

# BRIDGING THE GAP TO 82% RENEWABLE ELECTRICITY GENERATION BY 2030

AUGUST 2023



# FOREWORD



**The Clean Energy Council commissioned this Green Energy Markets report to outline the scale of the commitments and build that Australia needs in order to meet its 82 per cent renewable energy target by 2030.**

This target is not only essential for replacing Australia's ageing and unreliable coal-fired power generation with lower-cost, flexible and cleaner plant, but it also underpins Australia's national emissions reduction commitments.

The renewable energy capacity in the system today, combined with the existing commitments to new build, gets us to around 46 per cent renewables by the end of the decade. We will need an extra 100,000 GWh (100 TWh) of new clean and flexible renewable generation (beyond what is already anticipated) in order to bridge the gap to 82 per cent.

To deliver this new generation, we will need in the order of 6.9 GW of large-scale capacity and 3.6GW of rooftop solar to come online each year in the second half of this decade.

Both the large-scale renewables and rooftop solar sectors will need to invest and deploy at record levels to achieve this big build in the next seven years. Rooftop solar deployment has been consistently strong in recent years and this effort must continue and strengthen over the remainder of the decade. In the large-scale renewable energy sector, however, project commitments have been slowing.

There is no shortage of clean energy investment interest in Australia, nor of available projects. There are over 160,000 MW of onshore wind and solar farm projects in the development pipeline.

The task for Australia is to convert that strong investor appetite into investment commitments and boots on the ground through smart, enabling policies and reforms that can unleash the hundreds of billions of dollars of investment that is waiting in the wings.



**Kane Thornton**

Chief Executive  
Clean Energy Council

August 2023

# INTRODUCTION

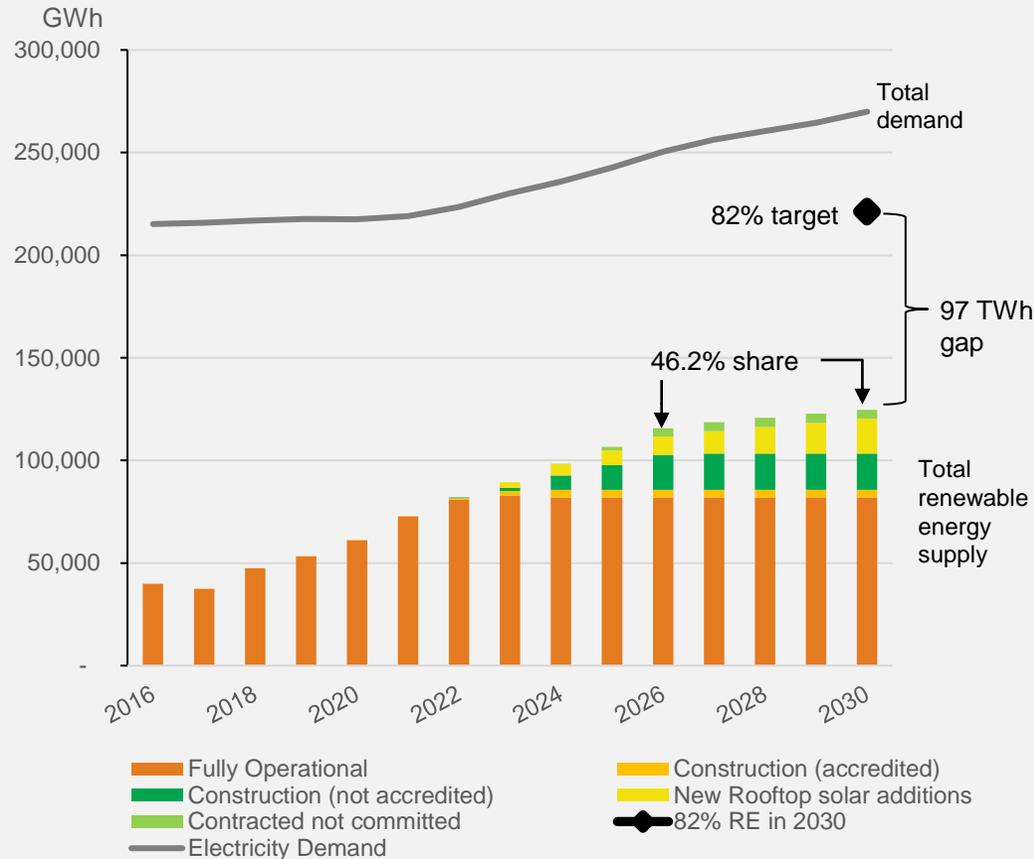


- A foundational element in achieving the Australian Government's international climate change commitment of a 43 per cent reduction in the nation's carbon emissions (relative to 2005 levels), is that it will substantially decarbonise Australia's electricity system. This hinges on the Government's goal to grow the share of renewable energy to 82 per cent of Australia's electricity consumption.
- This will be important not just to reduce emissions from the electricity sector, but also from transport and direct heating in homes and businesses. This is because these sectors will rely on electrical energy to substitute out of more emissions-intensive fossil fuel sources of energy (petroleum and methane gas).
- This report attempts to quantify the amount of additional new renewable energy construction commitments Australia needs to make if the Federal Government is to achieve its target of having 82 per cent of electricity consumption met from renewable energy by 2030. It also seeks to put this into context by comparing the annual rate of new additions of renewable energy generation relative to what has unfolded in the recent past.
- The report essentially provides a baseline on the level of renewable energy which we can be reasonably confident will be in place over the years to 2027, based on large-scale projects which are already in operation, committed to construction or which are contracted, as well as likely future installations of rooftop solar photovoltaics (PV).
- Further capacity commitments will undoubtedly come over the next few years, but the issue is whether they will come forward at the scale and speed necessary to meet the Australian Government's climate change commitments.
- This report examines the three electricity grids serving Australia's capital cities across each state and territory: the National Electricity Market (the NEM), the Western Australian South-west Integrated System (SWIS) and the Northern Territory's Darwin-Katherine Integrated System (DKIS). These represent around 90 per cent of Australia's electricity consumption.
- This report was commissioned by the Clean Energy Council, Australia's peak body for the renewable energy sector, to help inform policy makers and interested stakeholders on the scale of the task ahead and the speed with which it needs to be achieved.
- The analysis within this report is based largely upon a database that Green Energy Markets maintains of all renewable energy projects in Australia which are either in operation, under construction or which have been contracted under a long-term power purchase agreement but are yet to be committed to construction.
- This database contains forecasts of the likely amount of power generation each project will produce on an annual basis.
- In addition, Green Energy Markets produces regular forecasts of the likely future levels of rooftop solar PV installations across Australia. These have historically been used by both the Clean Energy Regulator and the Australian Energy Market Operator (AEMO) to help inform their planning and activities. These forecasts have been used in combination with analysis produced by AEMO and the Northern Territory Government.

# REACHING AUSTRALIA'S 82 PER CENT TARGET REQUIRES SUBSTANTIAL ADDITIONAL NEW RENEWABLE ENERGY GENERATION



**Demand for electricity versus renewable energy supply across the NEM, WA SWIS and NT DKIS**



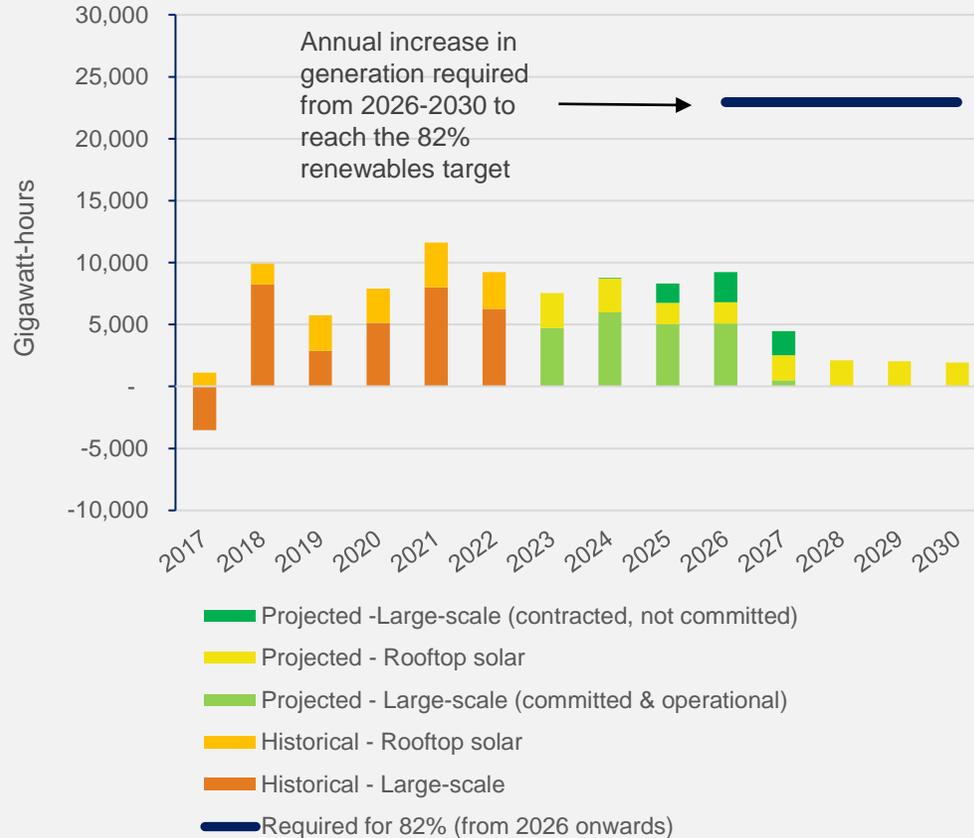
Note: Demand is for the electricity consumed at the customer site, excluding transmission and auxiliary losses and inclusive of solar PV. Supply is based on electricity generation after deducting transmission and auxiliary losses. Projects under construction are divided into those which are already accredited with the Clean Energy Regulator and therefore relatively close to becoming fully operational and those which are yet to be accredited.

- The chart to the left illustrates the results from Green Energy Market’s analysis.
- The grey solid line at the top represents aggregated demand for electricity as estimated by AEMO under its most probable scenarios for the NEM and SWIS, as well as the Northern Territory Government for the DKIS. The kink upwards in demand from 2022 is a product of AEMO’s expectation of increased demand for electricity as a product of electrification of transport and heating demand.
- The solid-coloured segments of the stacked bars represent supply from large-scale renewable energy projects which are already in operation, under construction or contracted, as well as projected rooftop solar. These are expected to generate almost 116TWh by the year 2026, representing 46.2 per cent share of consumption. After 2026 there is little growth in generation from projects already committed or contracted, although rooftop solar generation continues to grow. This growth in rooftop solar however, is only sufficient to maintain the renewable energy share at 46.2 per cent by 2030.
- In order to reach the 82 per cent share target by 2030 there needs to be substantial investment in additional new renewable energy capacity capable of generating almost 97 TWh per annum by 2030. See page 7 for an analysis of the capacity of physical plant required to meet this electricity generation gap.

# THE RATE OF BUILD TO REACH 82 PER CENT RENEWABLE ENERGY WILL HAVE TO ACCELERATE DRAMATICALLY



Annual incremental growth in renewable energy across the NEM, WA SWIS and NT DKIS



Notes: Estimates of generation are after deducting transmission and auxiliary losses. Net renewable generation declined in 2017 due to a combination of little investment in new capacity in the preceding years due to threats by the Abbott Government to reduce or abolish the Renewable Energy Target Scheme, and a large fall in hydro generation in 2017.

- The chart to the left details in each of the stacked bars the annual incremental increase in the level of generation from renewable energy since 2016, including what is highly probable into the future based on projects under construction or contracted, as well as new additions of rooftop solar capacity.
- The dark blue horizontal line at the top right shows the level of annual average generation increase that is required from 2026 onwards if the grids of the NEM, SWIS and DKIS were to achieve 82 per cent renewables by 2030. Due to lags between when government announces an initiative or contracts a project and when a project can complete construction and commissioning, there is a limited degree to which governments can change renewable energy generation levels in advance of 2026.
- As the chart clearly illustrates, there is a large gap between what is required to achieve the Government’s 82 per cent renewable energy target in the blue line and the level of growth in renewable energy generation achieved historically, as well as what will occur over the next few years based on highly probable additions to supply.
- **Achieving the target will require a 240 per cent expansion in annual additions of new generation from 2026 to 2030 to 23,000GWh, compared to the average annual additions achieved over the past three years of 9,600GWh.**
- While a range of government and private sector entities have announced intentions to scale up their level of contracting and/or construction of renewable energy, they will need to convert these intentions into firm commitments to construct projects far more rapidly than what has been evident to date.

# ELECTRICITY PRODUCTION IN REMOTE AREAS: FURTHER BEHIND IN ACHIEVING THE TARGET



- While this study has focussed its analysis on the National Electricity Market, Western Australia's SWIS and Northern Territory's DKIS, consideration of other sources of electricity demand (such as the Pilbara, Alice Springs and Mt Isa grids as well as remote mines and communities) would not materially change the substance of the findings.
- This is partly because these other sources of demand are small relative to the grids in scope. According to the Australian Government's 2022 Emission Projections, just 10 per cent of Australia's electricity generation in 2030 will come from demand outside these three grids. Based on our own numbers this would equate to around 30,000GWh of demand per annum.
- In addition, this off-grid and minor grid demand lags the NEM and SWIS in terms of the adoption of renewable energy. According to the Australian Government's 2022 Emission Projections, new renewable energy generation serving these loads reaches 3,500GWh by 2035. This equates to a renewable energy share of just 11.6 per cent for this segment of Australian electricity demand.
- If anything, this suggests the rate of new build to meet the Government's 82 per cent renewables target is slightly larger than what our analysis indicates.



# SCALE OF PHYSICAL PLANT REQUIRED

## Average capacity required to come online *each year* between 2026-2030



**5400MW**  
Wind capacity



**1500MW**  
Utility-scale solar capacity



**3600MW**  
Rooftop solar capacity

- **Our analysis suggests Australia needs to be adding around 23 TWh of additional new renewable energy generation each year from 2026 to 2030.** What this equates to in terms of the physical plant required is a function of the mix of fuel types that make economic and commercial sense in the future and is subject to considerable uncertainty. However, as an indicative guide, in AEMO's 2022 Integrated System Plan they estimated that wind would provide 68 per cent of the growth in renewable generation to 2030, distributed solar PV (mainly on rooftops) would provide 20 per cent, and the remainder (12 per cent) would come from utility-scale solar farms.
- **Assuming wind produced 68 per cent of the 23 TWh in annual generation growth, 5400MW of wind capacity needs to become operational each year from 2026 onwards.** As some context, last year Australia committed 3,120MW of wind capacity to construction which was a record high and will come online progressively over the next few years. Looking further back, since 2017 the average committed per year has been just under 1,700MW. This fuel-type is where the scale-up looks to be most pressing and challenging.
- **In terms of distributed solar, around 3600MW of capacity would need to come online each year for it to deliver its 20 per cent share of the 23TWh.** We are not too far behind in this case - last year around 2,800MW of small-scale solar PV was installed and in 2021 it was 3,192MW.
- **Lastly, we estimate around 1500MW of utility scale solar would need to become operational each year from 2026 for it to deliver 12 per cent of the 23 TWh in annual generation growth.** This is not out of keeping with historical levels of commitments. More than 1,900MW was committed to construction last year and the average committed per annum since 2017 has been running at just under 1,800MW.
- While the lead times for rooftop solar installations are quite short, for utility scale wind and solar farms lead times between construction commitment and full commissioning are around 2 years (but can be longer for large projects). **This suggests that we really need to be seeing annual construction commitments for 6900MW of wind and solar farms as soon as the 2024 calendar year.**
- It is important to note that there are more than enough renewable energy projects under development in Australia to easily cover the gap to reach the 2030 target. Green Energy Markets' database of projects in the development pipeline contains over 70,000MW of onshore wind projects and 90,000MW of solar farms.
- In addition, the level of capacity required for Australia to reach its 2030 targets is small relative to global wind and solar industry production. In the single year of 2022 there was 78,000MW of wind capacity installed and 191,000MW of solar PV globally.

# IMPLICATIONS OF THIS ANALYSIS WITHIN CONTEXT OF OTHER RENEWABLE ENERGY PROJECTIONS



- The Australian Government's 2022 Emissions Projections and AEMO's Integrated System Plan under its Step Change scenario project a significantly higher proportion of renewable energy within Australia's electricity systems than the estimates within this report.
- This is because both of these analyses project that a very large amount of new renewable energy capacity will be constructed beyond what is currently committed. This report has only considered supply that will come from projects already committed to construction or which are reasonably likely to be committed to construction because they have secured a long-term buyer.
- With respect to rooftop solar PV, this report uses projections that are also taken into account by AEMO and the Emissions Projections because this market is not amenable to a bottom-up project by project analysis but still needs to be taken into account to obtain useful results on future renewable energy market share.
- It is important that stakeholders and policy makers appreciate that the scale of renewable energy construction envisaged under both the Integrated System Plan and the Emissions Projections is not something that should be considered a fait accompli. Instead these projections make a series of pivotal assumptions, particularly about future actions by governments. These are based on governments' intentions, but which are in most cases still yet to be thoroughly implemented.
- However, if governments do not follow through in full and on a timely basis to implement actions to achieve their intentions, then the amount of renewable energy that is built will most likely fall below what is projected in the Emissions Projections and the Integrated System Plan.
- This report's analysis shows that the very large scale-up in renewable energy construction required to achieve 82% renewables cannot in any way be taken for granted. The scale of the renewable energy development pipeline and the capability of the renewable energy industry means it should be within the country's abilities to achieve this scale-up, but there is clearly little time left to waste.
- Governments' ambitions and targets need to be urgently converted into concrete actions that will spur a major scale-up in construction commitments well beyond what has been achieved to date.

# METHODS AND SOURCES



- **Large-scale electricity supply**

- Estimates of electricity generation from large-scale renewable energy projects are based upon Green Energy Market's Renewable Energy Project Database as at the end of April 2023. This database contains a listing of every individual renewable energy project (that is either registered or will be registered under the Large-Scale Renewable Energy Target) within Australia that is either operating, under construction or contracted under a long-term power purchase agreement but not yet committed to construction. Each individual project has its annual historical generation recorded (where relevant) as well as projections of average annual generation up until 2030. These generation estimates are after deducting auxiliary and transmission losses in order to be consistent with the way that certificates are awarded under the Large-Scale Renewable Energy Target.
- In cases where projects are already fully operational we estimate generation based on historical generation averages and current transmission loss factors.
- For projects not yet fully operational we apply generalised long-run capacity factors for each technology which are informed by historical average performance across a range of other projects using the same technology. We then also apply a transmission loss factor. In some cases this will be adjusted to account for differences seen across locations. For example, Victorian solar farms have a lower capacity factor than those located in inland Queensland.
- Also for projects which are not yet fully operational we apply construction completion schedules to determine when to phase in their output. These are based on a combination of project owner statements about likely completion, AEMO's Generation Information, construction times achieved by similar projects in the past, and where the project is energised, its generation profile and evidence of commissioning progress.

- **Electricity demand**

- This analysis is based on underlying electricity consumption incorporating electricity consumed from on-site generators. It deliberately omits efficiency losses from electricity that is consumed by power stations themselves (auxiliary losses) and lost in transmission.
- Within AEMO's NEM demand forecasts this is a combination of what they term "native demand" as well as estimates of rooftop solar PV generation. This report uses AEMO's 2022 Electricity Statement of Opportunities' Central Scenario for this demand data.
- For the WA SWIS we use AEMO's 2022 WEM Electricity Statement of Opportunities "Underlying Demand" estimate in their Expected Demand Scenario.
- For the NT DKIS we use the Northern Territory's Darwin-Katherine Electricity System Plan's Seek Different Scenario's estimate of "Underlying Demand".

- **Rooftop solar PV**

- For the WA SWIS we use AEMO's 2022 WEM Electricity Statement of Opportunities estimate in their Expected Demand Scenario.
- For the NT DKIS we use the Northern Territory's Darwin-Katherine Electricity System Plan's Seek Different Scenario estimate.
- For the NEM we use AEMO's projection in its Progressive Change scenario within the 2022 Integrated System Plan. We have opted to use this projection instead of its projection under the Step Change scenario because the modelling underlying the Step Change projection assumes a range of government policies to support solar PV and battery uptake which have not been adopted.

# APPENDIX – PROJECTS INCLUDED IN ANALYSIS WHICH ARE NOT YET FULLY OPERATIONAL (1/3)



The projected generation of renewable energy from utility scale projects is derived from projects already in operation as well the projects listed here, which are currently either in construction or have secured a power purchase agreement (PPA).

State	Construction status	CER accreditation	Primary Fuel Source	CER Project Name	Capacity (MW)
SA	PPA not committed	PPA not committed	Solar	Cultana Solar Farm	280
SA	Under Construction	Approved	Solar	Mannum Adelaide Pumping Station No 2 (MAPL2) - Solar	16.854
SA	Under Construction	Approved	Solar	Murray Bridge - Onkaparinga Pipeline Pump 2 (MU3322)	13.023
SA	Under Construction	Approved	Solar	PAREP 1 PTY LIMITED-SOLAR WIND- SA	107
SA	Under Construction	Pending assessment	Solar	Happy Valley Water Filtration Plant (HAWWTP) - Solar - S	8.37
SA	Under Construction	Pending assessment	Solar	Tailem Bend 2 Solar Farm	87
SA	Under Construction	Under construction	Solar	ADELAIDE DESALINATION PLANT - STAGE 2	13.52
SA	Under Construction	Under construction	Solar	Adelaide Desalination Plant solar farm Stage 1	11
SA	Under Construction	Under construction	Solar	Astronergy Solar Project 2 - SA	5
SA	Under Construction	Under construction	Solar	BOLIVAR WASTEWATER TREATMENT PLANT RESER	8.25
SA	Under Construction	Under construction	Solar	Green and Gold projects for Astronergy	24.34
SA	Under Construction	Under construction	Solar	Kerta Rd Mypolonga Solar Farm	5.3
SA	Under Construction	Under construction	Solar	MANNUM ADELAIDE PUMPING STATION NO 3 - MAPL	16.215
SA	Under Construction	Under construction	Solar	Mannum Solar Farm Stage 2	30
SA	Under Construction	Under construction	Solar	Moyhall Solar Farm	5
SA	Under Construction	Under construction	Wind	Goyder South Stage 1a Wind Farm	209
SA	Under Construction	Under construction	Wind	Goyder South Stage 1b Wind Farm	203
VIC	PPA not committed	PPA not committed	Solar	Carwarp Solar Farm	100
VIC	PPA not committed	PPA not committed	Solar	Derby Solar Project	95
VIC	PPA not committed	PPA not committed	Solar	Frasers Solar Farm	77
VIC	PPA not committed	PPA not committed	Solar	Fulham Solar Farm	80
VIC	PPA not committed	PPA not committed	Solar	Horsham Solar Farm	118.8
VIC	PPA not committed	PPA not committed	Solar	Kiamal Solar Farm Stage 2	150
VIC	PPA not committed	PPA not committed	Wind	Woolsthorpe Wind Farm	70
VIC	Under Construction	Approved	Wind	Berrybank 2 Wind Farm - Wind - VIC	109.2
VIC	Under Construction	Approved	Wind	Mortlake South Wind Farm - VIC	157.5
VIC	Under Construction	Under construction	Solar	Cosgrove Solar Farm	4.95
VIC	Under Construction	Under construction	Solar	Eastern Treatment Plant Solar Farm	19
VIC	Under Construction	Under construction	Solar	Girgarre Solar Farm	93
VIC	Under Construction	Under construction	Solar	Glenrowan Solar Farm	102
VIC	Under Construction	Under construction	Solar	Mangalore Renewable Energy Project	4.99
VIC	Under Construction	Under construction	Solar	Winneke Treatment Plant (Christmas Hills) Solar Farm	9
VIC	Under Construction	Under construction	Solar	Wunghnu Solar Farm	90
VIC	Under Construction	Under construction	Wind	Golden Plains Wind Farm Stage 1	756
VIC	Under Construction	Under construction	Wind	Hawkesdale Wind Farm	96.6
VIC	Under Construction	Under construction	Wind	Ryan Corner Wind Farm	218

# APPENDIX – PROJECTS INCLUDED IN ANALYSIS WHICH ARE NOT YET FULLY OPERATIONAL (2/3)



The projected generation of renewable energy from utility scale projects is derived from projects already in operation as well the projects listed here, which are currently either in construction or have secured a power purchase agreement (PPA).

State	Construction status	CER accreditation	Primary Fuel Source	CER Project Name	Capacity (MW)
NSW	PPA not committed	Yet to be approved	Solar	Myocum (Byron Bay Council) Solar Farm	4.9
NSW	PPA not committed	Yet to be approved	Wind	Uungula Wind Farm	414
NSW	Under Construction	Approved	Solar	New England Solar Farm - NSW	400
NSW	Under Construction	Approved	Wind	Bango Wind Farm 1, feeder 973 - NSW	159
NSW	Under Construction	Approved	Wind	Bango Wind Farm 2, feeder 999- NSW	84.8
NSW	Under Construction	Yet to be approved	Solar	Avonlie Solar Farm-NSW	200
NSW	Under Construction	Yet to be approved	Solar	Moorebank Logistics Park (MLP)	60
NSW	Under Construction	Yet to be approved	Solar	Mulwala Waters Solar Farm	4.99
NSW	Under Construction	Yet to be approved	Solar	Narromine Renewable Energy Project	4.99
NSW	Under Construction	Yet to be approved	Solar	Stubbo Solar Farm	400
NSW	Under Construction	Yet to be approved	Solar	Wagga Wagga North Solar Farm - Stage 2	19.644
NSW	Under Construction	Yet to be approved	Solar	Walla Walla Solar Farm	300
NSW	Under Construction	Yet to be approved	Solar	Wellington North Solar Farm	400
NSW	Under Construction	Yet to be approved	Solar	West Wyalong Solar Farm - Solar - NSW	107
NSW	Under Construction	Yet to be approved	Solar	Wollar Solar Farm	280
NSW	Under Construction	Yet to be approved	Solar	Wyalong Solar Farm	52.5
NSW	Under Construction	Yet to be approved	Wind	Crookwell 3 wind farm	58
NSW	Under Construction	Yet to be approved	Wind	Flyers Creek Wind Farm	145
NSW	Under Construction	Yet to be approved	Wind	Rye Park Wind Farm	396
QLD	PPA not committed	Yet to be approved	Wind	Mount Hopeful Wind Farm	350
QLD	Under Construction	Approved	Solar	Columboola Solar Farm - QLD	162
QLD	Under Construction	Approved	Solar	Gangarri Solar Farm - Solar - QLD	120
QLD	Under Construction	Approved	Solar	Moura Solar Farm - Solar - QLD	110
QLD	Under Construction	Approved	Solar	Woolooga Solar Farm - Solar - QLD	176
QLD	Under Construction	Approved	Wind	Kaban Wind Farm - Wind Power - QLD	157
QLD	Under Construction	Approved	Wind	Kennedy Energy Park - Wind and Solar - QLD	58.2
QLD	Under Construction	Pending assessment	Solar	Mica Creek Solar Farm - Solar - QLD	88
QLD	Under Construction	Pending assessment	Solar	Wandoan Solar Farm 1	125
QLD	Under Construction	Yet to be approved	Bagasse	Tableland Mill upgrade	24
QLD	Under Construction	Yet to be approved	Solar	Edenvale Solar Park - Solar - QLD	204
QLD	Under Construction	Yet to be approved	Solar	Kingaroy Solar Farm	40
QLD	Under Construction	Yet to be approved	Wind	Clarke Creek Wind Farm Stage 1	450
QLD	Under Construction	Yet to be approved	Wind	Diamondy Wind Farm (Wambo) Stage 1	252
QLD	Under Construction	Yet to be approved	Wind	Dulacca Renewable Energy Hub	180
QLD	Under Construction	Yet to be approved	Wind	Karara Wind Farm	103
QLD	Under Construction	Yet to be approved	Wind	MacIntyre Wind Farm	923

# APPENDIX – PROJECTS INCLUDED IN ANALYSIS WHICH ARE NOT YET FULLY OPERATIONAL (3/3)



The projected generation of renewable energy from utility scale projects is derived from projects already in operation as well the projects listed here, which are currently either in construction or have secured a power purchase agreement (PPA).

State	Construction status	CER accreditation	Primary Fuel Source	CER Project Name	Capacity (MW)
WA	PPA not committed	PPA not committed	Wind	Flat Rocks Wind Farm Stage 2	100
WA	Under Construction	Under construction	Other Biomass	East Rockingham Resource Recovery Facility	28.9
WA	Under Construction	Under construction	Other Biomass	Kwinana Waste-to-energy plant	32
WA	Under Construction	Under construction	Wind	Flat Rocks Wind Farm Stage 1	76
NT	Under Construction	Approved	Solar	Batchelor Pell - Solar - NT	10
NT	Under Construction	Approved	Solar	Batchelor Solar Power Station - Solar - NT	10
NT	Under Construction	Approved	Solar	Katherine Solar Power Station - Solar - NT	25
NT	Under Construction	Approved	Solar	Manton Dam Solar Power Station - Solar - NT	10
NT	Under Construction	Under construction	Solar	Robertson Barracks	10.874



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