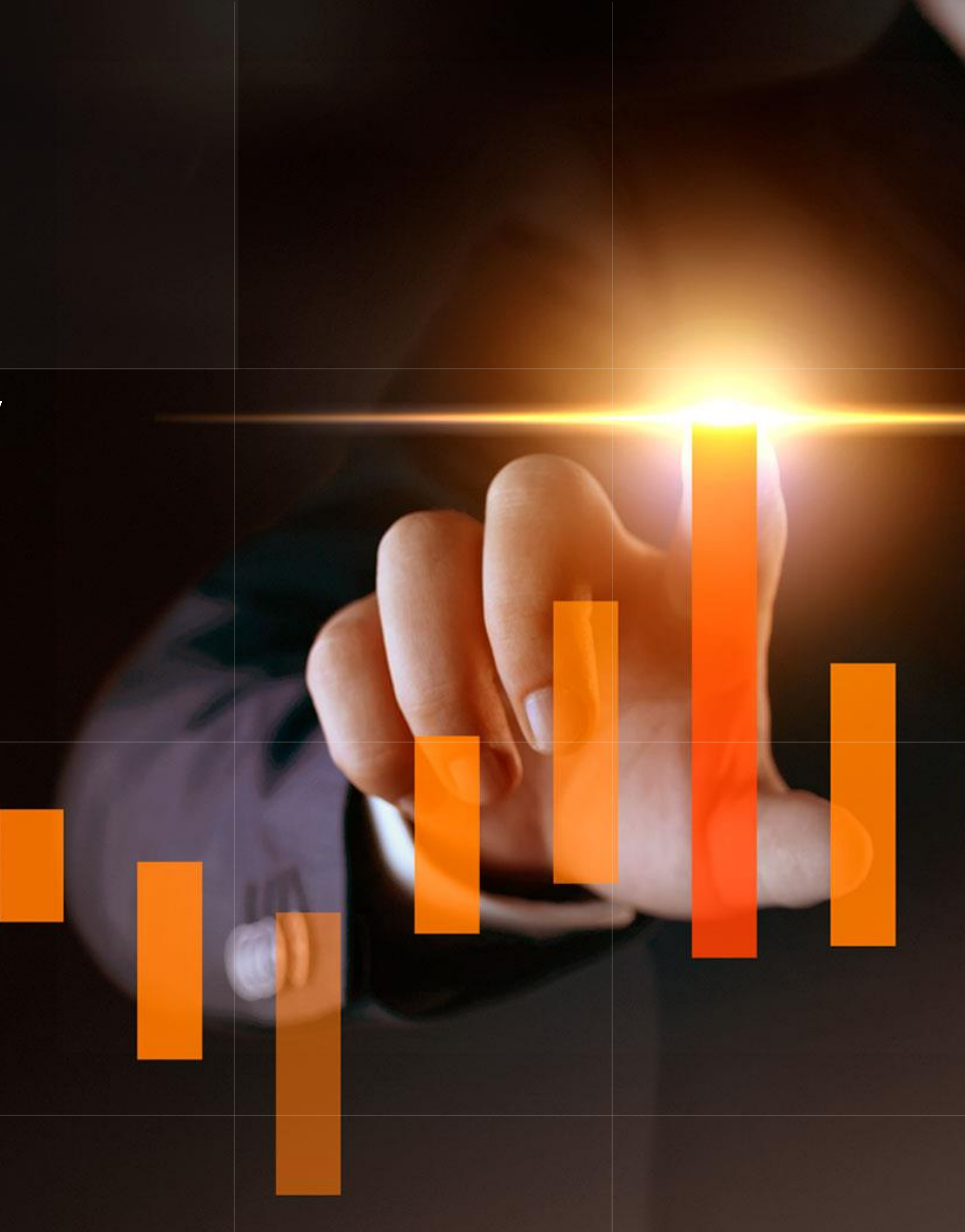
Update on the Australian battery storage sector

November 2022



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Summary

Battery storage is a required link for growing levels of intermittent generation

De-carbonising the grid will require significant investment in new low-emissions technologies.

One issue with increasing the proportion of renewables (or intermittent generation) is that it will lead to grid issues requiring ongoing management.

A key solution is utilising energy storage systems, specifically, battery energy storage systems (BESS). While other energy storage technologies, such as pumped hydro, are an important element of the energy mix, this paper looks at the emerging sector of BESS, given it will likely be a critical element of grid de-carbonisation. Battery storage provides a practical solution to many of the challenges of intermittent renewable generation.

Battery storage backdrop

Are the payments based on plant availability or generation capacity or generation output?

The length of the power purchase agreements (PPA) should be sufficient to support optimal debt financing, debt amortisation, useful life of the asset, and provide for stable cash distributions and equity payback.

The commercial structure may have liquidated damages provisions enforced upon the operator in the case of underperformance, or in the case of severe underperformance, there may be termination rights.

Should include appropriate risk allocation for commissioning. Contract structure may encompass outcomes for late project delivery/commissioning delays, and the process for testing. These may ultimately result in liquidated damages for delay or future underperformance.

Appropriate risk allocation in the case of a change in law affecting the operations of the asset - typically a developer/operator may seek waiver or pass-through of this risk.

Operating issues typically include scheduled and maintenance outages, operation and maintenance requirements. These may be in the form of operator obligations for minimum availability of plant or make-good provisions for extended outages.

Battery storage outlook

We believe growth in grid-scale energy storage will remain strong, supporting energy transition

Grid support

Increasing intermittent generation across the rooftop and grid-scale generation has led to the energy grid requiring increasing levels of support, ensuring proper operations and maintenance of grid services.

Climate mitigation

More regular and severe weather events continue adding to grid stress, requiring new solutions and technologies to ensure continuing operations.

Curtailment

Curtailment of generation is rising. Utilising BESSs as part of projects likely increases grid stability and may allow generation that would otherwise go unitised captured, enhancing returns.

Improving economics

Reduced need for government support through improvement in unit economics driven by a decline in the levelised cost of storage – providing a supporting backdrop.

Demand management

Continued demand for intermittent generation, as well as the development of Australia's offshore wind sector, require continued investment – either as standalone projects or add-ons to greenfield or operating assets.

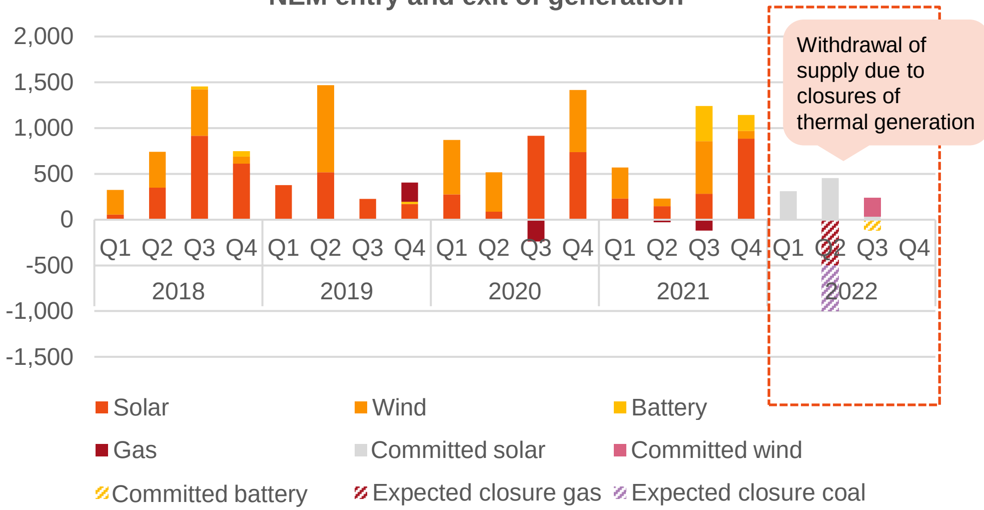
Portfolio integration

Standalone storage is currently limited. As such, investments are likely to form part of an overall renewable/energy transition platform.

Renewable generation over time

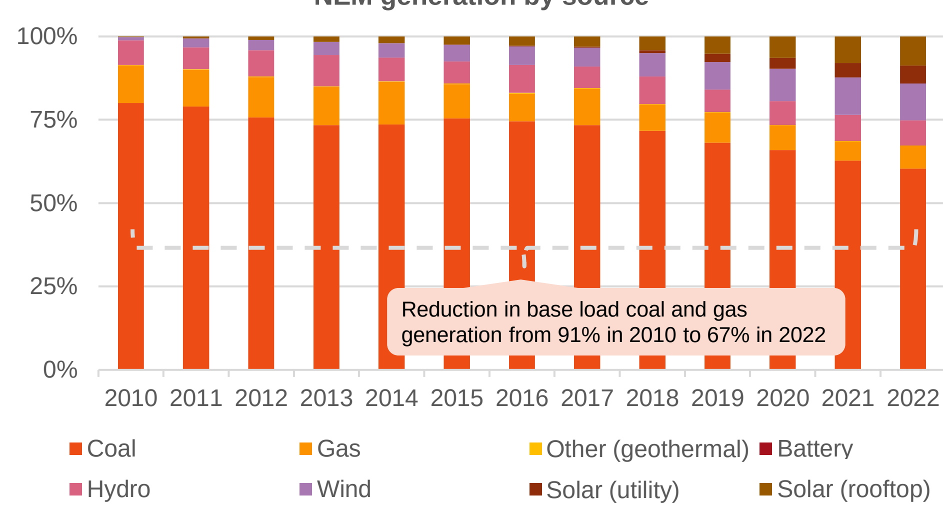
From a very slow start, renewable generation in Australia has grown significantly

NEM entry and exit of generation



Source: Australian Energy Regulator (AER)

NEM generation by source



Source: Australian Energy Regulator (AER)

- Renewable generation grew significantly from a standing start in the early 2010s when the initial Renewable Energy Target (RET) of 33TWhr by 2020 was established. Australia met the target in 2019, ahead of schedule.
- Grid-scale solar generation, specifically solar photovoltaics or solar PV, which significantly lags wind generation, is proliferating through continued reductions in the levelised cost of energy (LCOE).
- Given the need for climate change mitigation, net zero ambitions, electrification and growth in grid-scale renewable generation are expected to continue and may require policy support. This support may include additional subsidies, specific land designations, and government-led procurement processes to underwrite grid-scale developments.
- The additional level of intermittent generation – specifically renewable generation – in conjunction with the continual reduction in coal-fired baseload generation (retirement of coal-fired plants) has elevated the role of battery energy storage systems (BESS) in the renewable energy thematic. However, the BESS sector is still nascent, requiring government funding to be economically feasible.

Australia's path to 2050

AEMO expects significant growth in installed capacity by 2050 and for coal to be phased out by 2040

It is expected renewable generation capacity will grow approximately five-fold by 2050.

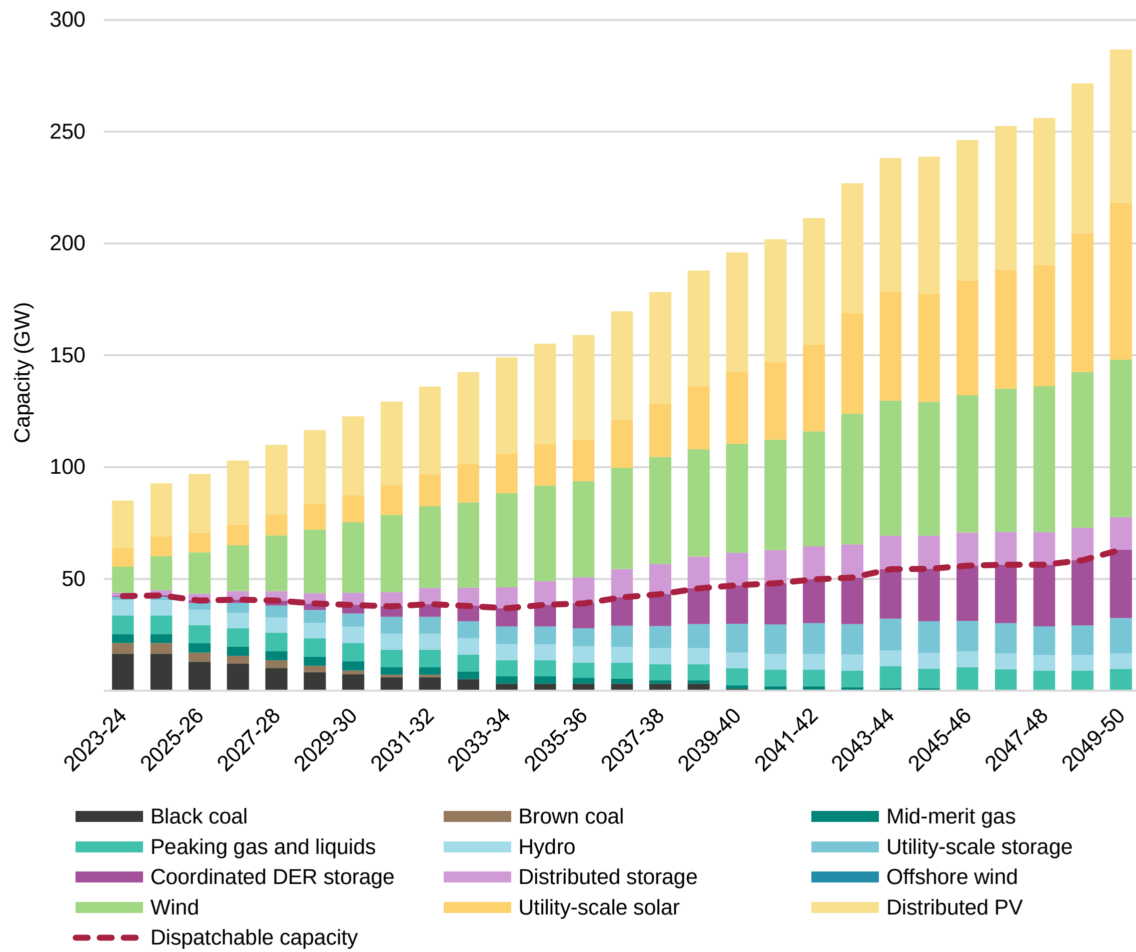
- The NEM delivers just under 180 TWh of electricity today.
- To meet the electrification strategy set by policymakers the NEM would need to almost double its capacity to 320 TWh – with the required growth coming from intermittent generation – thus increasing the need for storage to support the grid.
- The expectation is that coal-fired generation will be withdrawn faster than planned – with 60% of capacity to be withdrawn by 2030 – increasing the proportion of renewables.
- The feed-in capability of households will also drive the NEM's transformation. Today ~30% of detached homes in the NEM have rooftop PV, which is expected to rise to 50% by 2032 and 65% by 2050.

All of these require significant investment in storage; as per the Integrated System Plan,

"…the most pressing need in the next decade is for dispatchable batteries, pumped hydro or alternative storage to manage daily and seasonal variations in the output from fast-growing solar and wind generation."

Source: AEMO

NEM capacity forecast to 2050



Source: AEMO "2022 Integrated System Plan"

Why battery storage?

The intermittent nature and timing of the generation of renewables requires storage for efficiency

- The increasing usage of renewables in the energy mix is favourable for reducing the carbon intensity level of the grid. However, the intermittent nature of these generation sources reduces overall generation efficiency.
- Both the timing of generation and increasing levels of renewable penetration lead to supply/demand mismatches leading to dramatic increases in lost production.

BESS captures excess power generation and matches it with periods when renewable generation is low or unavailable.

Storage can come in several packages.

Grid-scale storage

Large-scale projects utilised as the interface between utility-scale renewable projects and the grid, i.e. Hornsdale Power Reserve and the Victorian Big Battery.

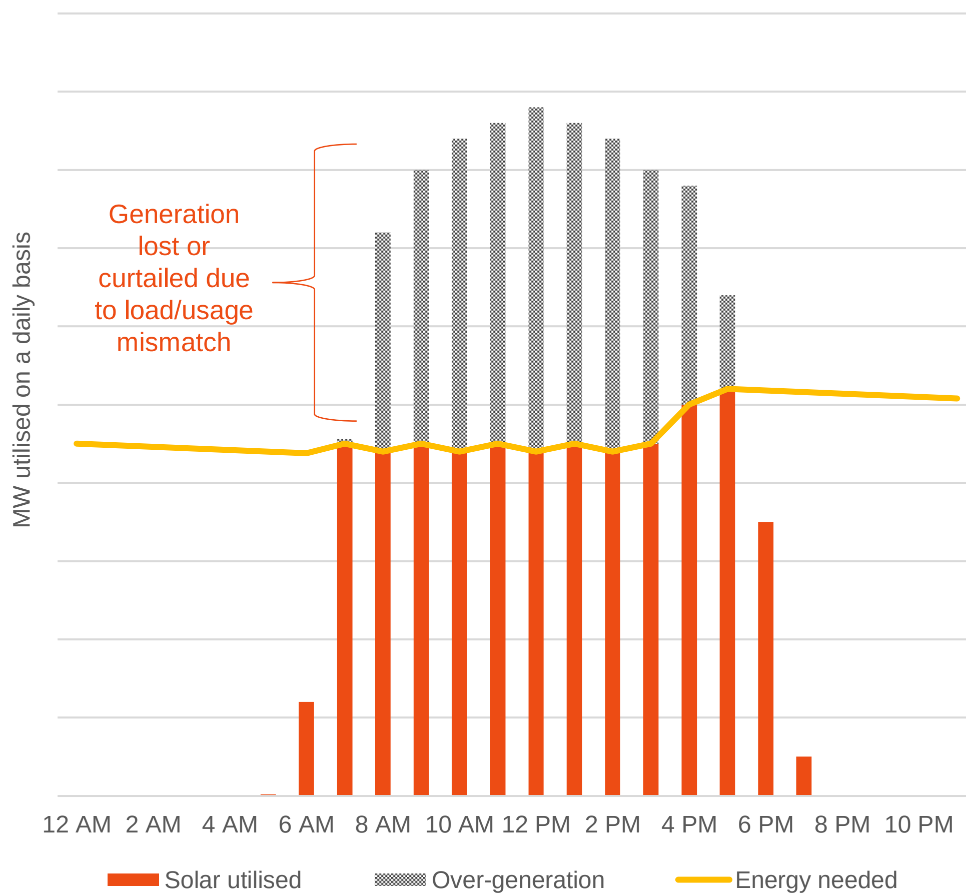
'Behind the meter'

BESS utilised at homes, businesses or at industrial sites. These are usually smaller installations that meet the facility's needs on premise.

Fringes of the grid

BESS are also installed in parts of the grid where there may be poor connections or where there are microgrids supporting contingency generation.

Indicative illustration of solar-load mismatch



Source: UBS Asset Management

Network benefits of storage

Including BESS within a network increases grid efficiency allows for networks to add more significant levels of renewables and reduces the aggregate emissions intensity of the grid.

Grid-scale batteries offer vital benefits to grid operators to overcome technical issues arising from increasing intermittent generation:

Frequency modulation

The addition of intermittent generation can lead to changes in frequency during specific periods. Changes in frequency can lead to 'brownouts' or an intentional or unintentional drop in voltage requiring amendments to supply. Adding grid storage can overcome this limitation by assisting the frequency within the grid – removing intermittent supply risks.

Transmission support

The grid must always have a balance of supply and demand. As such, with the addition of significant levels of intermittent generation, short-term supply can change dramatically. The use of storage and its ability for minimal start-up time coupled with software management, voltage support and fast frequency control enables a more diverse supply base adding grid resilience.

Inertia

Increasing intermittent generation results in a lack of grid inertia. When called upon batteries provide synthetic inertia, ensuring grid stability.

Inertia is an electrical engineering characteristic of traditional thermal and hydropower generation (predominantly baseload) helping grid stability and maintenance of stable frequency. Inertia is lost as traditional baseload generation is displaced by wind and solar generation.

Attractive economics

Energy storage provides pricing arbitrage opportunities to investors

Revenues earned by energy storage predominantly come from three primary sources:

Buy low, sell high

- Much like other commodities, electricity is also volatile. During a typical day, prices can fluctuate between A$50 per MWh to $100 per MWh as demand and supply vary throughout the day.
- There may be periods during the day when both wind and solar generation are at their peak, coinciding with periods of low demand and capping prices.
- Therefore, energy storage can potentially help operators acquire power at lower prices during the day and export power as prices rise at other times of the day – earning the difference between charging and discharging.

Ancillary services

- The grid operator will also pay for energy storage projects, supporting both resiliency and reliability.
- These services can cover several mechanisms, including frequency regulation, short-term backup capacity, voltage regulation, and quick start. Demand for these services has increased with rising renewable penetration.

Contractual revenues

- Storage can also be provided on a contractual basis (in the form of BESS capacity contracts). A storage operator is paid a fixed fee to be utilised as a virtual power plant (VPP) – thus repaying capital over time at a fixed rate.

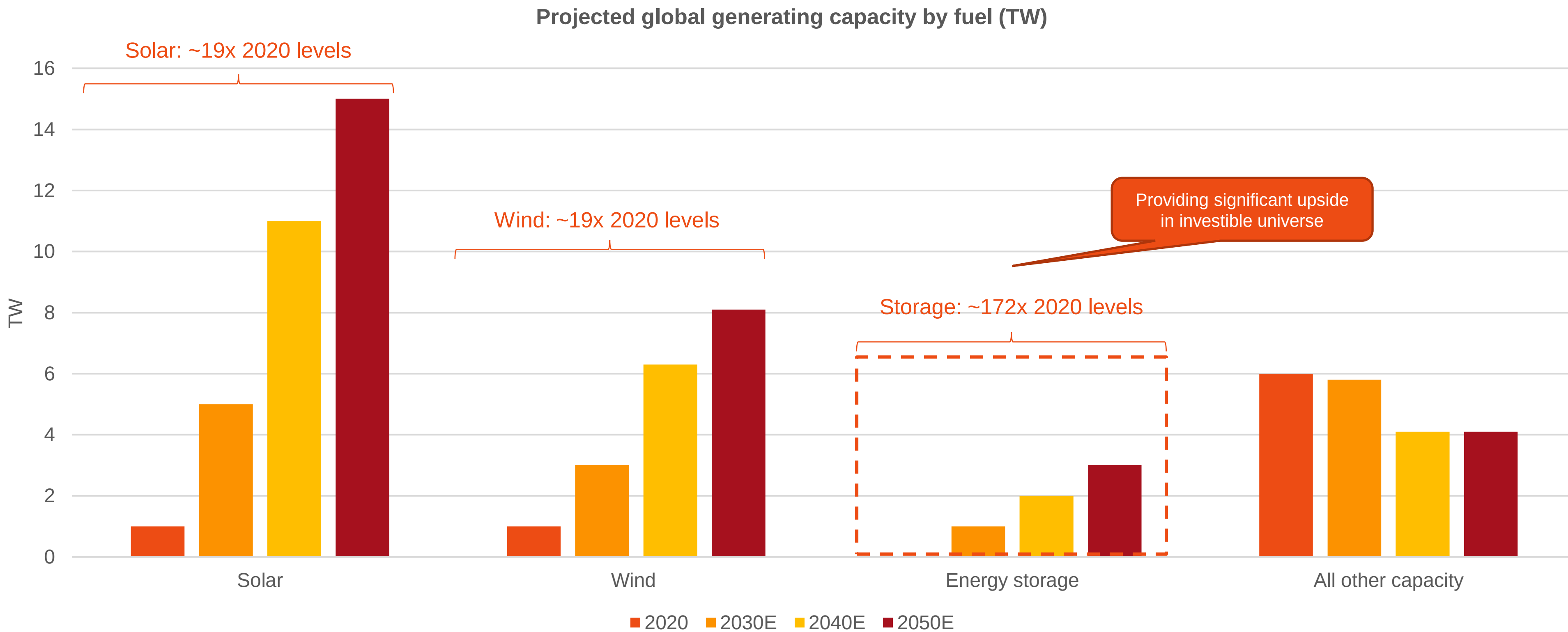
Example of daily energy price vs. solar generation

Source: UBS Asset Management

The energy transition will transform the grid

Targeted decarbonisation will require significant acceleration in renewable energy development

Total global renewable generation is projected to grow from 1.5TW in 2020 to 22.7 TW by 2050.



Source: International Energy Agency ("IEA"), Net Zero by 2050 A Roadmap for the Global Energy Sector, May 2021

Supporting the energy transition

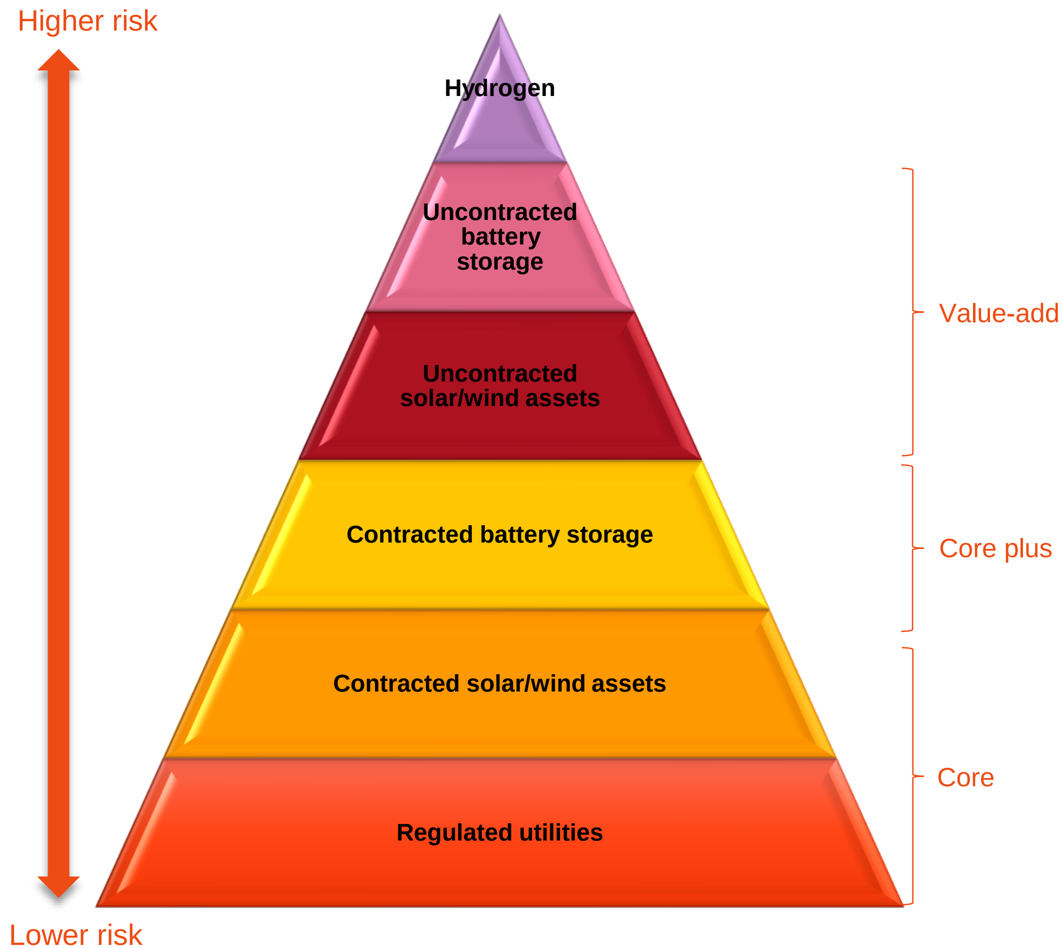
Batteries make up a small portion of the directly available investable universe

While standalone BESS investments currently make up a small portion of the investable universe, exposure to BESS is possible via several other infrastructure subsectors that have a long-term focus on utilising battery storage. These opportunities operate across the risk spectrum.

- The energy transition will drive the incorporation of renewables into electricity grids, requiring additional storage utilisation.
- With increased levels of pricing volatility in the NEM, asset owners are now analysing new BESS installations within operating assets.
- For investors looking to allocate assets towards the energy transition, grid-scale storage will be part of that process, however participation, at least in the short term, will likely be alongside other investments or require a specific allocation to a specialist manager.
- An investment in BESS storage may diversify a highly concentrated renewable portfolio, de-risk existing assets and provide a long-term platform to participate in newly established energy markets.
- Noting the tailwinds for the energy transition and the requirement for ongoing investments, investors should consider how BESS could add value to their assets.

Falling unit economics, increased pricing volatility, and a strengthened focus on grid stability provides ongoing support for privately developed battery storage solutions.

Hypothetical battery storage participation across the risk spectrum



Next steps

Methodology of investment access

- Total energy capacity will need to rise substantially to support domestic and international net zero targets.
- Private capital allocations to renewable energy and storage will play a meaningful role in developing the required energy capacity given constrained public balance sheets.
- The inclusion of energy storage will assist in maximising the capacity of renewable energy facilities during daily periods when demand outstrips supply, improving project economics.
- In a portfolio context, sector interest should be coupled with an initial analysis of portfolio positions, highlighting any investment constraints, portfolio limitations or targeted strategic outcomes for renewable investments. For example, portfolio net zero targets, current or targeted renewables exposure, and sector investment experience – such analysis to assist with investment planning and investment pathways.
- Energy storage as an investment is in a nascent stage of development. As such, energy storage economics would likely be accessed within a wider portfolio of energy assets.
- Depending on investor size, a sub-sector exposure would likely be achieved through:
    - **Co-mingled funds:** with a manager specialising in the development of renewable assets – such funds have the development, financing, contracting and asset management expertise ensuring the correct risk allocation structures, as well as the ability to operate energy storage assets on a long-term basis.
    - **Direct ownership:** large investors: with direct asset ownership in either greenfield/development sites or operating assets should analyse whether undertaking energy storage capex can enhance project returns or de-risk in-situ assets.

Whilst, at least in the short term, Frontier believes energy storage will be included within an overall portfolio context, we have met with managers looking at energy storage-specific investment strategies, targeting very high returns – given the bourgeoning sector.

The final word

Whilst the installed capacity of grid-scale BESS is coming off a low base, it is a sector experiencing significant growth. Growth in an intermittent generation coupled with reductions in the levelised cost of storage provides a supportive backdrop for the thematic. It is also important to note that storage systems are required. Without them, reductions in grid level emissions intensity are unlikely to be achieved.

1. **Global intermittent generation**

   The growth of intermittent generation globally, increasing grid stress, ultimately requiring 21st century technology for grid support and resiliency.

2. **Significant curtailment**

   Curtailment will continually impact renewable developments – inclusion of storage will help with profitability through curtailment reductions.

3. **Attractive economics**

   Construction of intermittent generation in and around renewable resources is leading to difficulty capturing dispatch prices. BESS can help with value capture.

4. **Substantial network/resiliency benefits**

   Installation of batteries provides grid resilience and other engineering system benefits required for a pathway to net zero.

5. **Opportunities**

   The inclusion of batteries in any business case, either greenfield or brownfield developments provides opportunities for value capture – and analysis for BESSs should be undertaken for both greenfield and brownfield assets.

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