CLIMATE COUNCIL

RENEWABLES READY: STATES LEADING THE CHARGE

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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.

This report follows on from previous state renewable energy updates from the Climate Council in 2014 and 2016. Since the Climate Council's previous report in 2016, all state and territory governments have taken proactive steps to encourage renewable energy uptake. This report compares states and territories across a range of renewable energy metrics, revealing leaders and laggards. 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.

We would like to thank Tim Buckley and Renate Egan for kindly reviewing the report. We also appreciate the assistance of Lucy Hough, Christian Lohmüller and Dylan Pursche in its preparation.

Climate Council CEO Amanda McKenzie served on the Queensland Renewable Energy Expert Panel, while McKenzie and Climate Councillor Greg Bourne are currently serving on the Northern Territory Renewable Energy Expert Panel as NT and QLD look at pathways to achieving 50% renewable energy by 2030.

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Key Findings

1

States and territories are driving the Australian energy transition in the absence of Federal policy.

- Australia's energy system is ageing and inefficient and will need to be replaced in coming decades. Power prices are rising due to a lack of new generation capacity to increase electricity supply, ongoing policy uncertainty and rising gas prices.
- New low-cost electricity generation is urgently required and renewable energy is the cheapest source of new power plants.
- In the absence of national energy and climate policy, all states and territories (except Western Australia) now have strong renewable energy targets and/or net zero emissions targets in place.
- State and territory targets, plus existing and announced coal closures (such as Liddell Power Station) are expected to deliver the Federal government's 2030 emissions reduction target of 26-28% reduction on 2005 levels, even without any action from the Federal Government.

2

In the last year state and territory governments have increased commitments to renewable power, including sources providing 24/7 power.

- In the last year Victoria (40% by 2025), the Northern Territory (50% by 2030) and Tasmania (100% by 2022) have put in place strong new renewable energy targets, and New South Wales, Tasmania, Queensland and Victoria have all adopted targets for net zero emissions by 2050.
- Within the last year, all Australian states and territories except Tasmania have increased or kept constant their proportion of electricity from renewable energy.
- States and territories are now focusing on energy storage as a key element underpinning the shift to higher levels of renewable energy.

3

New South Wales and Queensland are set for a significant increase in renewable energy.

- The greatest capacity and number (respectively) of large-scale wind and solar plants under construction in 2017 are in New South Wales and Queensland.
- This will create thousands of jobs in construction and operation of plants.

4

Queensland, South Australian and Western Australian households continue to lead in the proportion of homes with rooftop solar.

- Australia now has 5.6GW of rooftop solar across 1.7 million households, a global record in per capita terms.
- Western Australia has seen the largest increase in rooftop solar installations in the past year.

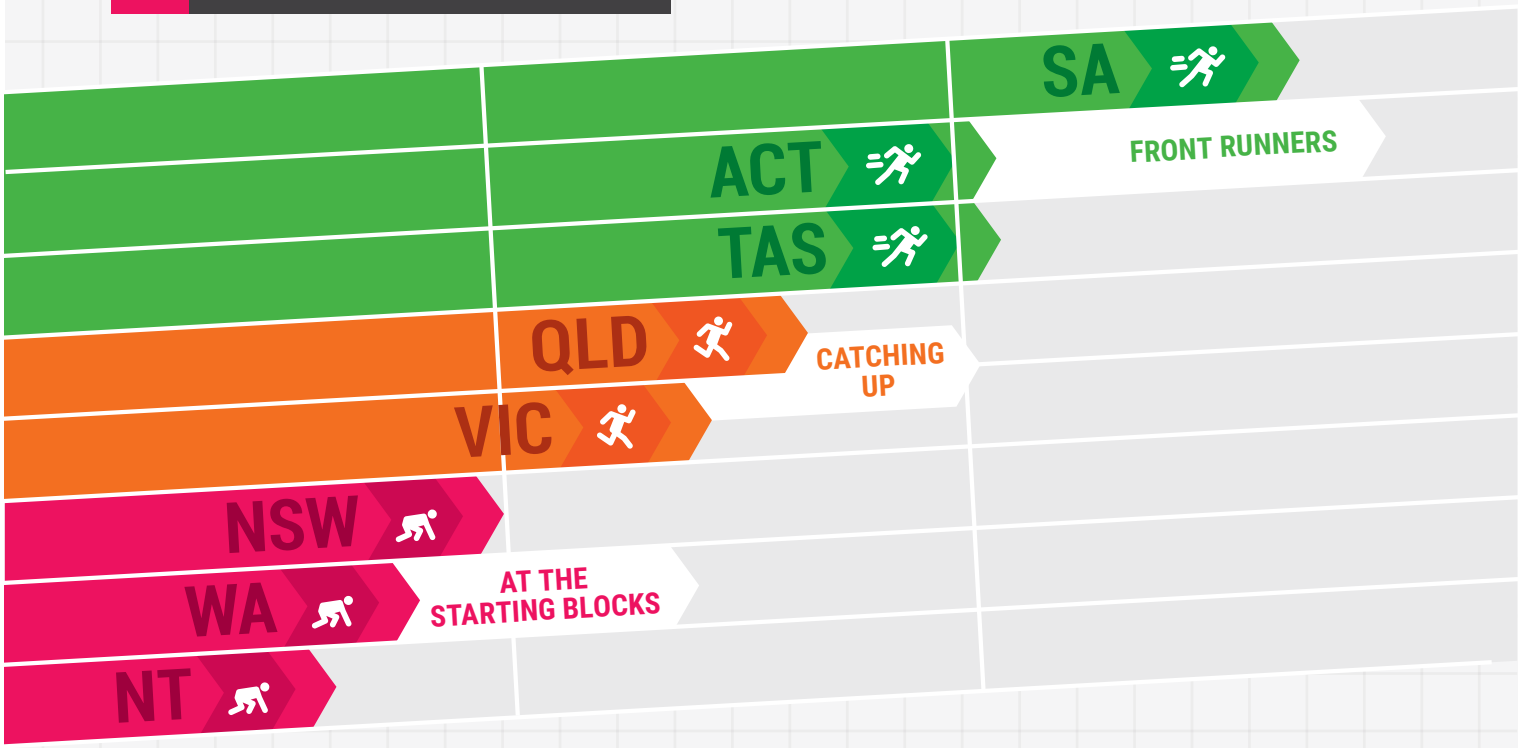
5

Energy storage is increasingly coming to the fore as part of state and territory energy policy.

- The Northern Territory, Australia Capital Territory, South Australia, Victoria and Queensland are rolling out or planning for battery storage to provide greater grid security.
- South Australia is building the world's largest lithium ion battery storage facility at the 315MW Hornsdale Wind Farm. The giant battery is expected to be up and running by the end of 2017 in preparation for the 2017-18 summer.
- The Federal government is examining a significant boost with its proposed Snowy Mountain Pumped Hydro Storage expansion proposal (requiring $2 billion of capital investment plus $2 billion of grid upgrades), but this is years away from approval and even more in terms of completion.

THE AUSTRALIAN RENEWABLE ENERGY RACE:

2017 SCORE CARD



State / Territory	NT	WA	NSW	VIC	QLD	TAS	ACT	SA
Overall Score	C	C	C	B	B	A	A	A
Renewable Electricity (%)	2	7	17	12	7	92	22	47
Capacity Per Capita (kw/cap) (excluding large hydro)	0.1	0.2	0.1	0.2	0.2	0.6	0.4	0.9
Solar Households (%)	11%	25%	15%	15%	32%	13%	14%	31%
Renewable Electricity Targets	50% by 2030	-	-	25% by 2020 40% by 2025	50% by 2030	100% by 2022	100% by 2020	50% by 2025
Net zero emissions targets	-	-	Net zero emissions by 2050	Net zero emissions by 2050	Net zero emissions by 2050	Net zero emissions by 2050	Net zero emissions by 2050	Net zero emissions by 2050
Progress since 2016	Expert panel and consultation on approach to Renewable Energy Target.	Largest increase in rooftop solar in 2016.	Continued policy support. Largest capacity of new projects under construc-tion.	Renewable Energy Target legislated.	Initial response to Renewable Energy Target. Largest no. of new projects under construc-tion.	New renewable energy target and zero net emissions target. No new projects added in 2016.	Final reverse auction.	SA Energy Plan. 100MW Battery announce-ment.
2016 Scores	-	C	D	C	C	B	-	A

Note: See Appendix A, Table A1 for more detailed scoring methodology.

States and Territories Renewable Energy Leaderboards

In the past year, all state and territory governments have taken proactive steps to encourage renewable energy uptake. We have identified the frontrunners in different categories (Figure 1; Figure 2).

TARGETS AND POLICIES

All states and territories except Western Australia now have strong renewable energy targets or net zero emissions targets in place. The targets in place are broadly consistent with the level of renewable energy needed across Australia by 2030 so it can do its fair share in keeping global temperature rise below two degrees Celsius (2°C) (Jacobs 2016).

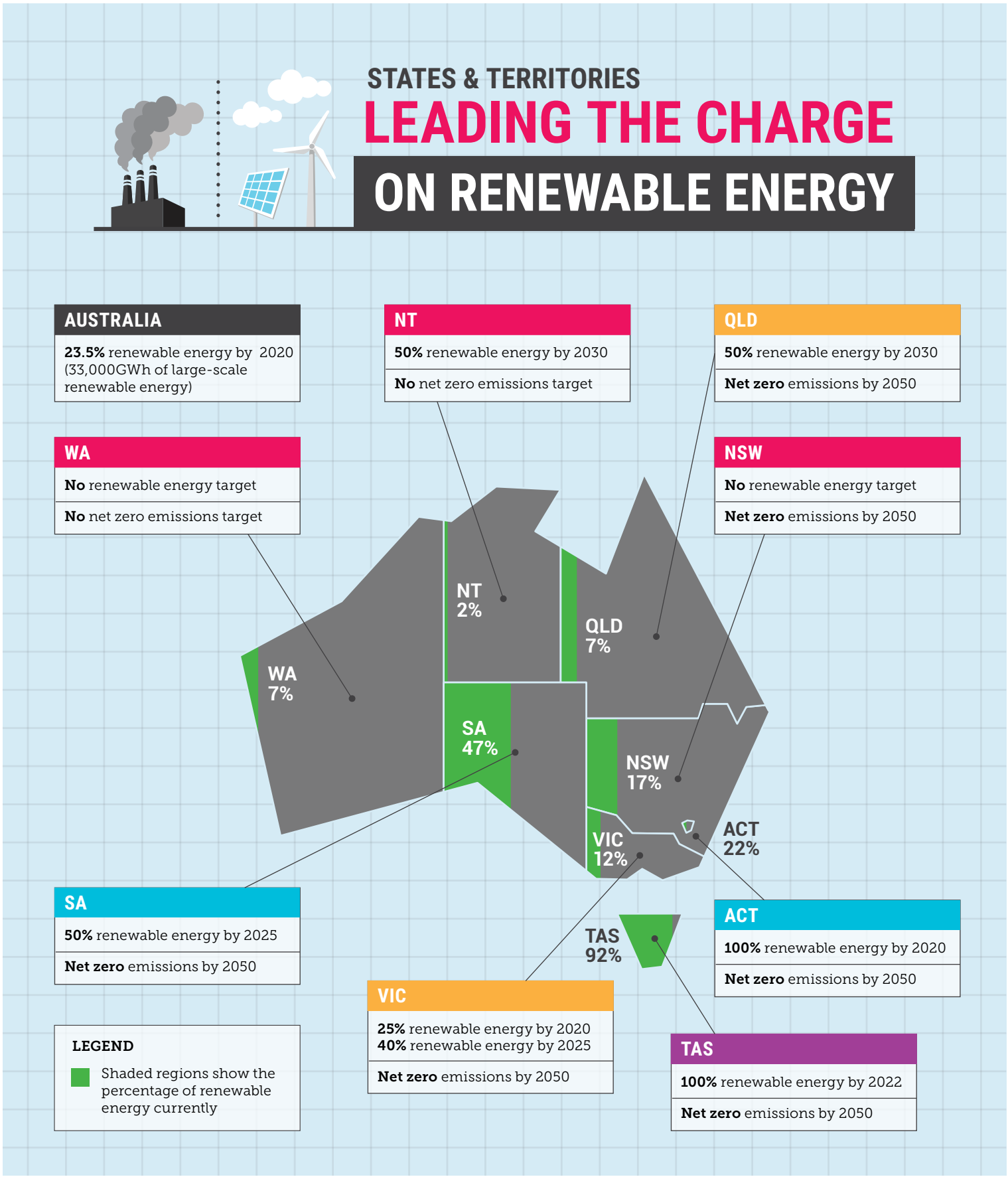
Under the Paris Agreement, world leaders including those from Australia agreed to limit global temperature rise to well below 2°C above pre-industrial levels, and to pursue efforts to limit temperature rise to only 1.5°C. While 2°C may not sound like much, this level of temperature rise will have serious impacts on the lives and livelihoods of people all over the world. Already at about 1°C temperature increase from pre-industrial levels, climate change is intensifying extreme weather events.

Most improved policy environment:
Since the Climate Council's 2016 report, New South Wales and the Northern Territory have seen the most dramatic positive shift in policy support for renewable energy and emissions reductions.

At risk of falling behind:
Western Australia is now the only state or territory in Australia without a target for renewable energy or net zero emissions.

Figure 1 (opposite): The Australian renewable energy race showing which states and territories are leading the way on renewable energy.

Figure 2: Renewable energy and net zero emissions targets of states and territories.



Sources: ACT Government 2015; ACT Government 2017a; Government of South Australia 2015a; Government of South Australia 2015b; Office of Environment and Heritage 2016; Tasmanian Government 2017a; Tasmanian Government 2017b; Victoria State Government 2017a.

PERCENTAGE RENEWABLE ELECTRICITY

1. Tasmania	92% (decrease)
2. South Australia	47% (increase)
3. Australian Capital Territory	22% (increase)

Note: Data are for 2016.

Greatest increase:
South Australia (increased wind generation and a reduction in coal power) and New South Wales (doubling in hydro generation due to low water levels in the previous year) saw the largest increase in their shares of renewable electricity.

Decrease:
Tasmania was the only state where its share of renewable electricity decreased.

LARGE-SCALE RENEWABLE ENERGY CAPACITY (EXCLUDING LARGE HYDRO) PER CAPITA

1. South Australia	0.9 kW/person
2. Tasmania	0.6 kW/person
3. Australian Capital Territory	0.4 kW/person

Note: Data are for 2016.

New large-scale projects underway:
New South Wales (1,018MW; 8 projects) and Queensland (784MW; 10 projects) have the greatest capacity and number of projects under construction.

Nothing added:
Tasmania is the only state which did not add any new renewable energy capacity in 2016.

PROPORTION OF HOUSEHOLDS WITH SOLAR PANELS

1. Queensland	31.6%
2. South Australia	30.5%
3. Western Australia	25.4%

Note: Based on most recent data from April 2017.

Largest growth in rooftop solar:
Western Australia (2.9% increase).

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1. Introduction

Around the world, governments at state, regional and local levels are playing an increasingly crucial role in the transition from fossil fuelled to renewable power. In many cases, state, regional and local governments are adopting stronger renewable energy targets and policies than their national counterparts, and advocating for climate action. For example, in the United States (US), 160 mayors and several states have already responded to the US President's proposal to withdraw from the Paris Agreement on climate change by pledging themselves to meeting the country's emissions targets without the Federal Government (Los Angeles Times 2017). In Australia, states and territories are leading the energy transition by setting stronger renewable energy and emissions reduction policies and targets while the Federal Government is yet to decide on renewable energy policy beyond 2020.

State and territory renewable targets are broadly consistent with action needed on climate change.

Australia's energy system is ageing and inefficient and will need to be replaced in coming decades. Power prices are rising due to a lack of new generation capacity to increase electricity supply, ongoing policy uncertainty and rising gas prices. Renewable energy is the cheapest way to power the future electricity system (see Table 1, page 4).

Accelerating the shift from fossil fuelled to renewable power generation is imperative for reducing pollution and protecting Australia from the effects of climate change such as worsening extreme weather events (e.g. bushfires, heatwaves and storms) (Figure 3). Current state and territory renewable energy targets are broadly consistent with the minimum level of renewable energy required for Australia to tackle climate change meaningfully (Jacobs 2016). Two degrees is a threshold that is considered too dangerous to cross. Limiting global temperature rise well below 2°C was agreed universally in Paris in 2015 by 195 nations including Australia, with a commitment to "ratchet-up" our collective targets over time.

This report updates state and territory renewable energy progress since previous state renewable energy reports from the Climate Council in 2014 and 2016. In the last three years enormous progress has been achieved by Australian states and territories with most increasing their commitments. In the absence of Federal government mechanisms driving more investment in renewable energy beyond 2020, the approaches taken by States and Territories are the primary mechanisms for increasing renewable energy generation.

Since our 2016 report:

- The Australian Capital Territory completed their final renewable energy reverse auction and is on track to meet its target of 100% renewable electricity by 2020.
- South Australia released a new Energy Plan detailing the next steps in its energy transition, and will build the world's largest lithium ion battery storage facility (100MW/129MWh) by December 2017.
- Queensland's expert panel released its final 50% Renewable Energy Target report. The government has made an initial response to the expert panel report, but is yet to detail its final plan for reaching the target.
- Victoria, the Northern Territory and Tasmania have set new renewable energy targets. Victoria has determined its approach to achieving its target, but is yet to introduce legislation.
- Four states: New South Wales, Tasmania, Queensland and Victoria introduced targets for net zero emissions by 2050.
- The new Western Australian government committed to investing in research into renewable energy and storage technology.
- The Australian Capital Territory, Northern Territory, South Australia, Victoria and Queensland are all rolling out or planning for battery storage.
- The Council of Australian Governments established an Independent Review into the Future Security of the National Electricity Market (known as the Finkel Review), which was released in June 2017.
- The Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC) launched and concluded a stimulus program resulting in 12 large scale solar PV projects being committed and built, catalysing steep reductions in large scale solar PV project costs, and increasing industry competitiveness. The program will more than triple Australia's large-scale solar capacity, and attract $1 billion in commercial investment (ARENA 2016) for a surprisingly low $91 million of subsidies. Subsequently, many new renewable projects have been announced without any capital subsidies, showing the merit of ARENA's program.

Figure 3: Bushfire smoke over Sydney in 2013.

2. Globally, the Renewable Energy Transition Continues

Renewable energy uptake continues at a rapid pace around the world. Globally, carbon dioxide (CO_2) emissions flat-lined for the third year in a row in 2016 (Le Quéré et al. 2016). Last year, a record 139GW of new renewable power capacity (wind, solar, biomass, waste-to-energy, geothermal, small hydro and marine sources) was added worldwide – an 8% increase on the previous year. This is about twice the entire electricity generating capacity of Australia (63GW) (Australian Government 2016).

These record-high global capacity additions were largely driven by rapidly falling renewable energy costs (UNEP 2017). Wind and solar prices continue to plummet (with the levelised cost of energy for wind and solar falling 18% and 17% respectively in 2016) as a result of low-cost financing and greater efficiency (The Guardian 2017a; UNEP 2017). With the addition of 15GW of large hydro capacity (projects greater than 50MW), renewable energy made up 64% of all new power capacity added globally in 2016 (UNEP 2017).

2016 was also a record year for the solar photovoltaic (PV) industry, with 75GW of new capacity added, eclipsing the previous 2015 record of 50GW (BNEF 2017a; Climate Council 2017c; UNEP 2017). Energy storage technologies are receiving increasing attention and investment. Most of the renewable energy growth has occurred in developing countries, with China leading the way (IEA 2016). For example, during the 2016 to 2020 period, China will invest close to $500 billion into renewable power generation (Deutsche Welle 2017). Consistent with this, China announced it installed a record 24.4GW of new solar in the first six months of 2017. China is also on track to introduce its national emissions trading scheme (ETS) across three sectors by December 2017.

Renewable energy made up 64% of all new power capacity globally.

To have a reasonable chance of holding global temperature rise to less than 2°C above pre-industrial levels, Australia needs to play its part by transitioning its power generation systems to zero pollution renewables by 2050 at the latest. Greenhouse gas emissions of some of our closest trading partners including the United States and the European Union are trending downwards (Le Quéré et al. 2016), while Australia's emissions are trending upwards (Commonwealth of Australia 2017). Latest Australian Government data shows that in the year to March 2017, Australia's emissions rose by 1.2% (Commonwealth of Australia 2017).

Analysis from Frontier Economics (2017) reveals that Australia could meet its 2030 emission reduction targets of 26-28% below 2005 levels through the implementation of state and territory policies and targets supporting renewable energy together with announced, planned closures of polluting coal power stations such as Liddell Power Station, NSW in 2022 (AEMO 2016).

Australia has a competitive advantage in renewable energy, with some of the best wind and solar resources in the world (Geoscience Australia 2014), a low population density and enormous financial capital resources available to fund new infrastructure investments. Further, renewable energy technologies such as solar PV, wind and solar thermal are now the lowest cost form of new electricity generation (Table 1). Australia has the potential to generate a much higher proportion of our electricity from renewables without compromising security. Our renewable energy resources could potentially provide 500 times the amount of electricity we currently use (Commonwealth of Australia 2014). However, compared to similar countries, Australia has one of the lowest levels of renewable electricity generation (Australian Energy Council 2016).

Table 1: Cost of new build power plants.

Power technology	Levelised Cost of Energy (LCOE)$ (AUD)/MWh
SA Solar Thermal Plant	$78[1]
Wind	$61 - 118[2]
Solar	$78 - 140
Gas Combined cycle	$74 - 90[3]
Coal	$134 - 203
Coal with Carbon Capture and Storage (CCS)	$352

Sources: BNEF 2017b. 1. Government of South Australia 2017. 2. Recent prices for wind are even lower - Stockyard Hill Wind Farm "well below" $60/MWh. 3. Based on gas prices of $8/GJ. Current gas prices are much higher than this.

3. Renewable Energy Performance

To compare the performance of state and territory governments on renewable energy (see Figure 1 and Appendix 1 for Score card), we used the following measures:

1. Policy support for renewable energy and emissions reduction targets.
2. Percentage of renewable energy in electricity supply.
3. Large-scale renewable energy capacity (excluding large-scale hydro) installed per capita (Figure 4).
4. Proportion of households with solar panels.

Figure 4: Kilikanoon Winery in South Australia, with more than 400 solar panels.

3.1 Proportion of Electricity Produced from Renewable Energy

Renewable energy provided 16% of Australia's electricity in 2016 based on government data (Department of Environment and Energy 2017; Table 2). Australia's renewable energy generation – 42,022 GWh in 2016 – was enough electricity to power the equivalent of nearly 7 million homes (calculated based on the usage of an average NSW household in ACIL Allen 2015). Further, Australia's proportion of renewable energy increased by more than 1% on the previous year, and actual renewable energy output rose 8.6% to 5,596GWh in 2016 (Department of Environment and Energy 2017). The majority of new projects brought online were as a result of the ACT's renewable energy target.

At a state level, the proportion of renewable electricity generated in Tasmania and South Australia continues to be well ahead of other states and territories. Tasmania was the only state where the proportion of renewable electricity fell. Tasmania relies mainly on its historic development of hydropower. The state is increasingly reliant on gas generation after Tasmania's Tamar Valley gas power station was turned on after the Basslink cable failed in late 2015.

South Australia and New South Wales saw the largest increase in their shares of renewable electricity. South Australia's renewable electricity is made up almost entirely of wind and solar PV developed in the last 12 years. Recent reports indicate South Australia has already achieved its renewable energy target of 50% renewable electricity production in 2017 – eight years early (ABC 2017b). South Australia's increased share in 2016 has been driven largely by an increase in wind and the cessation of coal fired power generation in South Australia (Department of Environment and Energy 2017). New South Wales' renewable electricity is mostly hydro (58%) followed by wind (17%) and solar (17%). New South Wales' increased share in 2016 was largely due to a doubling of generation from existing hydro power plants and a doubling of generation from large-scale solar plants.

The proportion of renewable electricity in Western Australia and the Northern Territory remained unchanged. Fossil fuels continue to dominate the electricity supply in Queensland, Western Australia and the Northern Territory.

Data for the Australian Capital Territory is based on renewable electricity consumed. This is because the territory purchases renewable energy from projects located in other states to meet its target. Further, Department of Environment and Energy (2017) data does not separate out the Australian Capital Territory's electricity production from New South Wales' figures.

Table 2: Proportion of renewable electricity for Australian states and territories.

	2015	2016	Change
States and territories			
Tasmania	99	92	▼
South Australia	40	47	▲
Australian Capital Territory*	19	22	▲
Western Australia	7	7	-
Victoria	11	12	▲
New South Wales	12	17	▲
Queensland	6	7	▲
Northern Territory	2	2	-
National			
Australia	14	16	▲

Source: ACT Government 2016a and data provided by the ACT government. Department of Environment and Energy 2017.

* States and Northern Territory renewable electricity data is the proportion of electricity production whereas Australian Capital Territory data is calculated based on electricity consumption.

Note: The NSW Government has published figures for 2015 claiming a higher percentage (14%) of renewable energy for 2015 than Australian Government figures shown in Table 2. The difference relates to the NSW Government including solar hot water (NSW Government 2017b). For consistency, renewable energy data presented herein is for the year 2016.

The majority of states and territories have increased their proportion of renewable electricity.

3.2 Large-scale Renewable Energy Per Person

Among the states and territories, South Australia, Victoria, Queensland and New South Wales have the greatest total capacity of large-scale renewable energy (excluding large hydro) with over 1,100MW capacity in 2016 (Table 3). However, on a per capita basis, South Australia leads, followed by Tasmania and the Australian Capital Territory (ABS 2017; Clean Energy Regulator 2016b; Table 3).

Across Australia, 265MW of new large-scale renewable energy capacity was added in 2016. The greatest share of new capacity was added in South Australia (120MW), more than double the next highest state, New South Wales (56MW). The Clean Energy Council (2017a) reports that large renewable energy projects under construction or starting in 2017 will add 3,300MW capacity and will support 4,100 jobs across the nation with New South Wales, Queensland and South Australia adding the most.

It should be noted, that while the ACT has a low share of large-scale renewable energy capacity within its borders, the ACT Government has supported large-scale wind projects in South Australia, New South Wales and Victoria through its renewable energy reverse auctions and 100% renewable energy target. A reverse auction is a process where the best value, lowest priced renewable energy bids are successful. 143MW of new renewable energy added in 2016 was supported by the ACT's renewable energy target. Completed projects under the ACT's reverse auction scheme are included as part of the ACT's capacity per person below (Table 3).

South Australia, New South Wales and Queensland added the most renewable energy capacity in 2016.

Table 3: Large-scale renewable electricity capacity per person (excluding large hydro) for Australian states and territories.

	2015 (MW)[1]	2016 (MW added)[2]	Total capacity 2016 (MW)	Population ('000 people)[3]	MW/person
States and territories					
Tasmania	320	0	320	520	0.6
South Australia	1,505	120	1,625	1,711	0.9
Western Australia	600	10	610	2,623	0.2
Victoria	1,378	20	1,398	6,101	0.2
New South Wales	1,070	56	1,126	7,758	0.1
Queensland	1,136	30	1,166	4,860	0.2
Northern Territory	12	6	18	246	0.1
Australian Capital Territory		23 (in ACT)	1604	398	0.4
Australia	6,021	265	6,286	24,217	0.3

Sources: 1. Clean Energy Regulator 2016b. 2. Clean Energy Council 2017a. 3. ABS 2017. Total capacity of completed projects under the ACT's reverse auction scheme - Royalla Solar Farm, Mugga Lane Solar Farm, Williamsdale Solar Farm, Coonooer Bridge Wind Farm, Hornsdale Wind Farm (Stage 1). Note that the capacity of these projects is also included under the state in which they are built.

Ten large-scale renewable energy projects were completed in 2016 totaling 265MW of capacity (Clean Energy Council 2017a) – enough electricity to power 90,000 homes (based on information from project websites).

New projects include:

- Hornsdale Stage 1 Wind Farm, SA 100MW (Figure 5).
- Waterloo Stage 2 Wind Farm, SA 19.8MW.
- Moree Solar Farm, NSW 56MW.
- Barcaldine Solar Farm, Queensland 25MW.
- Normanton Solar Farm, Queensland 5MW.
- Mugga Lane Solar Farm, ACT 13MW.
- Williamsdale Solar Farm, ACT 10MW.
- DeGrussa Mine Solar, Western Australia 10MW.
- Coonooer Bridge Wind Farm, Vic 19.8MW.
- Darwin Airport, NT 5.5MW.

Table 4 shows that New South Wales and Queensland could be set for a significant increase with the greatest capacity and number of projects under construction.

Table 4: Large-scale renewable energy projects under construction in 2017.

	Total capacity (MW)	Number of projects	Number of jobs created
States			
South Australia	644	4	620
Victoria	687	7	535
New South Wales	1,018	8	1,245
Queensland	784	10	1,896
Western Australia	20	1	100
Australia	3,151	30	4,396

Source: Clean Energy Council 2017b.

Note some projects have been announced as commencing construction in 2017 since the above data was compiled. For example, two wind projects - Cattle Hill and Granville Harbour - in Tasmania are likely to begin construction in 2017 (The Mercury 2017).

Figure 5: Hornsdale Wind Farm under construction near Jamestown, South Australia. This is one of the largest wind farms (100MW capacity for Stage 1) added in Australia in 2016.

3.3 Rooftop Solar

Australia is a world leader in household solar PV, with double the rate of uptake – 21% of households on average (Renew Economy 2017b) – compared to any other country in the world (excluding small nations like Kiribati; see Bruce and MacGill 2016) (ESAA 2015).

More than 1.7 million Australian households have installed solar PV panels (as of March 2017) (Clean Energy Regulator 2017; Figure 6). Bruce and MacGill (2016) identify a number of reasons that household rooftop solar is popular in Australia:

- Initial state-based feed-in tariffs plus high and rising residential electricity costs.
- Large-roof space on a large proportion of houses.
- A sunny climate.
- Cost effective.
- Relatively high rates of home-ownership.

The total capacity of Australian rooftop solar was 5.6GW as of April 2017 (Renew Economy 2017a). At the state and territory level, Queensland, South Australia and Western Australia have the highest proportion of households with solar PV installations (APVI 2017; Table 5).

Table 5: Proportion of households with solar PV.

State/Territory	Proportion of households with solar PV systems installed (May 2016)	Proportion of households with solar PV systems installed (April 2017)	Total capacity (MW) (April 2017)	Change
Queensland	29.6%	31.6%	1,727	▲
South Australia	28.8%	30.5%	738	▲
Western Australia	22.5%	25.4%	726	▲
Victoria	14.2%	15.4%	1,048	▲
New South Wales	14.1%	15.3%	1,413	▲
Australian Capital Territory	13.1%	13.9%	107	▲
Tasmania	12.1%	13.2%	104	▲
Northern Territory	8.7%	11.4%	58	▲

Source: APVI 2017.

Queensland, South Australia and Western Australia have the highest proportion of households with solar.

Historically, state and territory governments have actively driven the uptake of rooftop solar through premium feed-in tariffs, however most of these programs have been wound back as solar has become cost competitive with grid sourced retail electricity prices. State governments can also play a role encouraging or discouraging solar PV through planning policies (for example heritage legislation can restrict solar PV in certain locations), regulations impacting on households' ability to feed solar PV into the grid and whether extra fees or charges are imposed by networks on solar households, or should restrictions to the installation of battery storage be brought in. For example, Standards Australia has released prohibitive draft guidelines for battery storage which if adopted or required by state governments would impact negatively on battery storage uptake (Renew Economy 2017f).

Figure 6: Worker installing solar PV on the rooftop of a house.

3.4 Leading Solar Suburbs

There are 22 postcodes in Australia where half or more of households have rooftop solar PV with the majority in Queensland and Western Australia (Figure 7; see Appendix B; APVI 2017). The suburbs of Baldivis (Western Australia; 69% uptake), Elimbah (Queensland; 63% uptake) and Tamborine (Queensland; 57% uptake) are leading the way with installations on houses. The best performing postcodes in each state are provided in Table 6. Suburbs with high levels of rooftop solar PV have generally low to medium income levels and tend to be located in the outer metropolitan "mortgage belt", or in regional areas.

Some new suburbs are now being built with 100% solar. For example, Denman Prospect in Canberra, will be the first suburb in Australia to require a minimum of 3kW of solar PV on every house (Canberra Times 2015). Breezes Muirhead in Darwin being developed by Defence Housing Australia plans to include a 4.5kW solar system and charging points for electric vehicles on each house – features which are anticipated to save residents over $2,000 a year on their electricity bills (Renew Economy 2015).

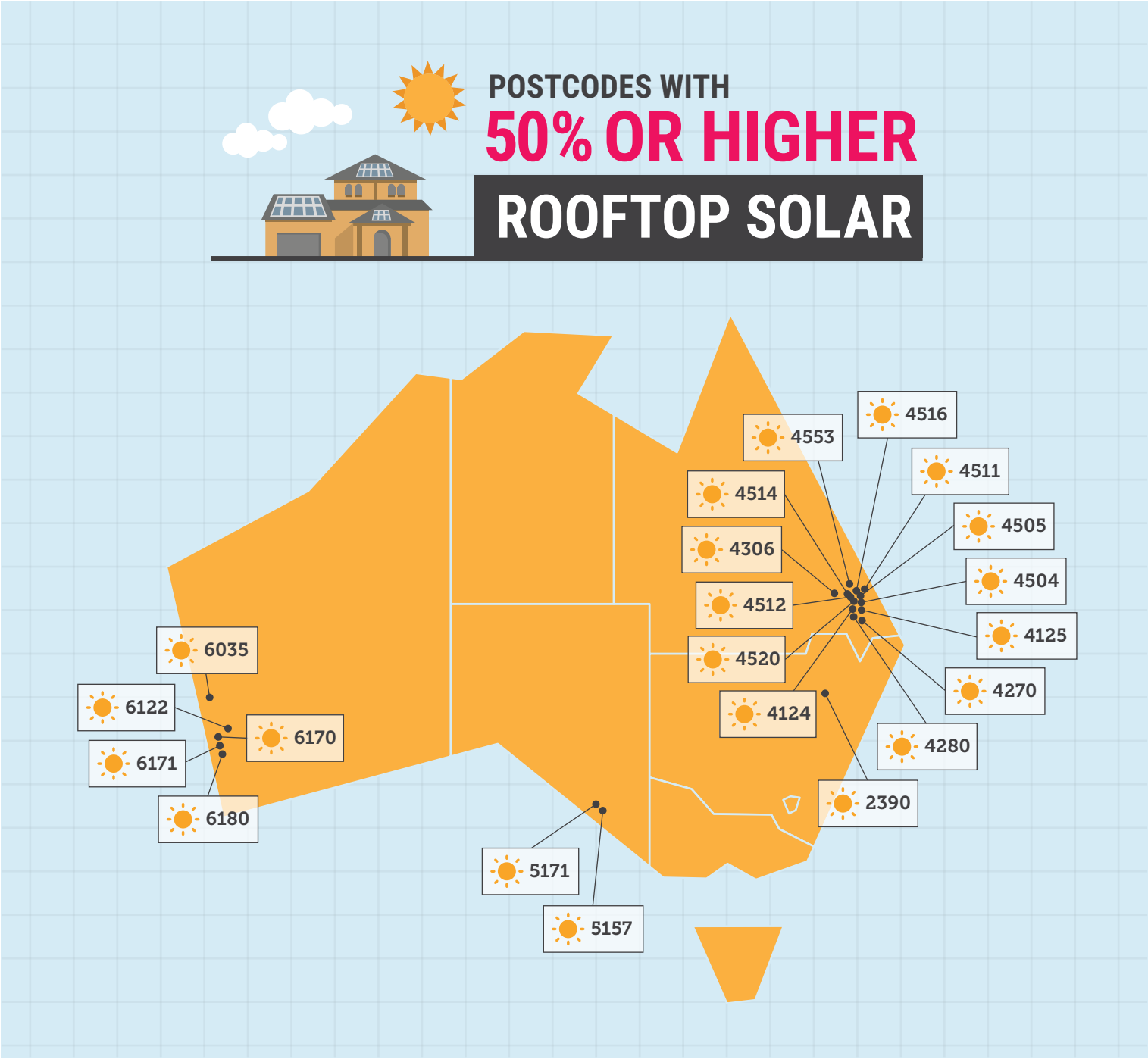
Other recent developments include the largest residential "virtual power plant" in the world, which went live in March 2017 in Adelaide (AGL 2017). The virtual power plant is made up of numerous individual solar battery systems installed in homes. The batteries store excess solar energy to use when required and the virtual power plant will sometimes help support the electricity grid by providing stored electricity to power the home or to feed back into the grid. 1,000 batteries are expected to be installed across Adelaide by the end of next year (AGL 2017). Meanwhile, in Western Australia, Horizon Power has run a successful trial of solar and battery storage in remote locations, providing reliable power, with more systems to be rolled out by the end of the year (ABC 2017a).

Table 6: Best performing postcodes for each state and territory for residential uptake of solar PV. Values are based on suburbs with more than 1,000 dwellings.

State	Postcode	Suburbs	Installs	Capacity
Western Australia	6171	Baldivis	3951	69%
Queensland	4516	Elimbah	763	63%
South Australia	5171	Blewitt Springs, McLaren Flat, McLaren Vale, Pedler Creek, Tatachilla	1201	50%
New South Wales	2390	Baan Baa, Bohena Creek, Bullawa Creek, Couradda, Edgeroi, Eulah Creek, Harparary, Jacks Creek, Kaputar, Narrabi, Narrabi West, Tarriaro, Turrawan	1601	50%
Victoria	3331	Bannockburn, Gheringhap, Maude, Russells Bridge, She Oaks, Steiglitz, Sutherlands Creek	546	37%
Tasmania	7017	Grasstree Hill, Honeywood, Old Beach, Otago, Risdon, Tea Tree	471	27%
Northern Territory	832	Rosebery	580	20%
Australian Capital Territory	2914	Amaroo, Bonner, Forde, Harrison	945	20%

Source: APVI 2017.

Figure 7: Postcodes in Australia that have 50% or more rooftop solar PV, based on residential uptake for suburbs with more than 1,000 dwellings (APVI 2017). The majority of the suburbs are located in southeast Queensland and southwest Western Australia.



4. Renewable Energy Targets and Policies

In the past year, all states and territories have taken steps to expand and strengthen their renewable energy and emissions reduction targets and policies:

- Victoria, the Northern Territory and Tasmania have set new renewable energy targets. The Northern Territory set a target for 50% renewable energy by 2030. Victoria has increased its renewable energy target from "at least 20% by 2020", to 25% by 2020 and 40% by 2025. The Tasmanian Government has announced plans to increase renewable energy generated in Tasmania so that the state would be 100% supplied by renewable energy by 2022 (Tasmanian Government 2017a). The Tasmanian Government has yet to formalise this new commitment in policy.
- The Australian Capital Territory announced the results of its final renewable energy reverse auction, setting the territory on track to achieve its 100% renewable energy target by 2020 (once all projects are completed and operating; e.g. Figure 8).
- South Australia released a new Energy Plan detailing measures for the next stage of the state's energy transition.
- The Queensland Government has made its initial response to its expert panel's final report detailing pathways and recommendations for the state to reach its 50% renewable energy target by 2030.
- New South Wales, Tasmania, Queensland and Victoria adopted new targets to reach net zero emissions by 2050.
- The newly elected Western Australian government has committed to funding for renewable energy and storage research.

All states and territories, except Western Australia, now have strong renewable energy targets or net zero emissions targets in place. The targets in place are broadly consistent with the minimum level of renewable energy needed for Australia to play its part in tackling climate change and transition to net zero emissions by 2050 at the latest (Jacobs 2016).

States and territories are continuing to expand their renewable energy goals and policies.

New South Wales and the Northern Territory have seen the most dramatic positive shifts in policy support for renewable energy since 2016:

- In 2016, the Northern Territory had no specific targets or policies to encourage renewable energy. The Northern Territory now has a target to achieve 50% renewable electricity by 2030, and has appointed an expert panel to develop a roadmap for achieving the target.

- The New South Wales government finalised planning guidelines for wind farms after more than five years of interim guidelines (the lack of final guidelines was creating uncertainty for wind energy developers). The state government also adopted a new target to reach zero net emissions by 2050.

Western Australia is now the only state or territory in Australia without a target for renewable energy or net zero emissions. The newly-elected government has committed to investing in research into renewable energy and battery technology (WA Labor 2016).

States and territories are at different stages in setting renewable energy targets and implementing actions to achieve them. For example, the Australian Capital Territory's renewable energy target has been in place since 2010 and is underpinned by measurable policies and quantifiable actions designed to meet its target, such as the renewable energy reverse auction process. Similarly in South Australia, more than a decade of consistent policy support, ratcheting up of renewable energy targets, and improving complementary planning legislation has established the state as an attractive location

Figure 8: Royalla Solar Farm near Canberra.

for wind (e.g. Figure 9) and solar, as well as battery storage. In contrast, Queensland, Victoria and the Northern Territory have recently set new renewable energy targets and are in the early stages of detailing plans to achieve these targets. States and territories with supportive renewable energy policies are benefiting from investment resulting from federal programs such as the Renewable Energy Target, the Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA).

The Federal Government has no plans to encourage investment in new renewable energy in Australia beyond the existing policy framework set in place prior to the current government's election (the 33,000GWh Renewable Energy Target expected to result in 23.5% renewable electricity in 2020, the Australian Renewable Energy Agency and the Clean Energy Finance Corporation). The Federal Government is currently deliberating on the findings of the Finkel Review into the future of Australia's national electricity market and has initiated a 2017 review of climate policy. Federal funding programs, established in 2011, have been crucial in supporting the growth of renewable energy projects. In 2016, ARENA and CEFC launched and concluded a stimulus program resulting in 12 large-scale solar PV projects being committed and built, catalysing steep reductions in large-scale solar PV project costs, and increasing industry competitiveness. The program is expected to triple Australia's large-scale solar capacity, and attract $1 billion in commercial investment (ARENA 2016).

Figure 9: Brown Hill Wind Farm, South Australia.

4.1 South Australia

BOX 1: SOUTH AUSTRALIA – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- The highest capacity of renewable energy (excluding large hydro) - **1,625 MW.**
- The highest capacity of new renewable energy per person (excluding large hydro).
- The second highest share of renewable electricity generation **(47%)** after Tasmania.
- South Australia had one of the largest increases in its share of renewable energy, driven largely by an increase in wind power and a decrease in coal generation.
- Added the most new renewable energy capacity (120MW) in 2016.

Households

- 30.5% of households with rooftop solar PV – second highest proportion after Queensland.

Policy

- Has a 50% by 2025 renewable energy target, a "zero net emissions" target for 2050 and introduced a new Energy Plan in 2017.

Power on-demand

- Announced plans to build the world's biggest lithium-ion battery storage facility by 1 December 2017.
- A new 150MW solar thermal power plant will supply 100% of the state government's electricity needs.

Sources: Government of South Australia 2015b; ABC 2017b; APVI 2017; Department of Environment and Energy 2017.

After more than a decade of consistent policy support for renewable energy, South Australia has shifted from 99% fossil fuelled electricity in 2003-04 to 47% renewable electricity generation (predominantly wind and solar power) in 2016 (Government of South Australia 2015a; Department of Environment and Energy 2017; Figure 10).

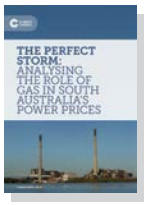
In 2014, South Australia increased its renewable energy target to 50% of electricity produced in the state to come from renewable sources by 2025 (Government of South Australia 2015a). In 2015, the state announced further plans designed to transition the state more quickly to a greater reliance on renewable energy sources whilst ensuring competitive prices, reliable and secure supplies of electricity, and setting in place a state target to achieve "zero net emissions" by 2050 (Government of South Australia 2015a).

A number of significant events have impacted on South Australia's electricity system since the start of 2016, including the closure of the Northern (coal-fired) Power Station; gas-fuelled electricity price spikes in July 2016; a whole-state black out in September (caused by an extreme storm); followed by power outages in December 2016 (due to a transmission fault); and power outages in February 2017 (during a heatwave). These events have focused significant

attention on South Australia, and influenced the establishment of the Independent Review into the future of the National Electricity Market (Finkel Review).

The following Climate Council reports provide more information on recent events in South Australia:

Fact Sheet: South Australian Storms & Power Outages



The Perfect Storm: Analysing the Role of Gas in South Australia's Power Prices

Mythbusting: Electricity Prices in South Australia

On 14 March 2017, the state government responded by publicly announcing a $550 million Energy Plan as the next step in the state's transition to secure its energy future (Government of South Australia 2017). This plan includes:

- Battery storage and renewable technology fund.
- New generation to increase competition, and drive down costs.
- State-owned gas power plant to have stand-by power for emergencies.
- Incentives to source more gas for use in South Australia instead of coal.
- Local powers over the national market.
- Introducing an energy security target to have more locally generated, cleaner and secure energy.

The proposed energy security target has, however, been criticised for its reliance on fossil fuels (particularly gas), increasing consumers' electricity costs by 12-15% per household over the life of the scheme and limiting renewable generation share (Stock 2017).

South Australia generates nearly half of its electricity from wind and solar power.

South Australia will build the largest lithium-ion battery storage facility in the world.

In the past few years, the South Australian Government has supported the rollout of battery storage, seeking tenders to provide battery storage to high profile buildings along North Terrace including the Museum, the State Library and the Art Gallery. The project complements the City of Adelaide's Sustainable City Incentives Scheme that provides rebates to households installing solar PV, battery storage systems and electric vehicle charging systems (City of Adelaide 2015).

Following the announcement of the Energy Plan in March 2017, the South Australian Government called for expressions of interest from the private sector to submit proposals to construct the nation's largest grid-connected battery. All proposals received were subject to a tender process which concluded on 7 July 2017 when the South Australian Government announced that Tesla and renewable energy company Neoen had won the bid. Tesla will now build a 100MW/129MWh lithium-ion battery storage facility by 1 December 2017 which will be paired with Neoen's Hornsdale Wind Farm to store renewable energy for later use, provide stability services for the electricity grid and emergency back-up power (Premier of South Australia 2017).

On 14 August, South Australia announced that a new 150MW solar thermal power plant located in Port Augusta will supply 100% of the state government's electricity needs (Government of South Australia 2017). Solar thermal plants use mirrors to concentrate sunlight and heat molten salt, in turn producing steam which drives the turbine. The solar thermal plant will be the largest of its kind in Australia and will be able to provide reliable, renewable power on-demand with 8-10 hours of storage. Batteries and solar thermal together represent a significant investment in large-scale renewable power that is available day and night and will enhance the reliability and security of the State's power system.

Figure 10: The 91MW Wattle Point Wind Farm on the coast of South Australia.

4.2 Australian Capital Territory

BOX 2: AUSTRALIAN CAPITAL TERRITORY – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- The third highest capacity of new renewable energy per person (excluding large hydro).

Households

- **13.9%** of ACT households have solar PV.
- The ACT is the first state or territory in Australia where both major political parties have provided bipartisan support for its renewable energy target.

Policy

- The third highest share of renewable energy **(22%).**
- More than half **(143MW)** of new renewable energy added in 2016 (built across the ACT, South Australia, Victoria) was supported by the ACT's renewable energy target.
- The ACT has completed its final renewable energy reverse auction putting the territory on track to reach **100%** renewable electricity by 2020.

Sources: ACT Government 2016a; APVI 2017.

The Australian Capital Territory (ACT) has a renewable energy target (for energy consumed) of 100% renewable electricity by 2020. The ACT Government has been progressively transitioning to renewable power sources since 2012, by holding five large-scale renewable energy reverse auctions aimed at purchasing renewable energy from wind and solar projects at the lowest price. The ACT's reverse auctions have supported 600MW of wind power (Figure 11) and 40MW of large-scale solar, with the projects supporting jobs and training opportunities across Canberra, Victoria and South Australia (ACT Government 2015; Climate Council 2016b). The following projects completed construction in 2016: Mugga Lane Solar Farm (13MW), Coonooer Bridge Wind Farm (19.4MW), Hornsdale 1 Wind Farm (100MW) and Willamsdale Solar Farm (10MW).

The ACT is the first state or territory where both major political parties have provided bipartisan support to its renewable energy target. In the context of national policy uncertainty, the ACT was able to capitalise on its "first mover advantage" and a buyer's market, by attracting some of the best renewable energy projects at low prices (Climate Council 2016b). As the Territory Government demonstrated its ability to meet each of its set targets with limited costs through its reverse auction process (Table 7), the ACT could then confidently increase its targets and bring them forward in time (The Sydney Morning Herald 2016). The ACT's leadership on renewable energy shows the positive impact that one small territory can have in a few short years with political will and smart policy design.

Table 7: The size, location and feed-in tariff price for renewable energy reverse auctions in the Australian Capital Territory.

Project name	Size (MW)	Fixed feed-in tariff price for renewable electricity over 20 years	Location	Current status
20MW Solar Auction 2012				
Royalla Solar Farm (Figure 8)	20	$186/MWh	South of Canberra, ACT	Completed 2014
20MW Solar Auction 2013				
Mugga Lane Solar Farm	13	$178/MWh	Tuggeranong, ACT	Completed 2016
Williamsdale Solar Farm	10	$186/MWh	Williamsdale, ACT	Completed 2016
200MW Wind Auction 2014				
Coonooer Bridge Wind Farm	19.4	$82/MWh	Northwest of Bendigo, VIC	Completed early 2016
Hornsdale Wind Farm (Stage 1)	100	$92/MWh	North of Jamestown, SA	Completed 2016
Ararat Wind Farm	80.5	$87/MWh	Northwest of Ballarat, VIC	Completed in early 2017
200MW Wind Auction 2015				
Hornsdale Wind Farm (Stage 2)	100	$77/MWh	North of Jamestown, SA	Under construction, to be completed 2017
Sapphire Wind Farm	100	$89/MWh	Near Glen Innes, NSW	Under construction, to be completed 2018
Next generation solar and wind (plus storage) 2016				
Hornsdale Wind Farm (Stage 3)	109	$73/MWh	Southeast of Port Augusta, SA	Construction to start late 2017, to be completed 2019
Crookwell 2 Wind Farm	91	$87/MWh	Northwest of Goulburn, NSW	Construction to start late 2017, to be completed 2019
Total	**640**			

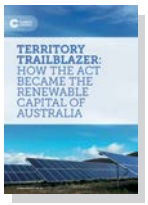
Sources: Renew Economy 2013; Jacobs 2015; ACT Government 2016b.

Successful solar and wind projects under the ACT's reverse auction process have delivered some of Australia's cheapest prices for renewable energy. The prices for successful wind energy projects (ranging from $73-92/MWh) under the ACT's process are equal to or lower than prices for electricity from new coal and gas plants (ranging from $78-91/MWh) (McConnell 2015). The ACT's 2012 and 2013 solar auctions produced some of the lowest prices for large-scale solar at the time, with all projects priced similar to or lower than the Australian industry benchmark of $180/MWh (SKM 2013). Since that time, prices for large-scale solar (including bids in the ACT's 2016 wind and solar auction) have come down substantially (Renew Economy 2016a).

While the ACT has some of Australia's cheapest power prices, from July the Independent Competition and Regulatory Commission increased power prices by 19% (ACT Government 2017b). This increase has been driven by rising wholesale prices in the National Electricity Market – in large part driven by dramatic gas price increases. The ACT's 20-year fixed price contracts to achieve 100% renewable energy from 2020, will partly shield its households and businesses from future wholesale price rises (ACT Government 2017b).

The ACT Government is undertaking one of the largest household battery storage programs in the world. The Next Generation Energy Storage Program aims to provide 36MW of distributed energy storage to households and businesses with battery storage by 2020 (ActSmart 2016).

The following Climate Council report provides more information on the ACT's renewable energy policy:



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

The ACT's renewable energy target is the only state or territory target with bipartisan support.

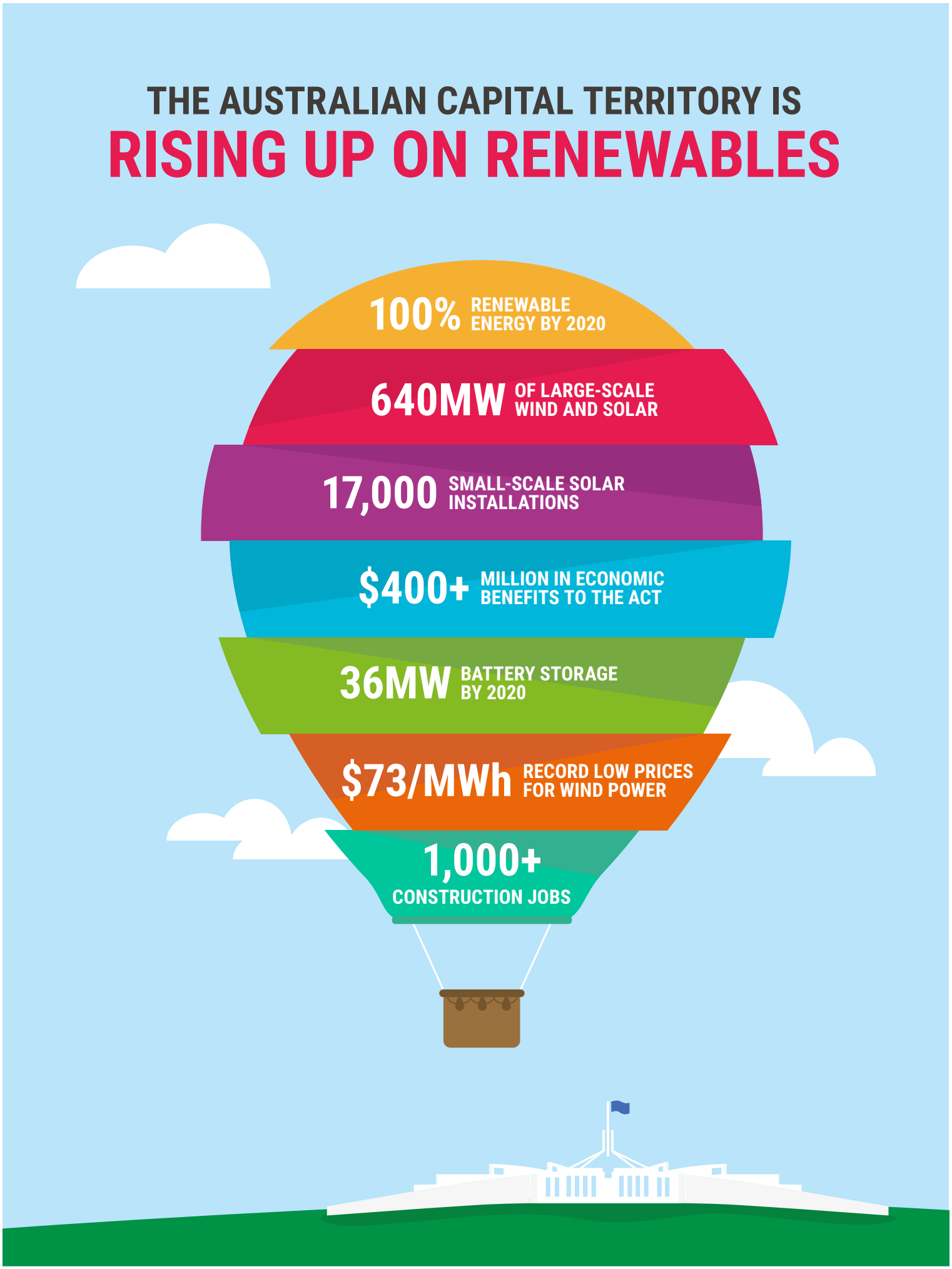


Figure 11: The Australian Capital Territory is leading the way on uptake of renewable energy in Australia.

4.3 Tasmania

BOX 3: TASMANIA – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- The highest share of renewable electricity **(92%)** mostly generated from hydro power (built between 1914-1983).
- The second highest capacity of new renewable energy per person (excluding large hydro), after South Australia.
- Tasmania was the only state or territory where the share of renewable energy fell in 2016 (despite increased generation from hydro, wind and solar). The decreased share of renewable energy was due to increased reliance on gas in response to a months-long outage of the Basslink Interconnector in 2015.
- Tasmania was the only state that added no new renewable energy capacity in 2016.

Households

- **13.2%** of Tasmanian households have solar PV.

Policy

- The Tasmanian Government has committed to 100% renewable energy by 2022 and **net zero emissions by 2050**.

Sources: APVI 2017; Department of Environment and Energy 2017; Hydro Tasmania 2017a; Tasmanian Government 2017a; Tasmanian Government 2017b.

Tasmania has long relied on renewable hydro-electric power to provide the majority of its power needs. Hydro energy is generated from six major water catchments, 50 dams, a number of lakes, and 29 power stations, with a total capacity of more than 2,600MW (Australian Government 2017b). Tasmania also has significant wind generation.

Despite having the highest renewable electricity proportion of any state or territory, Tasmania is yet to introduce detailed policy support for encouraging new renewable energy projects, despite Tasmania's energy strategy seeking to highlight and make the most of its existing "renewable energy advantage" (Tasmanian Government 2015). This strategy aims to reduce energy costs while also positioning Tasmania for a lower emissions future and as an attractive location for businesses such as data centres, silicon smelters and food processing seeking to power their operations by renewable energy. A second interconnection with the mainland states would provide greater opportunity for new renewable energy and energy storage projects in Tasmania.

In June 2017, the Tasmanian Government committed to be "energy self-sufficient", by 100% renewable energy by 2022 and to reaching net zero emissions by 2050 (Tasmania Government 2017a and Tasmanian Government 2017b).

Tasmania's major hydro resources are ideally positioned to supply large-scale pumped hydro energy storage to the mainland grid as renewable supply increases and coal plants close in future (Tasmanian Government

Tasmania is ideally positioned to expand its pumped hydro storage capacity into the future.

2017c). This was highlighted in April 2017, with feasibility studies announced into redeveloping the Tarraleah scheme and improving the Gordon Power Station (ABC 2017c; Figure 12). Pumped hydro energy storage schemes predicted to deliver up to 2,500MW of power are also being considered by ARENA (Hydro Tasmania 2017b). A 2016 Federal-State study which investigated the feasibility of a second interconnector between Tasmania and the mainland reveals that there were various scenarios in which a second cable would be economically viable (Australian Government 2017c).

Figure 12: The Gordon Dam in the Derwent Valley, southwest Tasmania. Gordon is the largest power station in Tasmania.

4.4 Queensland

BOX 4: QUEENSLAND – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- The second lowest share of renewable energy **(7%)** after the Northern Territory.
- The largest number of large-scale renewable energy projects under construction in 2017.

Households

- The highest proportion **(31.6%)** of households with solar PV (Figure 13).

Policy

- A target to reach **50% renewable energy generation** by 2030 and 1 million solar rooftops or 3,000MW of solar photovoltaics by 2020.
- Introduced a target to reach net zero emissions by 2050.

Sources: APVI 2017; Department of Environment and Energy 2017.

In 2016 the Queensland Government tasked an Expert Panel with conducting a public inquiry to investigate pathways to achieving a 50% renewable energy target in Queensland by 2030. In November 2016, the final report "Credible pathways to a 50% renewable energy target for Queensland" was delivered to the Queensland Government. The Queensland Government released its response to the report in June 2017, accepting almost all of the recommendations (Queensland Government 2017a).

The report found that Queensland has a high potential to grow its renewable energy industry as a result of decreasing technology costs, market dynamics and a strong pipeline of proposed large-scale renewable projects (Queensland Renewable Energy Expert Panel 2016a,b). For the state to achieve a 50% target, 4,000-5,500MW of new large-scale renewable energy generation capacity would need to be built by 2030. There are no technical barriers to reaching the 50% target, provided complementary measures are put in place. Achieving the 50% target is projected to be broadly cost neutral to electricity consumers out to 2030. More details of the Key Findings from this report can be found in Box 5.

In a bid to attract large-scale solar projects to Queensland, throughout 2015 and 2016 the Queensland Government collaborated with the Australian Renewable Energy Agency to support the development of 150MW of large-scale solar energy in the state. The purpose of the initiative was to encourage large-scale solar in Queensland, to demonstrate technical and economic feasibility and to facilitate future developments (Queensland Government 2017b). Since this program was undertaken, Queensland has experienced strong growth in its large-scale renewable energy industry, with almost 1,200MW of projects either under construction or having finalised commercial arrangements (at July 2017). To continue the momentum in the sector, the state government has committed

Australia's largest solar power plant has been approved near Wandoan in Queensland.

to undertaking a reverse auction in the second half of 2017 for up to 400MW of renewable energy, which will include 100MW of energy storage (Renew Economy 2017d), although there are no plans in place for more auctions beyond this. Australia's largest solar power plant has recently been approved near Wandoan in Queensland (AFR 2017). When built, the 1,000MW solar farm will be among the largest solar power plants in the world (PV Magazine 2017).

Most recently in July, the Queensland Government announced a new emissions target to achieve net zero emission by 2050 (Queensland Government 2017c).

While the state is actively pursuing a strong renewable energy and net zero emissions target, it is important to note the state support for fossil fuels, principally the opening up of the Galilee Basin for thermal coal and additional areas in the Surat Basin for exploring and developing coal seam gas. The burning of coal, oil and gas are key drivers of climate change. It is now very clear that tackling climate change requires that existing coal mines will need to be retired before they are fully exploited and any new mines simply cannot be built (Climate Council 2017a; 2017b). The emissions increases from extraction and burning of Galilee Basin coal, if development proceeds, will vastly exceed the emissions savings achieved by Queensland achieving its renewable energy targets. Thus, the development of the Carmichael mine in the Galilee Basin, or any new fossil fuel project, is fundamentally at odds with tackling climate change.

Figure 13: Rooftop solar panels at the University of Queensland, Brisbane. Queensland has the highest uptake of rooftop solar of any state in Australia.

BOX 5: HOW QUEENSLAND CAN REACH 50% RENEWABLES BY 2030

The Queensland Renewable Energy Expert Panel was established to provide advice on credible pathways to achieving a 50% renewable energy target for Queensland by 2030 (Queensland Renewable Energy Expert Panel 2016a,b). Some of the key findings from this report are:

- Queensland has **strong potential** to grow its renewable energy industry with a significant pipeline of large-scale projects. As at July 2017, almost 1,200MW of large-scale renewable projects are either under construction or have finalised commercial arrangements, with a further 5,000MW of projects at an earlier stage of investigation.
- To reach the **50% renewable target**, 4,000-5,500MW of new large scale renewable energy production will be required between 2020 and 2030 (e.g. Figure 14).
- Achieving the target will be broadly **cost neutral** for electricity consumers following recovery of the costs of the policy through market mechanisms.
- There is projected to be an increase in **$6.7 billion in investment** (net present value) with an associated **6,400-6,700 full time jobs per annum** in Queensland between 2020 and 2030 as a result of the target.

The Expert Panel suggested the Queensland Government should:

- Support the development of **integrated climate and energy policies at the national level.**
- Not pursue any carbon pricing or other state based economic policy mechanism to achieve the target due to previous Government promises.
- Continue to work with leading authorities on energy to continually assess the need for changes or improvements.

In June 2017, the Queensland Government accepted almost all of the recommendations of the Expert Panel.

Figure 14: Wind farm at Windy Hill, in the Atherton Tablelands. For Queensland to reach its 50% renewable target, significantly more installations of large-scale renewable energy such as wind farms will be required.

4.5 Victoria

BOX 6: VICTORIA – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- **12%** renewable electricity.
- **1,398MW** of renewable energy capacity.

Households

- **15%** of households with solar PV.

Policy

- A renewable energy target of 25% by 2020 and **40%** by 2025.
- A zero net emissions target by 2050.

Sources: APVI 2017; Department of Environment and Energy 2017.

In June 2016, the Victorian Government committed to renewable energy generation targets of 25% by 2020 and 40% by 2025 and a net zero emissions target by 2050 (DELWP 2016a,b). The Victorian Government has recently legislated its renewable energy target. The aim of Victoria's targets is to encourage investment in renewable energy in Victoria and increase the number of jobs, particularly in regional Victoria. The Victorian Government has proposed a reverse auction scheme to achieve its renewable energy targets, designed to deliver up to 1,500MW and 5,400MW of new, large-scale renewable energy projects by 2020 and 2025 respectively (DELWP 2016b). This process follows the Australian Capital Territory's successful use of reverse auctions to obtain low prices for electricity from large-scale solar and wind projects, with contracts awarded to projects that demonstrate the best value for money (Renew Economy 2016c; DELWP 2016b).

In the first quarter of 2016, tenders were sought under the Renewable Certificate Purchasing Initiative (RCPI) for an initial round of large-scale renewable energy projects. Successful projects include the 30MW Kiata Wind Farm and the 66MW (since extended to 132MW) Mt Gellibrand Wind Farm (DELWP 2017). Both wind farms are currently under construction with operation expected to commence in late 2017 and mid 2018 respectively (DELWP 2017). In March 2017, a tender was released as a second stage of the RCPI to build 75MW of solar energy projects in Victoria, to be completed by late 2018. 35MW of the solar generation will be linked to the power usage of Melbourne's entire tram network, resulting in the network being carbon neutral (DELWP 2017). In May 2017, Victoria also announced a $25 million call for proposals from companies to install up to two, 20MW battery storage facilities by January 2018 (DELWP 2017).

The 530MW Stockyard Hill wind farm, set to be Australia's largest wind farm (yet to be built; Figure 15), has set a record low price for renewable energy in Australia of below $60/MWh (Renew Economy 2017c). Further, Victoria could potentially be the first place in Australia to have an offshore wind farm.

Victoria has set a 40% renewable energy generation target by 2025.

A proposal for a 250-wind turbine, 2000MW offshore wind farm by Offshore Energy Pty Ltd has recently been presented to the Victorian government, which if built, could potentially provide 18% of Victoria's electricity needs, capable of powering 1.2 million homes (ABC 2017e; Offshore Energy 2017; Renew Economy 2017e).

In addition to Victoria's commitments on renewable energy, at the same time the state is imposing some restrictions on fossil fuels. This is important given that burning fossil fuels are the key driver of climate change and Victoria has had very high emissions. The Victorian Government has imposed a gas exploration moratorium. The legislation has bipartisan support and puts a permanent ban on onshore unconventional gas exploration in the state, with a moratorium on conventional onshore gas exploration until the end of June 2020 (ABC 2017d).

Figure 15: Victoria is home to Australia's largest wind farm (420MW), the Macarthur Wind Farm. The proposed Stockyard Hill wind farm will have even greater capacity at 530MW.

In July the Victorian Government released its coal policy. While the policy does not impose any new emissions limitations on existing brown coal generators and adopts an "open for business" approach to new uses for brown coal, it requires that any new uses for brown coal are consistent with the state's commitment to reaching net zero emissions by 2050 (Victoria State Government 2017b). It is clear that coal fired power, particularly from highly polluting brown coal, must be phased out in the coming decades.

In April 2017, Victoria's Hazelwood coal power plant closed after nearly 50 years of supplying electricity. The ageing and increasingly inefficient plant was no longer economically viable to operate (Engie 2016). The emissions from Hazelwood contributed about 3% of Australia's total emissions (Figure 16), while it generated about 20% of Victoria's electricity and 5% of electricity in the National Electricity Market (McConnell 2016). It is the ninth coal-fired power generator to close in Australia since 2012, which is part of the ongoing transition to renewables. Since Hazelwood closed and AEMO changed its operating protocols in South Australia, at times of high wind power production in that state, increasingly, South Australia is exporting a mix of surplus wind and gas fuelled power to Victoria, helping to lower that state's emissions.

Figure 16: Hazelwood coal power station in Victoria. This was Australia's oldest and most polluting power station.

4.6 New South Wales

BOX 7: NEW SOUTH WALES – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- **17%** renewable electricity (note that this includes the entire generation from Snowy Hydro).
- New South Wales had one of the largest increases in its share of renewable electricity over the past year. The increase was largely due to a seasonal doubling of hydro generation compared to 2015 due to higher rainfall and storage levels and a doubling of generation from large-scale solar.
- New South Wales has the greatest capacity of new renewable energy under construction in 2017.

Households

- **15%** of households with solar PV.

Policy

- A **net zero emissions** target by 2050.
- Seen one of the most dramatic positive shifts in policy support for renewable energy since 2016.

Sources: APVI 2017; Department of Environment and Energy 2017.

In November 2016, the New South Wales (NSW) Government announced its plan to reach net-zero emissions by 2050. The state government allocated $500 million from its Climate Change Fund over the next five years to help drive investment in making the transition (NSW Government 2017a). To meet its net zero emissions target, the NSW Government has consulted on a range of initiatives including those aimed at attracting investment in new generation capacity and ensuring energy security (NSW Government 2017a). These initiatives will be finalised and announced in Action Plans due to be released in the second half of 2017.

In 2016, the NSW Government undertook the following specific actions to support renewable energy in the state:

- Tendered for 50MW of installed solar capacity from large-scale solar projects (NSW Government 2017b).
- Finalised a new Wind Energy Planning Framework to provide certainty to wind farm developers and communities in the state (NSW Government 2016).

New South Wales have set a net-zero emissions target by 2050.

There are a number of large-scale renewable energy projects under construction, or with construction starting in 2017. In NSW, these projects account for 1,018MW of large-scale renewable energy, the highest capacity under construction or starting in 2017 of any state or territory (Clean Energy Council 2017b). This includes five solar farms that were awarded funding under the Australian Renewable Energy Agency's Competitive Solar Round, boosting NSW's lead in large-scale solar (e.g. Figure 17). A sixth solar farm is under construction near Goulburn and will be Australia's first solar project to be co-located with a major wind farm, making efficient use of the existing network and demonstrating a more reliable and diverse renewable energy model. In addition, the state's three largest wind farms are now under construction at Glen Innes, Inverell and Broken Hill.

Figure 17: Broken Hill solar farm, rural New South Wales. Australia's third largest solar farm has 670,000 solar panels and generates enough electricity to power 10,000 homes.

4.7 Western Australia

BOX 8: WESTERN AUSTRALIA – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- **7%** renewable electricity. The state's proportion of renewable energy did not change in the past year.
- **610MW** of renewable energy capacity.

Households

- The third highest proportion **(25.4%)** of households with solar PV (e.g. Figure 18).

Policy

- Western Australia is now the only state or territory without a target to increase renewable energy or achieve net zero emissions by 2050.

Sources: APVI 2017; Department of Environment and Energy 2017.

Despite its excellent renewable energy resources, Western Australia has lagged behind other states on renewable energy.

The newly-elected Western Australian government has committed to investing in research into renewable energy and battery technology (WA Labor 2016). A $50 million large-scale solar energy project is under construction in Emu Downs, and is expected to create 100 new jobs (Clean Energy Council 2017b).

Following the state election in March 2017, the government:

- Announced the closure of Muja AB coal fired power station units (Renew Economy 2017b).
- Committed $30 million to support the establishment of a solar farm in Collie (Energy Matters 2017).
- Continued support through the Low Emissions Energy Development (LEED) Fund, with contributions up to 25% (Government of Western Australia 2017).

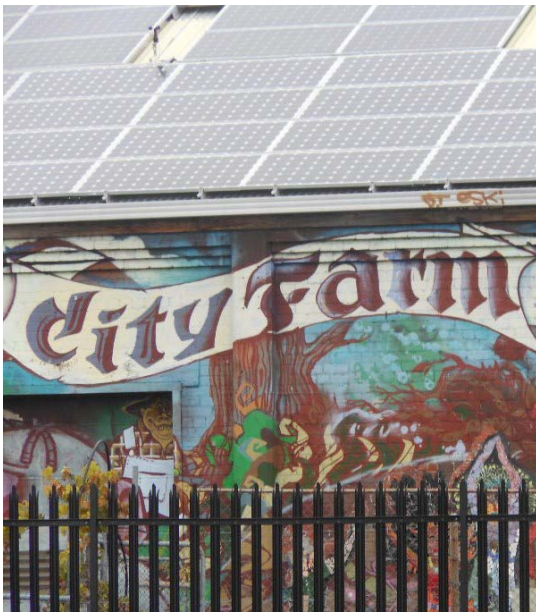


Figure 18: Rooftop solar on City Farm, Western Australia.

4.8 Northern Territory

BOX 9: NORTHERN TERRITORY – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- 2% renewable electricity.
- **18MW** of renewable energy capacity.

Households

- **11%** of households with solar PV.

Policy

- Introduced a new renewable energy target to reach **50% renewable electricity** by 2030.
- Seen one of the most dramatic positive shifts in policy support for renewable energy since 2016.

Sources: APVI 2017; Department of Environment and Energy 2017.

In December 2016, the Northern Territory government announced it will adopt a renewable energy target of 50% by 2030. This puts the Northern Territory in line with other state renewable energy targets such as South Australia, Queensland and Victoria. The target will require significant amounts of new renewable energy capacity to be built within the territory (Renew Economy 2016b).

Like the Queensland Government, the Northern Territory Government has established an expert panel to provide advice on how this target can be reached (Northern Territory Government 2017). The "Roadmap to Renewables Report" will be presented to the Northern Territory government in mid 2017.

Pursuing a 50% renewable energy target is a major step forward for the Northern Territory after very little progress in the past few years, where no specific targets or policies were in place to encourage renewable energy. The Northern Territory has the lowest proportion of households with solar panels (Clean Energy Council 2016; APVI 2017; Figure 19). This is despite high electricity costs, the quality of the solar resource and the most generous feed-in tariff rates in Australia (Climate Council 2014; 2016a).

The Northern Territory has also taken steps on energy storage. By the end of 2017, the Northern Territory's government-owned electricity provider will install a 5MW battery storage system in Alice Springs to support increased generation from solar power (Territory Generation 2017).

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

Figure 19: Solar panels on a hotel roof in Uluru, Northern Territory. The territory has the lowest level of household solar PV uptake of any Australian state or territory.

4.9 Federal: Relying on States and Territories to Meet Emissions Reductions Targets

BOX 10: NATIONAL – RENEWABLE ENERGY FACTS AND STATISTICS

Large-scale renewable power

- **16%** renewable electricity across the country.
- **6,286 MW** of renewable energy capacity.

Households

- 1,662,152 solar PV installations nationally (20% of households with solar PV).

Policy

- **33,000GWh by 2020 renewable energy target** (equivalent to 23.5% of renewable energy by 2020).

Sources: Australian Government (2017a); Clean Energy Council 2016; Clean Energy Regulator 2016a; Clean Energy Regulator 2016b.

The Federal Government has no plans to encourage investment in new renewable energy in Australia beyond the existing policy framework set in place prior to the current government's election (the 33,000GWh Renewable Energy Target expected to result in 23.5% renewable electricity in 2020, the Australian Renewable Energy Agency and the Clean Energy Finance Corporation).

The Finkel Review (Box 11) commissioned by the Council of Australian Governments recommended a Clean Energy Target to replace the Renewable Energy Target from 2020. The Clean Energy Target would encourage new investment in renewable energy (and other lower emissions sources of electricity – how "low" will depend on how the Target is designed) to meet electricity demand and put downward pressure on prices (Finkel 2017). However, the Clean Energy Target remains the only measure out of the Finkel Review's 50 recommendations, which the Federal Government has not yet accepted (The Guardian 2017b).

Renewable energy targets set by the Australian Government are not in line with effectively tackling climate change (Climate Change Authority 2015). Almost all states and territories (except Western Australia) now have higher renewable energy targets or net zero emissions reduction targets which are stronger than the Federal Government.

The targets of states and territories are more in line with the action required to tackle climate change. The targets in place are broadly consistent with the level of renewable

Targets set by the Australian Government are not in line with tackling climate change effectively.

energy needed across Australia by 2030 to keep global temperature rise below 2°C (Jacobs 2016). Further, most states have policies or programs to support investment in renewable energy, while the Federal Government has not implemented any new policies to support renewable energy investment (beyond measures in place before the Government took office).

In its latest budget released by the Federal Government in May, gas was a primary energy focus with $100 million set aside for gas expansion, reforms and pipeline research. This follows recent government support for "clean coal" technologies, which remain polluting, expensive and not economically viable (Climate Council 2017). For instance, the Federal Government has proposed changes to the Clean Energy Finance Corporation to allow funds earmarked for renewable energy to be invested in carbon capture and storage (Financial Review 2017a). The Federal Government is also considering supporting the Carmichael coal mine by offering loan insurance or guarantees, on top of a potential $1 billion loan from the Northern Australia Infrastructure Facility (West 2017).

However, the Federal government has taken some positive steps on energy storage. They have sought feasibility studies for pumped hydro energy storage schemes in New South Wales and Tasmania. In addition, a recent study funded by ARENA revealed 185 potential pumped hydro sites in South Australia. Energy storage will be an important part of Australia's electricity system once renewable energy penetration reaches beyond 30-50% (CSIRO and Energy Networks Australia 2017). In March, the Prime Minister announced a study into a $2 billion federal proposal to expand the Snowy Hydro Scheme through the additional use of pumped hydro storage (The Sydney Morning Herald 2017; Snowy Hydro 2017; Figure 20). The type of generation that drives pumped hydro storage is important. Without an increase in renewable energy, the electricity used to pump the water uphill for pumped hydro energy storage is likely to be generated from coal, which will actually increase emissions because the energy used in pumping the water uphill is not all recovered when it flows down again.

Figure 20: Murray 1 Power Station in New South Wales, part of the Snowy Hydro Scheme. The Australian Government has recently sought feasibility studies into expanding the scheme, as well as expanding the hydro schemes in Tasmania.

BOX 11: FINKEL REVIEW INTO NATIONAL ELECTRICITY MARKET

The independent review into the future of the national electricity market (NEM) led by Australia's Chief Scientist, Dr Alan Finkel, was established by the COAG Energy Council (Australia's federal and state energy ministers) in September 2016. The national electricity market (NEM) is expected to undergo a significant transition this decade, not only as a result of transitioning from fossil-fuelled electricity generation to renewables, but also:

- The rise of storage technology such as batteries.
- Consumer demand to modernise grid rules and infrastructure to create a fairer, smarter, more flexible grid.
- The security of infrastructure in the face of increasingly extreme weather due to climate change.
- Coal closures.
- Trebling of wholesale gas prices and domestic supply shortages.

The key recommendation of the review which relates to renewable energy is a Clean Energy Target (CET), which would create an incentive for new clean energy production after the Renewable Energy Target closes in 2020 (Finkel 2017).

However, this proposed approach to provide Australia with reliable, affordable, secure and low emissions electricity into the future – while in the right direction – falls short of addressing the urgent need to reduce the emissions from Australia's electricity sector.

The Climate Council report Unpacking the Finkel Review outlines concerns relating to how the Finkel Review addresses climate change and renewable energy:

- The modelled 28% emissions reduction for the electricity sector is far too weak even to meet the Federal Government's 2030 targets.
- Power generated by renewable energy in 2030 under the proposed Clean Energy Target – at 42% – is far too low for Australia to meet its fair share of emissions reductions.
- Gas and coal with carbon capture and storage are polluting and should not qualify under a Clean Energy Target.
- Requirements on new generation should be technology neutral, not act as a restriction on wind and solar development, which the Generator Reliability Obligation does by only applying to new wind and solar.
- Australia needs to phase out coal, quickly. The Finkel Review does not place any requirement on coal plants to close (other than recommending a three-year notice of closure for generators).
- The Review claims that "gas contributes to emissions reduction". However, gas is not significantly less polluting than coal and risks locking-in high emissions for decades.

Unpacking the Finkel Review

Appendix A – Summary of State and Territory Renewable Energy Measures

Table A1: Overview of state and territory renewable electricity measures - scoring methodology.

			At the starting blocks			Just off the pace		Frontrunners		
State/ Territory	Source	Scoring method	NT (C)	WA (C)	NSW (C)	VIC (B)	QLD (B)	ACT (A)	TAS (A)	SA (A)
Renewable Electricity (%)	Department of Clean Energy Regulator 2016 Environment and Energy 2017	*** 50%+ **20%+ *10%+	2	7	17	12	7	20	92	47
Capacity (excluding large hydro) Per Capita (kw/cap)	Clean Energy Council 2017a	*** 0.6+ ** 0.4+ * 0.2+	0.1	0.2 *	0.1	0.2 *	0.2 *	0.4 **	0.6 ***	0.9 ***
Solar Households (%)	APVI 2017	*** 30%+ ** 20%+ * 10%+	11% *	25% **	15% *	15% *	32% ***	14% *	13% *	31% ***
Renewable Electricity Targets	State and territory websites and information	*** Target and detailed plan ** Target * Policy support	50% by 2030 **	*	*	25% by 2020 40% by 2025 **	50% by 2030 **	100% by 2020 ***	100% by 2022 (Yet to formalise target in policy) *	50% by 2025 ***
Net zero emissions targets	State and territory websites and information	** Target			Net zero emissions by 2050 **	Net zero emissions by 2050 **	Net zero emissions by 2050 **	Net zero emissions by 2050 **	Net zero emissions by 2050 **	Net zero emissions by 2050 **
Progress since 2016	State and territory websites and information		Expert panel and consultation on approach to Renewable Energy Target.		Continued policy support. Largest capacity of new projects under construction.	Renewable Energy Target legislated.	Initial response to Renewable Energy Target. Largest no of new projects under construction.	Final reverse auction.	Renewable % falling. No new projects added in 2016 and none under construction in 2017.	SA Energy Plan. 100MW Battery announcement.
	TOTALS		3	4	5	7	8	10	10	13
		2016 Scores	-	(C)	(D)	(C)	(C)	-	(B)	(A)

Appendix B – Top Solar Postcodes in Australia

Table A2: Top solar postcodes in Australia with 50% or greater installations for suburbs with more than 1,000 dwellings.

Postcode	Suburbs	State	Installations	Capacity
6171	Baldivis	WA	69%	11636kW
4516	Elimbah	QLD	63%	2797kW
4270	Tamborine, Tamborine Village	QLD	57%	2417kW
6035	Yanchep	WA	56%	3032kW
6122	Byford, Cardup, Darling Downs, Karrakup	WA	56%	6420kW
4280	Jimboomba, Maclean, North Maclean, South Maclean, Stockleigh	QLD	55%	9228kW
4512	Bracalba, Wamuran, Wamuran Basin	QLD	54%	2032kW
4511	Godwin Beach, Ningi, Sandstone Point	QLD	53%	4774kW
4504	Narangba	QLD	53%	9477kW
6170	Leda, Wellard	WA	53%	3576kW
4514	Bellthorpe, Cedarton, Commissioners Flat, D'aguilar, Delaneys Creek, Mount Delaney, Neurum, Stanmore, Stony Creek, Villeneuve, Woodford	QLD	53%	3970kW
4505	Burpengary	QLD	53%	11655kW
4306	Amberley and 61 other areas	QLD	51%	19487kW
4520	Camp Mountain and 16 other areas	QLD	51%	7805kW
4553	Diamond Valley, Glenview, Mooloolah Valley, Palmview	QLD	50%	3177kW
4124	Boronia Heights, Greenbank, Lyons, New Beith	QLD	50%	9969kW
5171	Blewitt Springs, Mclaren Flat, Mclaren Vale, Pedler Creek, Tatachilla	SA	50%	5495kW
5157	Ashbourne, Bull Creek, Cherry Gardens, Clarendon, Coromandel East, Dorset Vale, Kangarilla, Mcharg Creek	SA	50%	2163kW
6180	Lakelands, Parklands	WA	50%	1863kW
5172	Dingabledinga and 12 other areas	SA	50%	2911kW
4125	Munruben, Park Ridge, Park Ridge South	QLD	50%	4020kW
2390	Baan Baa and 12 other areas	NSW	50%	4879kW

Source: Australian PV Institute 2017.

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