: <https://onestepoffthegrid.com.au/australia-rooftop-solar-charts-another-record-month-even-prices-edge/>

Image Credits

Territory Generation (2017) Battery Energy Storage project underway. 1 November 2017. Accessed at: <http://territorygeneration.com.au/uncategorized/battery-energy-storage-project-underway/>

The Guardian (2018) Scott Morrison says national energy guarantee 'is dead'. Accessed at: <https://www.theguardian.com/australia-news/2018/sep/08/scott-morrison-says-national-energy-guarantee-is-dead>

The West Australian (2017) Collie's Muja AB power station to close in multi-million dollar loss. 14 September 2017. Accessed at: <https://thewest.com.au/news/wa/collies-muja-ab-power-station-to-close-in-multi-million-dollar-loss-ng-b88597943z>

Victorian Government (2017) Renewable Energy Action Plan. Accessed at: https://www.energy.vic.gov.au/__data/assets/pdf_file/0014/74012/Web-pdf-Renewable-Energy-Action-Plan.pdf

Victorian Government (2018a) Victoria's renewable energy targets. Accessed at: <https://www.energy.vic.gov.au/renewable-energy/victorias-renewable-energy-targets>

Victorian Government (2018b) Victorian Renewable Energy Auction Scheme. Accessed at: <https://www.energy.vic.gov.au/renewable-energy/victorian-renewable-energy-auction-scheme>

Victorian Government (2018c) Government renewable energy purchasing. Accessed at: <https://www.energy.vic.gov.au/renewable-energy/victorias-renewable-energy-roadmap/government-renewable-energy-purchasing>

Western Power (2018) Kalbarri microgrid. Accessed at: <https://westernpower.com.au/energy-solutions/projects-and-trials/kalbarri-microgrid/>

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