

RENEWABLE PROJECTS QUARTERLY REPORT

Q4 2023

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We respectfully acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the lands and waters on which we work and live. We commit to collaborate with First Nations communities, to promote sustainable practice, protect ancient sites and culture with equitable access to the benefits of clean energy. Sovereignty has never been ceded. We acknowledge Elders, past and present, and their continuing culture and connection to Country.

HIGHLIGHTS

Key points:

- Record-breaking quarter for large-scale storage investment decisions
- Uptick in financial investment decisions for large-scale generation, but dramatic acceleration needed
- A number of projects either commenced construction or were commissioned, however overall rate of deployment continues to lag behind required target of 6GW per annum of large-scale energisation

Storage rallies to surpass record breaking second quarter for new investment

Large-scale energy storage sprinted to the 2023 finish line with six projects, representing 2,140 MW (installed capacity)/4,680 MWh (energy generation) financially committed for the final calendar quarter. These impressive results included three projects each with an energy generation capability of at least 1,000 MWh. These were:

- the Melbourne Renewable Energy Hub (600 MW installed capacity / 1,600 MWh energy)
- the Blackstone Battery Project (500 MW / 1,000 MWh), and
- the Liddell Battery (500 MW / 1,000 MWh).

The Melbourne Renewable Energy Hub commenced construction in the same quarter.

The Q4 large-scale storage results broke all records which were previously achieved in Q2 of 2023, notably with a new installed capacity record of 2,140 MW (previously 1,497 MW), energy generation at 4,680 MWh (3,802 MWh) and investment passing the \$2 billion mark for the second time at \$2.3 billion* (previously \$2.1 billion).

The newly revised rolling 12-month quarterly energy storage average of 2,274 MWh passed the 2,000 MWh mark for the first time ever. The rolling average for investment also broke a significant milestone, passing the \$1 billion mark for the first time at \$1.2 billion, a 90 per cent increase on the rolling average when compared to the previous quarter.

The state with the largest share of financially committed storage projects in terms of energy was Victoria with 785 MW / 1,970 MWh, while Queensland had the most projects (three) reaching this stage.

*Figure most likely higher as not all projects provide publicly available capital investment data

HIGHLIGHTS

New generation projects continue to lag behind required targets

Large-scale renewable energy generation projects in Q4 recorded their best quarterly return for the year, with four projects totalling 747 MW achieving financial close during the period. The largest project committed was the Aldoga Solar Farm in Queensland, contributing over half of the total quarterly project capacity with 380 MW.

Despite Q4 rallying to become the best-performing quarter of 2023 in terms of new financially committed projects, this did not prevent the year from recording the lowest level of new financial investment commitments to large-scale generation projects – just 1.3 GW - since the Clean Energy Council began recording data in 2017.

The rolling 12-month quarterly average for financially committed generation projects fell for the fourth consecutive quarter and, at 315 MW, this average is now at its lowest level since the CEC began tracking project investments in 2017. This was a drop of over 50 per cent when compared to the rolling average of Q3.

From an investment perspective, Q4 recorded \$1.1 billion worth of financially committed large-scale renewable energy projects. This was an improvement on previous quarters for 2023, however it remained substantially lower than the \$4.3 billion recorded over the same period 12 months ago. As such, the rolling 12-month quarterly average for investment of financially committed renewable generation projects fell by 67 per cent to \$380 million. This is the first time the rolling average has fallen below the \$1 billion mark since Q4 2022.

This slowdown in new financially committed generation projects highlights challenging project development conditions – including higher supply chain costs, drawn out planning and environmental assessment processes in some jurisdictions, uncertainty relating to long-term policy settings, and the legacy of a decade of under-investment in our transmission network.

Movement seen along construction stages of project pipeline

740 MW of installed capacity for generation projects moved into construction, with building commencing at Aldoga Solar Farm, Bell Bay Solar Farm, Bostocks Creek Solar Farm and Culcairn Solar Farm (three of these projects reached financial commitment in the same quarter). This was 57 per cent larger than the amount of generation projects which commenced construction in the same quarter 12-months ago.

Meanwhile, 1,060 MW / 2,520 MWh of energy storage projects also commenced construction. Combined, these projects totalled \$2.7 billion worth of investment for renewable projects commencing construction for the quarter. These projects were:

- the Eraring Battery Storage System (BESS) – Stage 1 (460 MW installed capacity / 920 MWh energy)
- the Melbourne Renewable Energy Hub (600 MW / 1,600 MWh).

HIGHLIGHTS

New projects reach completion and connect to the grid

Four renewable generation projects were commissioned in Q4, representing 677 MW of new installed capacity in the grid, and \$905 million worth of investment. These were the Avonlie Solar Farm, Dulacca Renewable Energy Project, Edenvale Solar Farm and Northern Goldfields Solar Farm. Meanwhile, two storage projects worth 160 MW / 305 MWh reached commissioning: the Northern Goldfields Solar Farm BESS and Riverina Energy Storage System.

A large pipeline of generation and storage projects are under development

As at 31 December 2023, there were 119 generation and storage projects which have either reached financial commitment or are under construction. This equates to 12.3 GW generation project capacity, as well as 7.6 GW / 16.1 GWh of energy projects. Overall, 210 generation and storage projects have now been commissioned since 2017, contributing 16 GW of generation projects and 1.8 GW / 2.4 GWh of storage projects.

Note: Project data is retrospective, and so is subject to change depending on updated public information.

CEC definitions

Financial commitment: publicly available information stating that a project's financing agreements have been signed and the owner can begin drawing on the financing to commence work on the project.

Under construction: publicly available information that a project started construction work.

Commissioned: publicly available information that a project is fully completed and operational (a project that is currently operational and not commissioned falls under the category under construction).

Q4 2023 PROJECT TRACKER

Name	Owner	Type	State	MW (MWh)
Amrun Solar Farm	Aggreko	Solar	QLD	12
Blackstone Battery Project	Octopus	Storage	QLD	500 (1,000)
Brendale Battery	Akaysha Energy	Storage	QLD	205 (410)
Koorangie Energy Storage System	Edify Energy	Storage	VIC	185 (370)
Liddell Battery	AGL Energy	Storage	NSW	500 (1,000)
Ulinda Park BESS	Akaysha Energy	Storage	QLD	150 (300)

Table 1. Generation and storage projects reaching financial commitment

Name	Owner	Type	State	MW (MWh)
Aldoga Solar Farm	Acciona/Stanwell Corporation	Solar	QLD	380
Bell Bay Solar Farm	Diamond Energy	Solar	TAS	5
Bostocks Creek Solar Farm	Bison Energy	Solar	VIC	5
Culcairn Solar Farm	Bouygues Construction	Solar	NSW	350
Eraring BESS – Stage 1	Origin Energy	Storage	NSW	460 (920)
Melbourne Renewable Energy Hub	Equis / SEC	Storage	VIC	600 (1,600)

Table 2. Generation and storage projects commencing construction

Name	Owner	Type	State	MW (MWh)
Avonlie Solar Farm	Iberdrola	Solar	NSW	245
Dulacca Renewable Energy Project	Octopus	Onshore Wind	QLD	180
Edenvale Solar Farm	Sojitz/ENEOS Corporation	Solar	QLD	204
Northern Goldfields Solar Farm	BHP	Solar	WA	48
Northern Goldfields Solar Farm BESS	BHP	Storage	WA	10 (5)
Riverina Energy Storage System	Edify Energy	Storage	NSW	150 (300)

Table 3. Generation and storage projects reaching commissioning

View our [project tracker](#) for further details on all projects.

Note: Projects which have reached multiple stages in the same quarter have only been included in the latest stage.



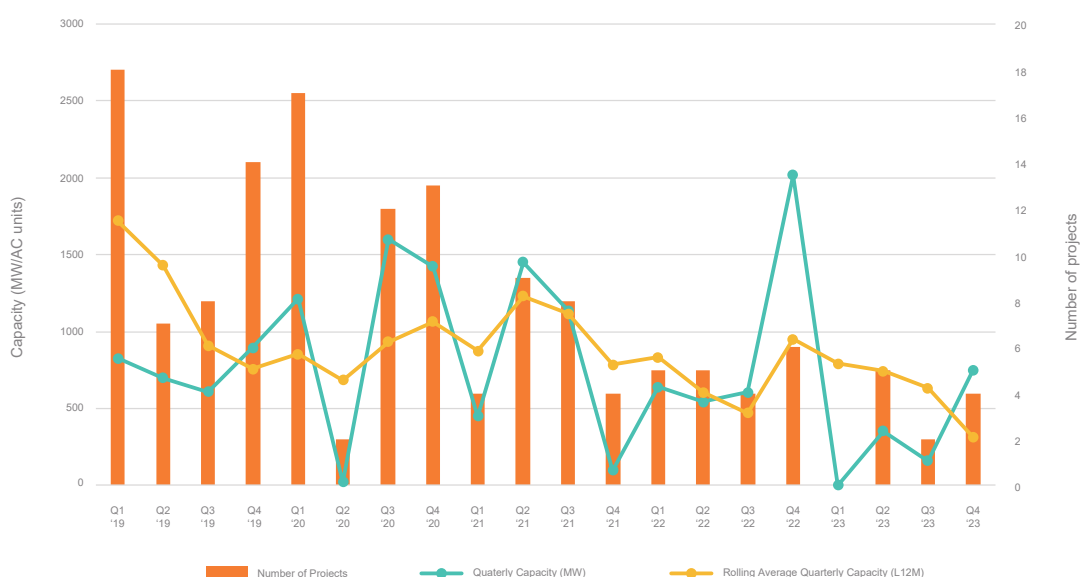
GENERATION PROJECTS

Generation project installed capacity

2023 saw the lowest level of new large-scale renewable generation capacity reaching final investment decision since the Clean Energy Council began tracking project data in 2017.

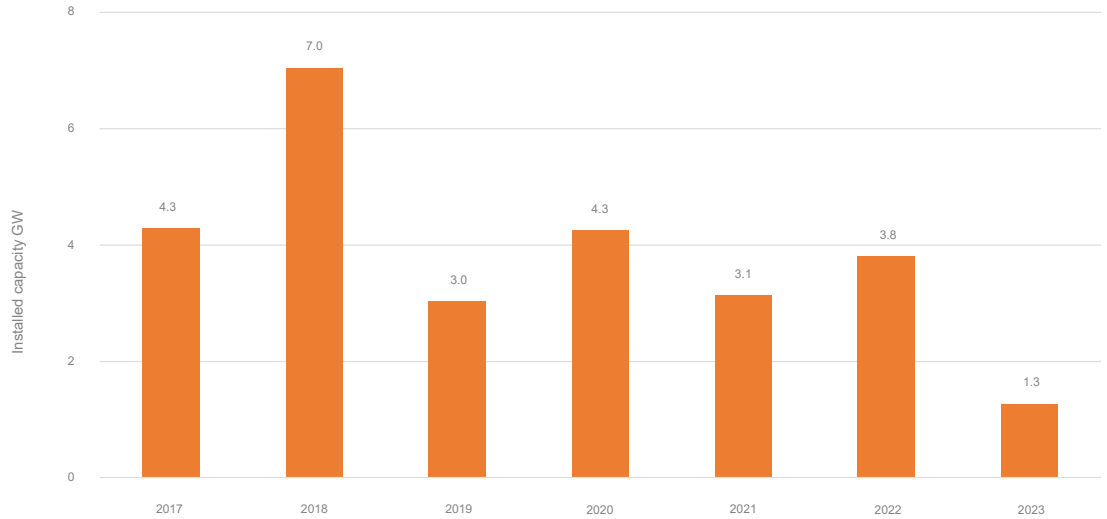
This reflects challenging project development conditions, complexity in the connection process, uncertainty relating to long-term policy settings, and the legacies of a decade of underinvestment in our transmission network. The 1.3 GW was over a third of the total seen in 2022 at 3.8 GW. The chart below shows the rolling average of quarterly capacity now dipping below 500 MW for only the second time in the last five years.

Financially committed generation projects and megawatt capacity (by quarter)

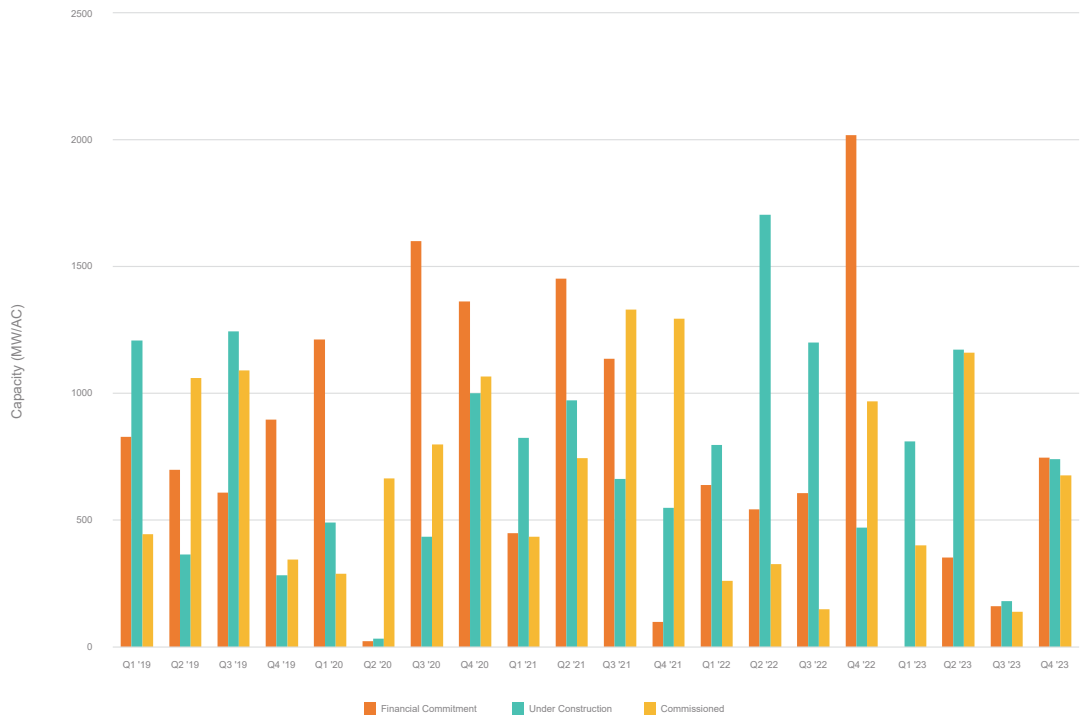


GENERATION PROJECTS

Total annual gigawatts of financially committed generation projects



Total capacity of generation projects by development status, quarterly



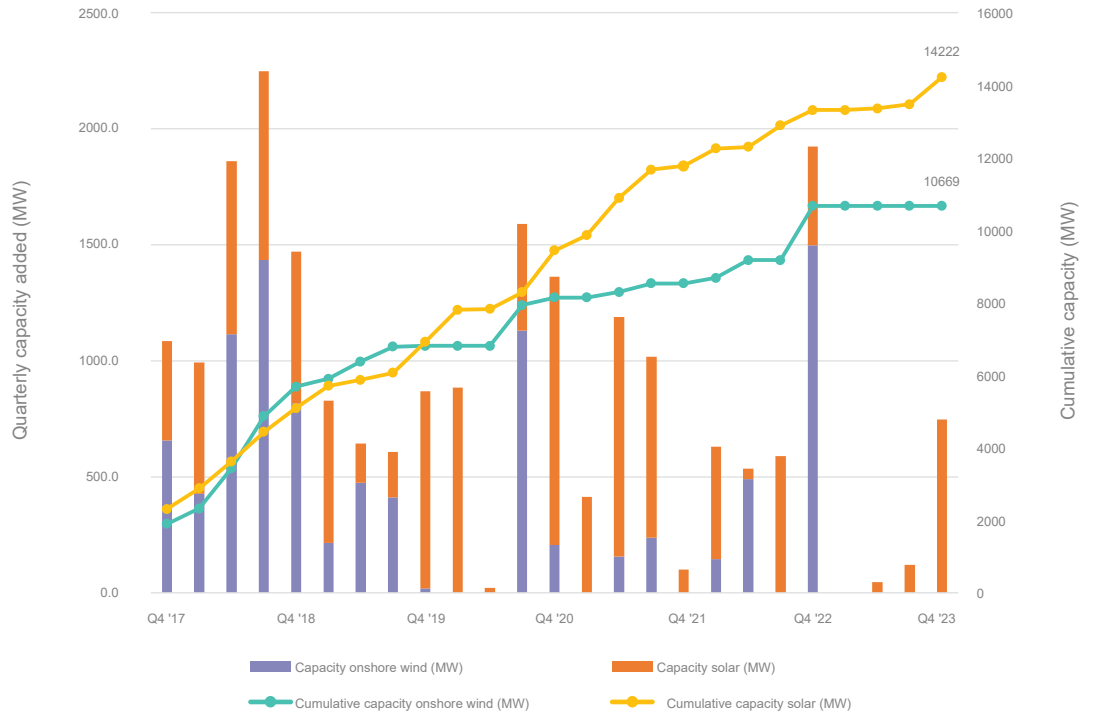
	Financially committed	Under construction	Commissioned
Q4 generation project count	4	4	4
Q4 generation project installed capacity	747 MW	740 MW	677 MW
2023 generation project count	11	20	14
2023 generation project installed capacity	1,261 MW	2,903 MW	2,436 MW

Table 4. Quarterly and annual breakdown of generation projects by development stage

Note: Projects which reach multiple stages have been included in each stage

Onshore wind and solar installed capacity comparison

Since late 2020, large-scale solar has continued to pull away from onshore wind in terms of cumulative installed capacity added, with totals of 14.2GW and 10.7GW added respectively since 2017.



There are many implications for system and market operation that may flow from this divergence of wind and solar investment. Wind and solar are complementary, and a balanced mix of both types of technology supports more stable operation of the power system and is key to keeping costs down for consumers.

There are a number of factors likely impacting on wind generation investment relative to solar, including technical connection issues and social licence considerations. It's critical these specific issues are addressed as quickly as possible, in order to support balanced investment across both forms of renewable generation technology.

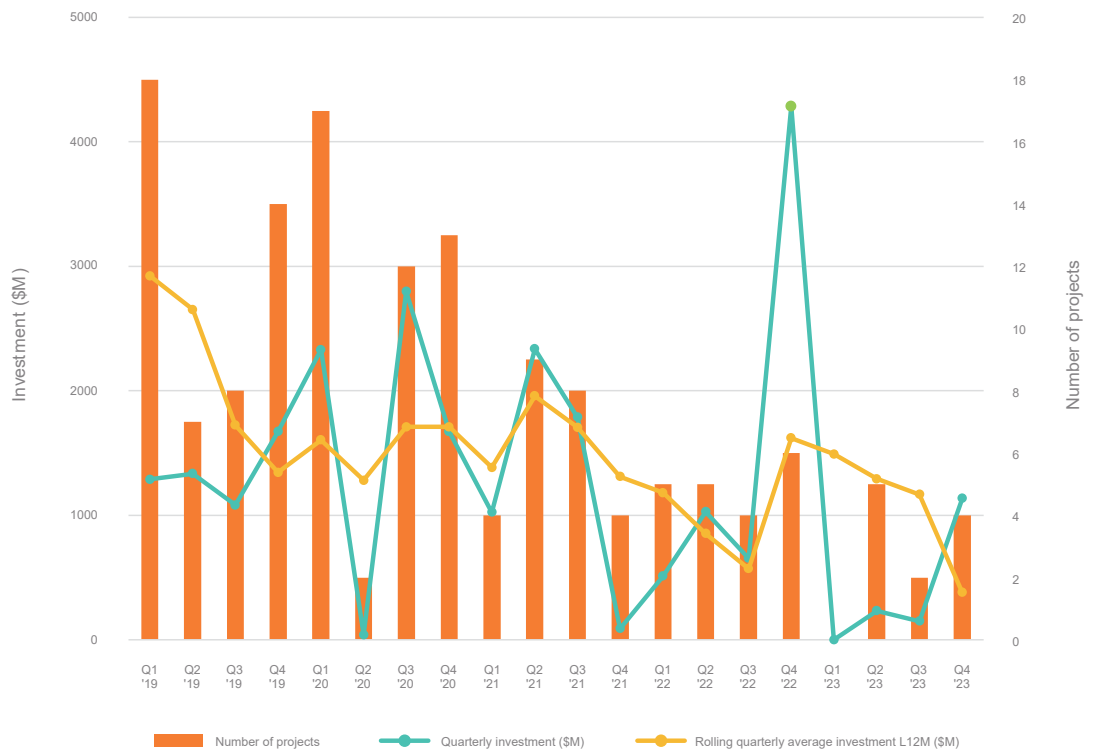
GENERATION PROJECTS

Generation project investment

Investment commitments to new large-scale renewable generation projects in Q4 surpassed \$1.1 billion, the highest quarterly result for 2023. Despite this small uplift within the year, it was a long way from the record breaking quarter seen 12 months prior (\$4.3 billion).

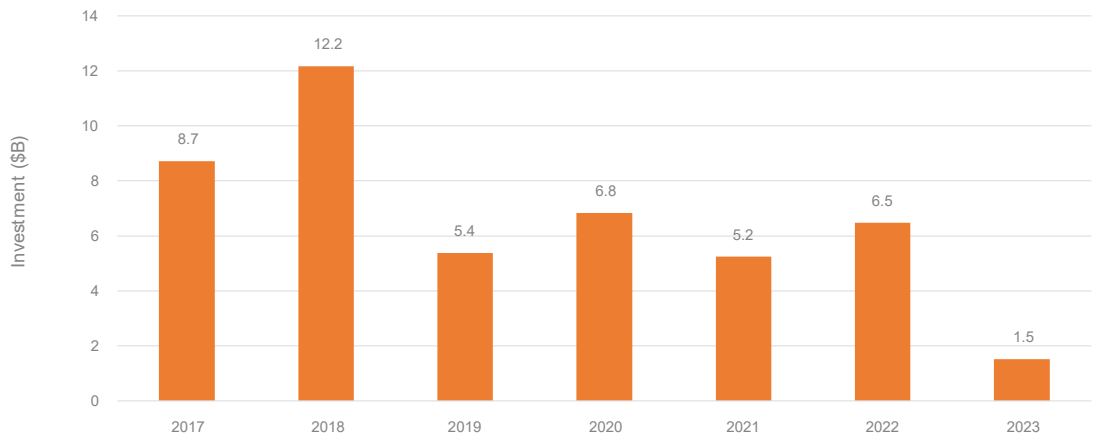
The rolling 12-month quarterly average has continued a downward trend seen since the beginning of 2019, with only four brief upticks over this period.

Financially committed generation projects and investment (\$), by quarter.





Total annual investment of financially committed generation projects



	Financially committed	Under construction	Commissioned
Q4 generation project investment	\$1.1 billion	\$1.1 billion	\$905 million
2023 generation investment	\$1.5 billion	\$4.9 billion	\$3.6 billion

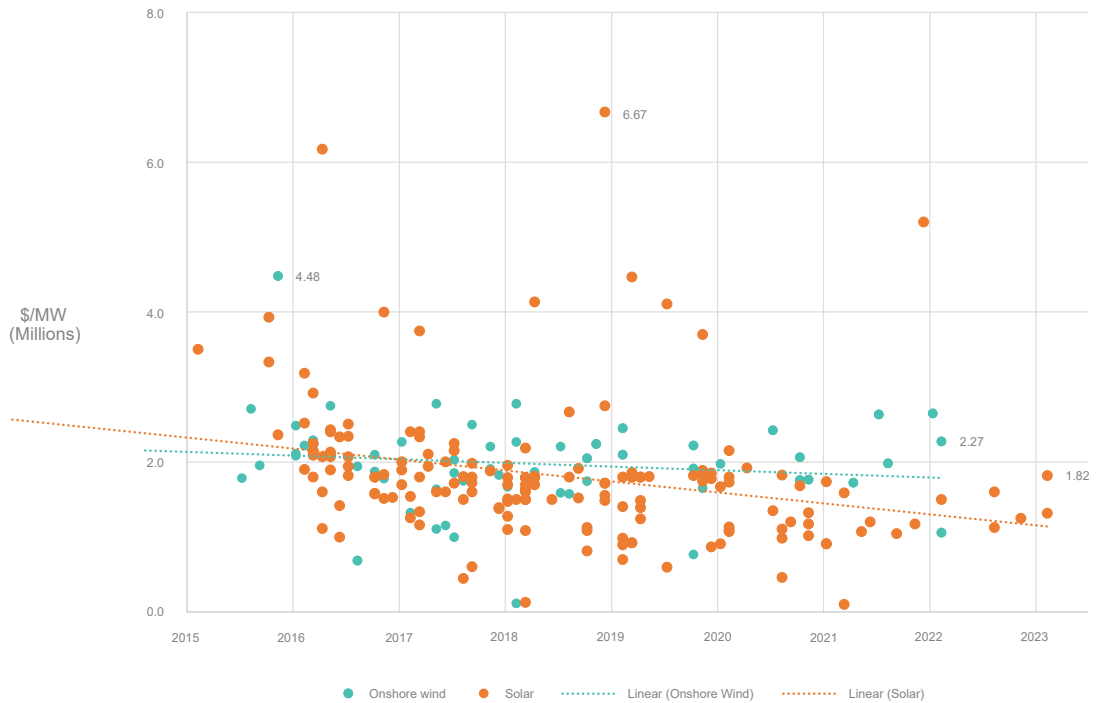
Table 5. Quarterly and annual breakdown of generation project investment by development stage

GENERATION PROJECTS

Generation project capital investment spend per MW

The below chart shows the relationship between the amount of capital investment required for each MW of capacity of generation projects. Expressed in terms of millions, all solar and onshore wind projects which reached financial commitment from 2017 onwards have been included to view the trend over time. It is typically expected that as technologies and project delivery systems mature, costs will decrease, and this is reflected in the downward trend seen for both these technology types. Ultimately a continuation of this trend will place further downward pressure on the cost of delivering energy for consumers.

\$/MW for wind and large-scale solar projects

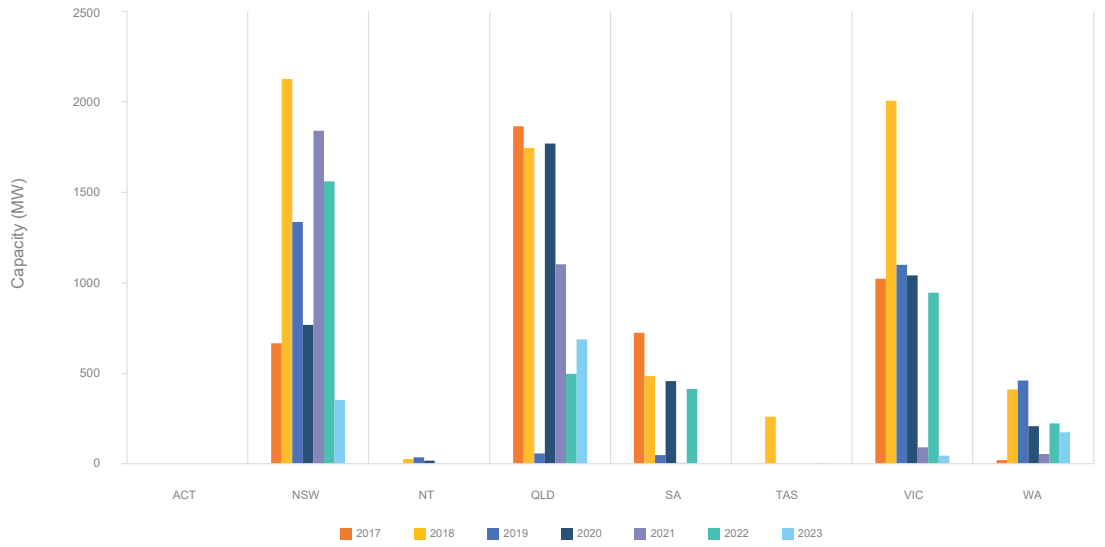


GENERATION PROJECTS

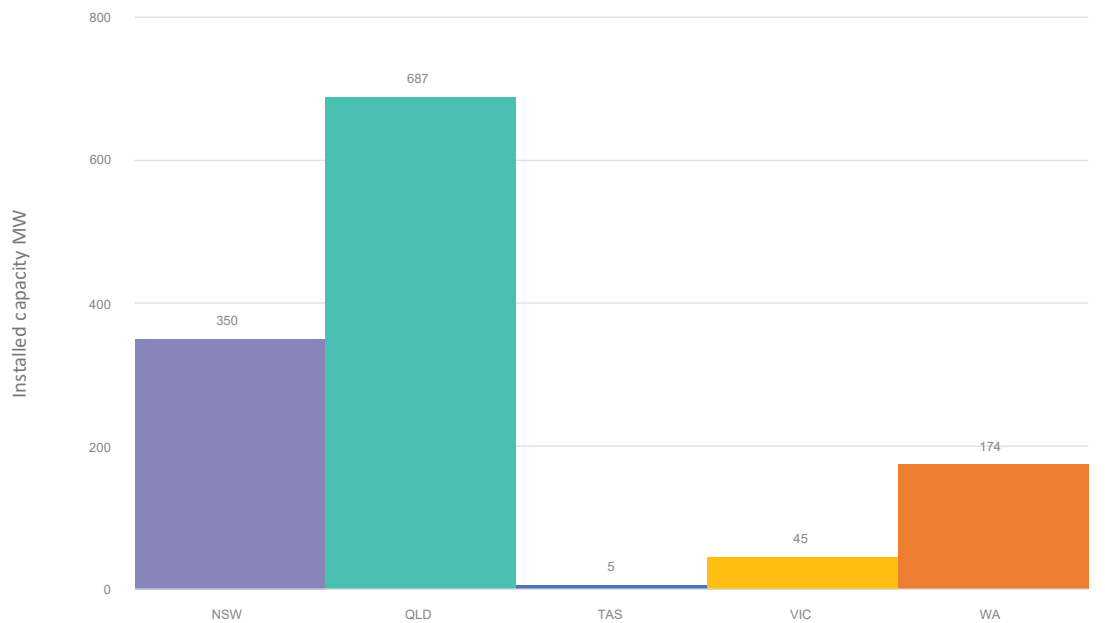
Generation projects by state

Eleven large-scale renewable energy generation projects reached financial close across Australia in 2023, totalling 1,261 MW. Queensland led the way amongst the states for most projects, with four projects contributing 687 MW. This was followed by Western Australia with three projects totalling 174 MW.

Total annual financial commitments for large scale generation, by state (MW)



Total capacity of projects financially committed in 2023, by state



GENERATION PROJECTS

On average across Australia, it takes solar projects six months less than wind projects to progress from financial commitment to the final commissioned stage. South Australia leads all states when it comes to average commissioning time for all technology types.

Commissioned project duration by state & tech (months)

State	Solar	Onshore wind	Storage
VIC	17	24	19
NSW	20	29	N/A
QLD	22	N/A	N/A
SA	16	21	17
WA	20	N/A	30
Total average by tech:	19	25	22

Table 6. Project completion time – from financial commitment to commissioning**

*Average based on solar, onshore wind and storage projects that have reached commission since 2017.

**The stated timeframe excludes the project development phases (e.g. Project design, planning & environmental assessments etc.) prior to Financial Commitment.

***Each technology type needs to have at least five commissioned projects in a state for the average to be included.

As highlighted in Table 6 above, there are a number of reasons for, and implications of, the divergence in the number of wind versus solar generation projects that are reaching the financial investment decision stage. The figures above illustrate another dimension of this divergence, where wind projects are tending to take longer to get through the connection and commissioning process relative to solar.

Technical issues relevant to wind generation are likely a key culprit here, however construction complexities may also play a role. While wind energy projects are important for supporting electricity system reliability and suppressing the total system costs, they are typically more costly and complex to design, develop and connect than large-scale solar plants.

The Clean Energy Council is focussed on addressing many of these issues through processes such as the Connection Reform Initiative and reforms to the System Strength frameworks.

STORAGE PROJECTS

2023 concluded as the most successful year on record for large-scale energy storage projects, with a total of 3,949 MW / 9,095 MWh, and \$4.9 billion worth of investment commitments for the calendar year. Q4's total of 4,680 MWh of energy generation was more than double the newly revised rolling 12-month quarterly average of 2,274 MWh, with both figures alone reaching new records for highest individual quarter total and highest ever rolling average total, respectively.

While the Melbourne Renewable Energy Hub was the largest battery to reach financial commitment for the quarter at 600 MW / 1,600 MWh, it fell just short of being the largest battery of the year. This title went to the Waratah Super Battery at 850 MW / 1,680 MWh.

Turning to the latter development stages also highlights why 2023 was the year of the battery, with 2,539 MW / 6,032 MWh commencing construction, and a further 757 MW / 1,028 MWh worth of projects becoming operational. Forecasts have predicted the strong storage results seen from 2023 to continue into 2024.

	Financially committed	Under construction	Commissioned
Q4 storage project count	6	2	2
Q4 storage project energy generation	4,680 MWh	2,520 MWh	305 MWh
Q4 storage project investment	\$2.3 billion	\$1.6 billion	\$215 million
2023 storage project count	15	8	8
2023 storage project energy generation	9,095 MWh	6,032 MWh	1,028 MWh
2023 storage project investment	\$4.9 billion	\$2.9 billion	\$995 million

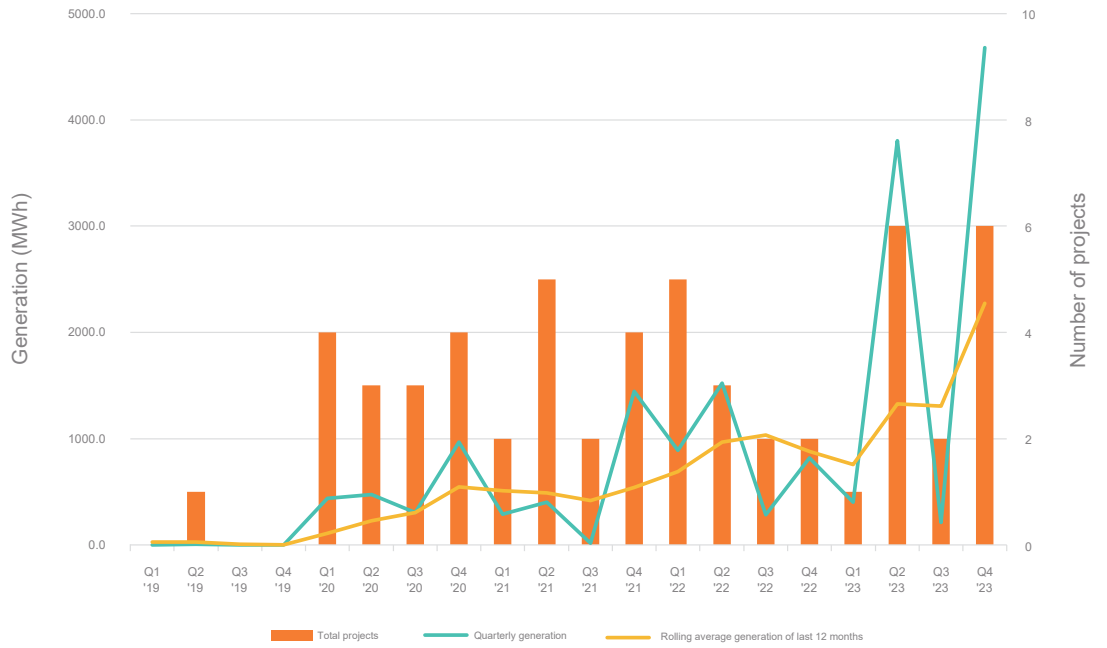
Table 7. Quarterly and annual breakdown of storage projects by development stage

Note: Includes hybrid projects with a storage component

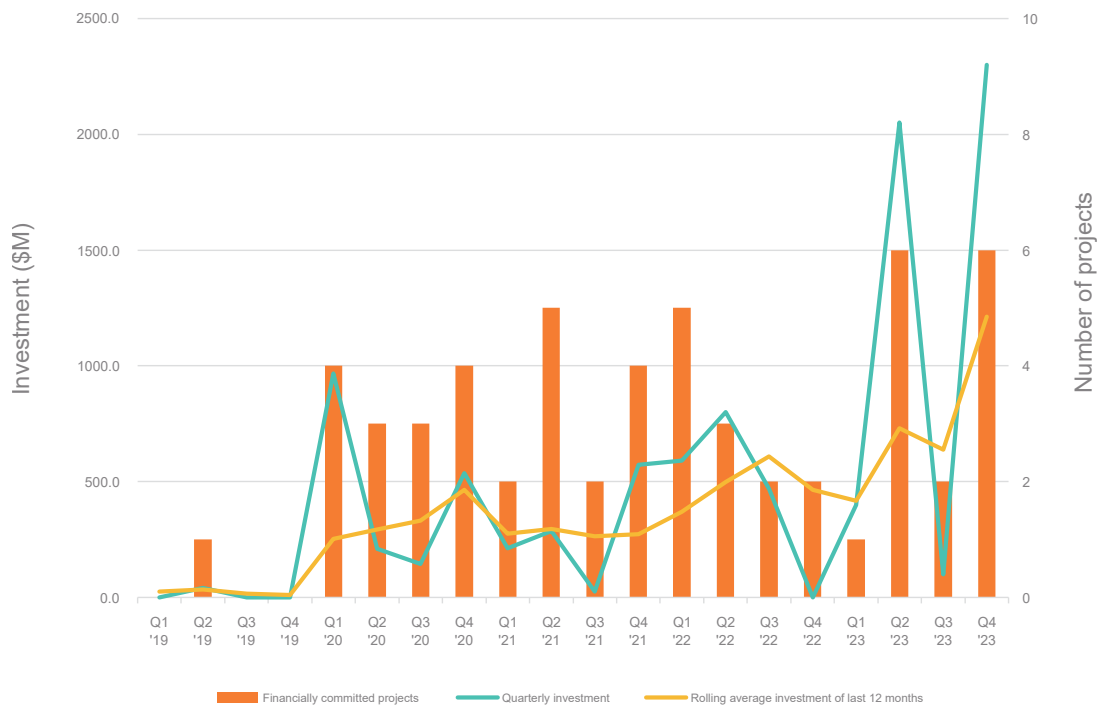
Projects which reach multiple stages have been included in each stage

STORAGE PROJECTS

Financially committed storage projects by energy (MWh), quarterly

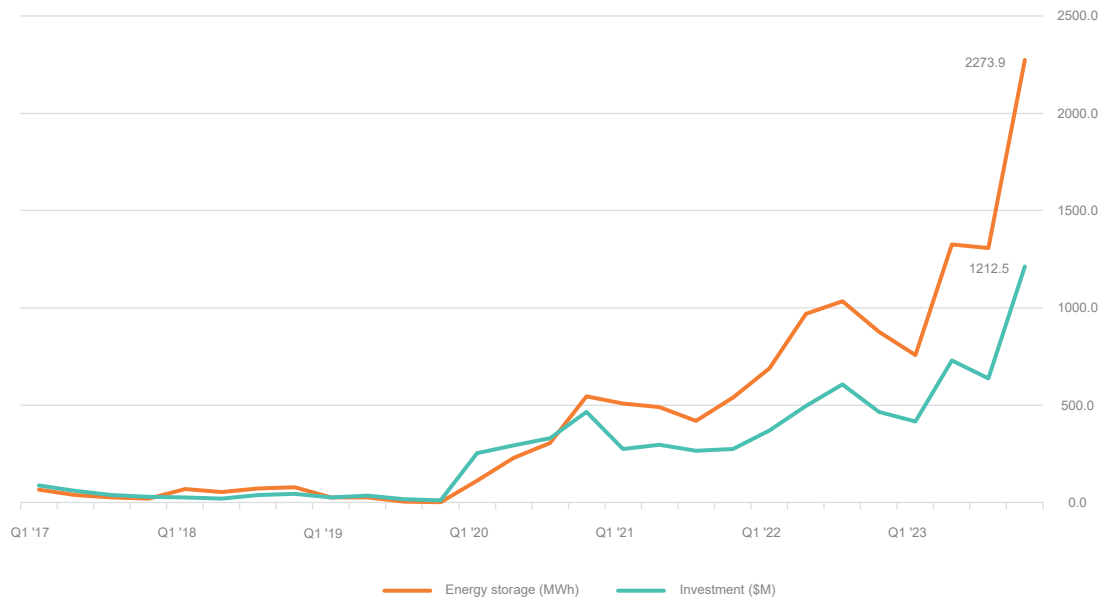


Financially committed storage projects by investment, quarterly



STORAGE PROJECTS

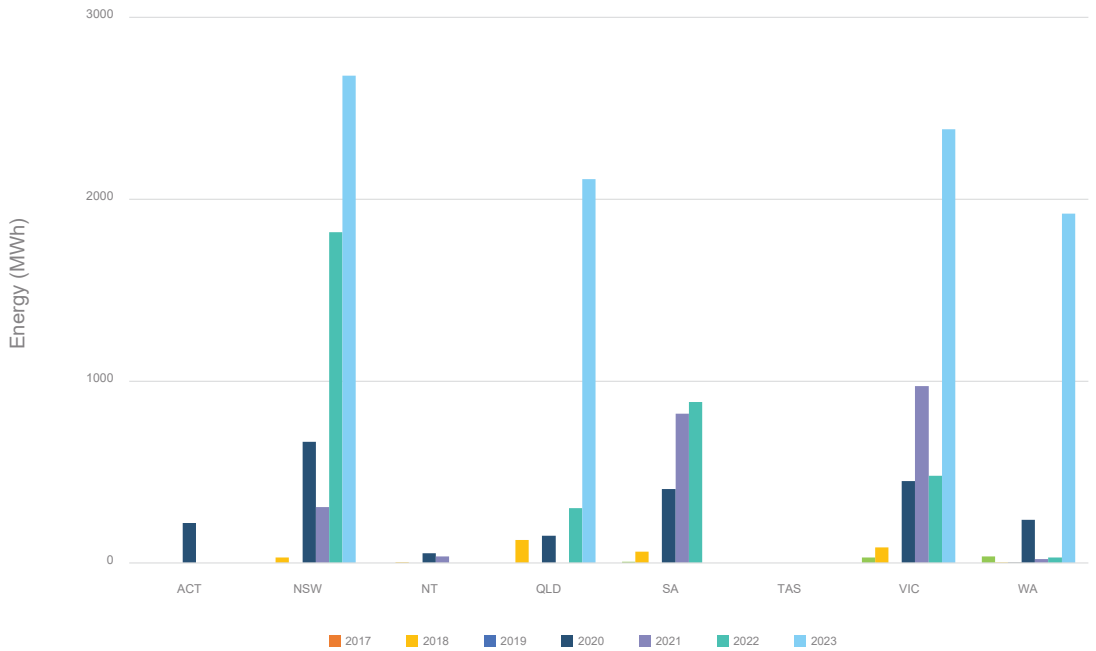
Rolling 12-month quarterly average of energy (MWh) and investment (\$M) of storage projects.



STORAGE PROJECTS

Storage projects by state

Financially committed energy storage projects by state (MWh)



Commissioned storage projects by year

Component	2017	2018	2019	2020	2021	2022	2023
Number of projects	1	3	4	2	5	4	8
Investment (A\$m)	90	129	72	132	374	87	995
MW	100	90	155	163	432	69	757
Average MW	100	30	39	86	86	17	95
MWh	129	115	185	198	693	101	1028
Average MWh	129	38	46	99	139	25	129

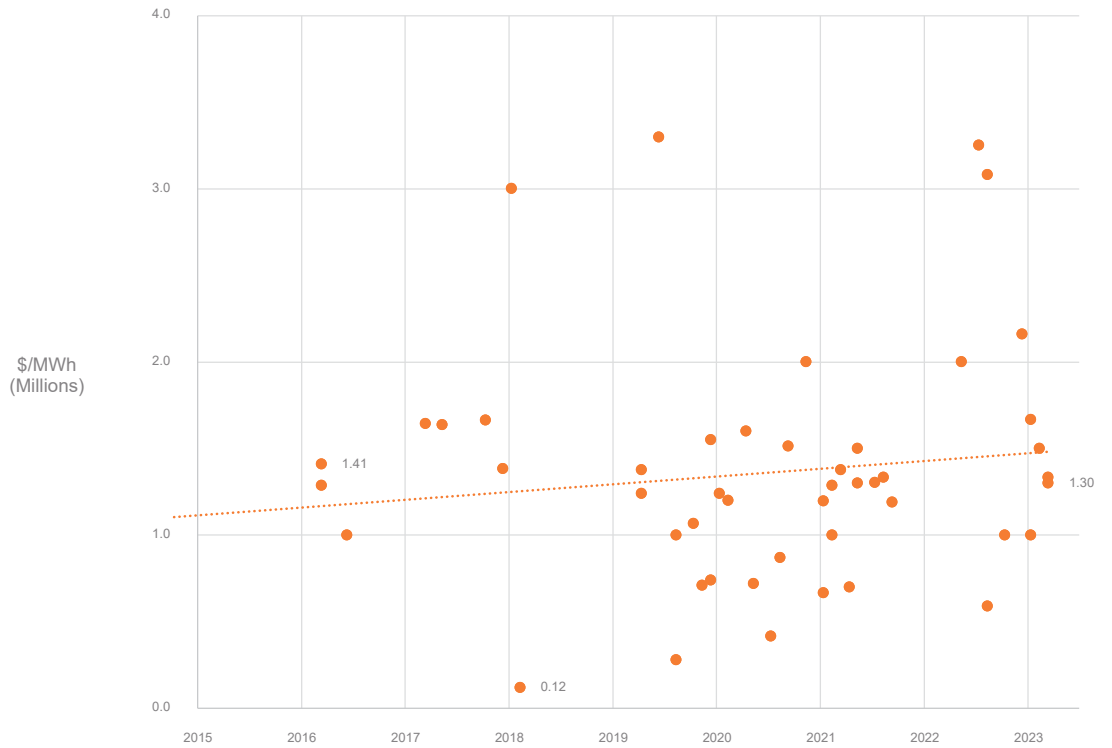
Table 8. Commissioned energy storage projects

STORAGE PROJECTS

Storage project capital investment spend per MWh

The below chart shows the relationship between the amount of capital investment required for each MWh of energy for storage projects. Expressed in terms of millions, all storage projects which reached financial commitment from 2017 onwards have been included to view the trend over time. The chart below indicates battery energy storage system costs are increasing as they move towards higher energy (MWh) levels.

\$/MWh of storage projects



ABOUT THIS REPORT

The Clean Energy Council's quarterly investment report tracks projects from the financial investment commitment stage through to the completion and operation of the plant. The financial investment commitment stage – in which projects receive agreement for access to debt and equity, based on the necessary project development and connection approvals and contracting arrangements being in place – is considered a crucial lead indicator for new capacity build. Once projects have received a financial investment commitment, they are considered likely to proceed. Projects are classified as having reached construction commitment based on the date that the commitment is announced publicly. The Clean Energy Council is aware that a range of different definitions are used by different organisations for the development stages, and as such slight variations may exist between different datasets for each individual reporting period.



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