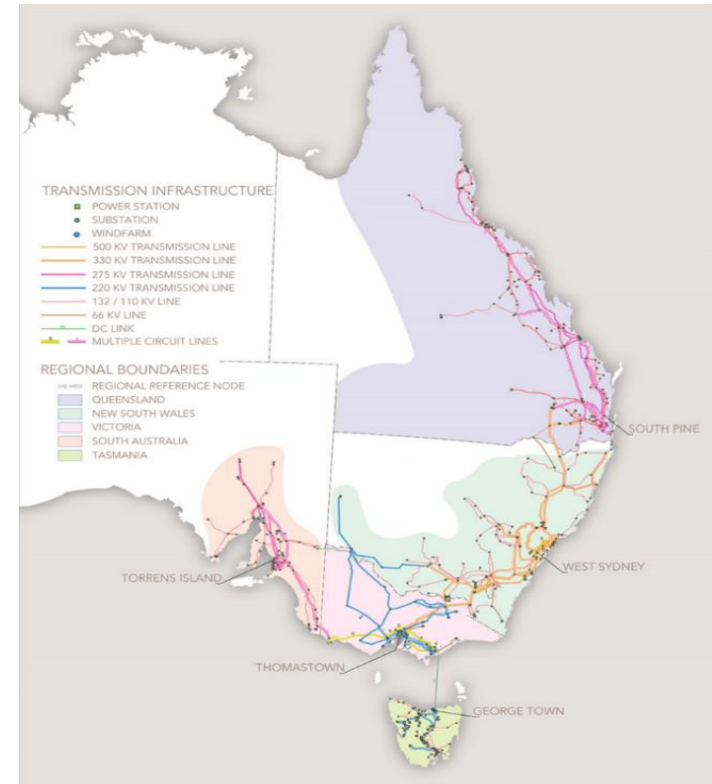


2020 Annual Conference
Challenges facing Australian renewables
July 2020

Overview of the National Electricity Market (NEM)

- The NEM is the electricity grid covering the Southern and Eastern states of Australia
- It was designed around centralised large-scale coal, hydro and gas generation with centralised demand centres (mainly cities and industrial regions)
- This has resulted in a long, thin transmission network, which is one of the longest globally
- Outside the core of the network, it is relatively sparse with low capacity
- Many areas with available land and good solar and wind resources are located on the fringes of the network

The National Electricity Market

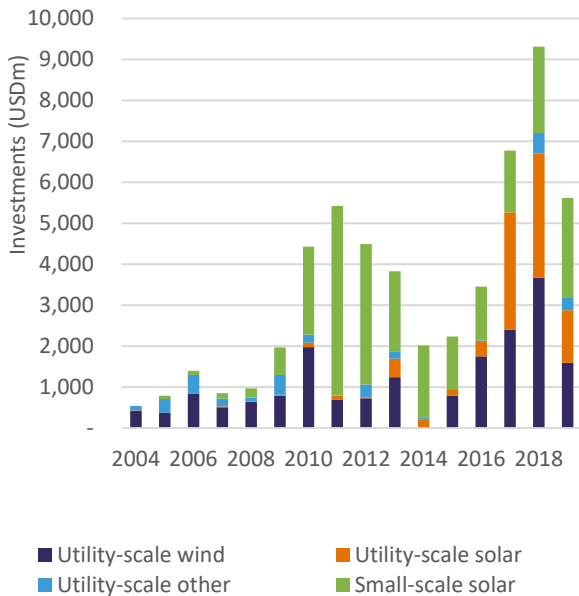


Source: AEMO

The NEM has been built to service historical power generation and distribution, and there are challenges in modernising this

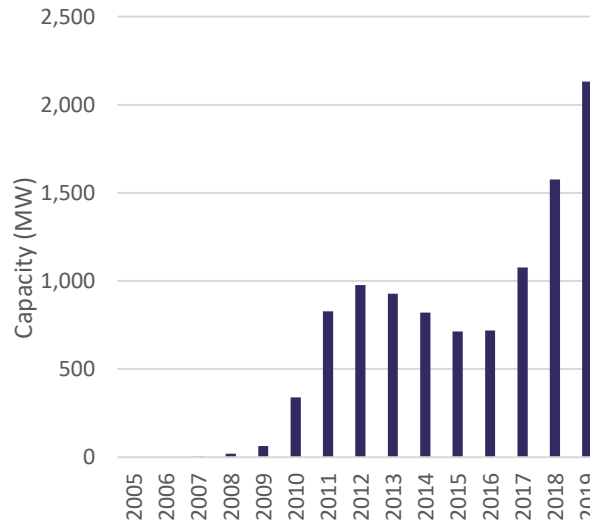
The changing energy mix

New investment in renewable energy capacity



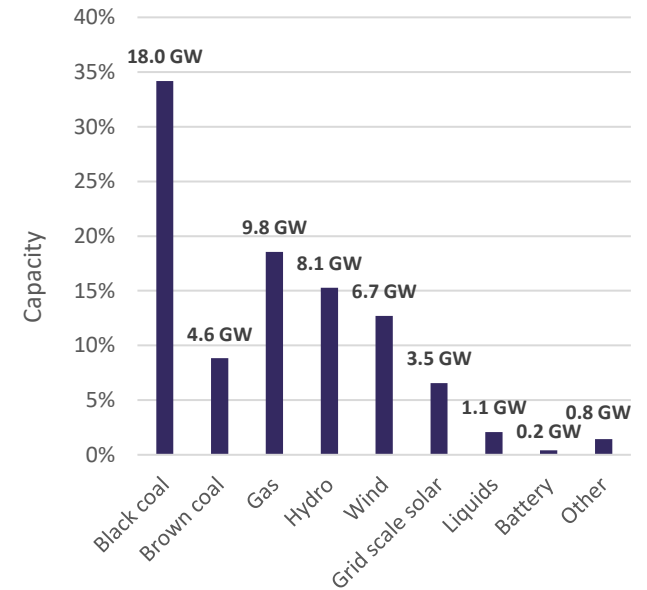
Source: Bloomberg New Energy Finance

Small scale solar installed per year



Source: Sunwiz

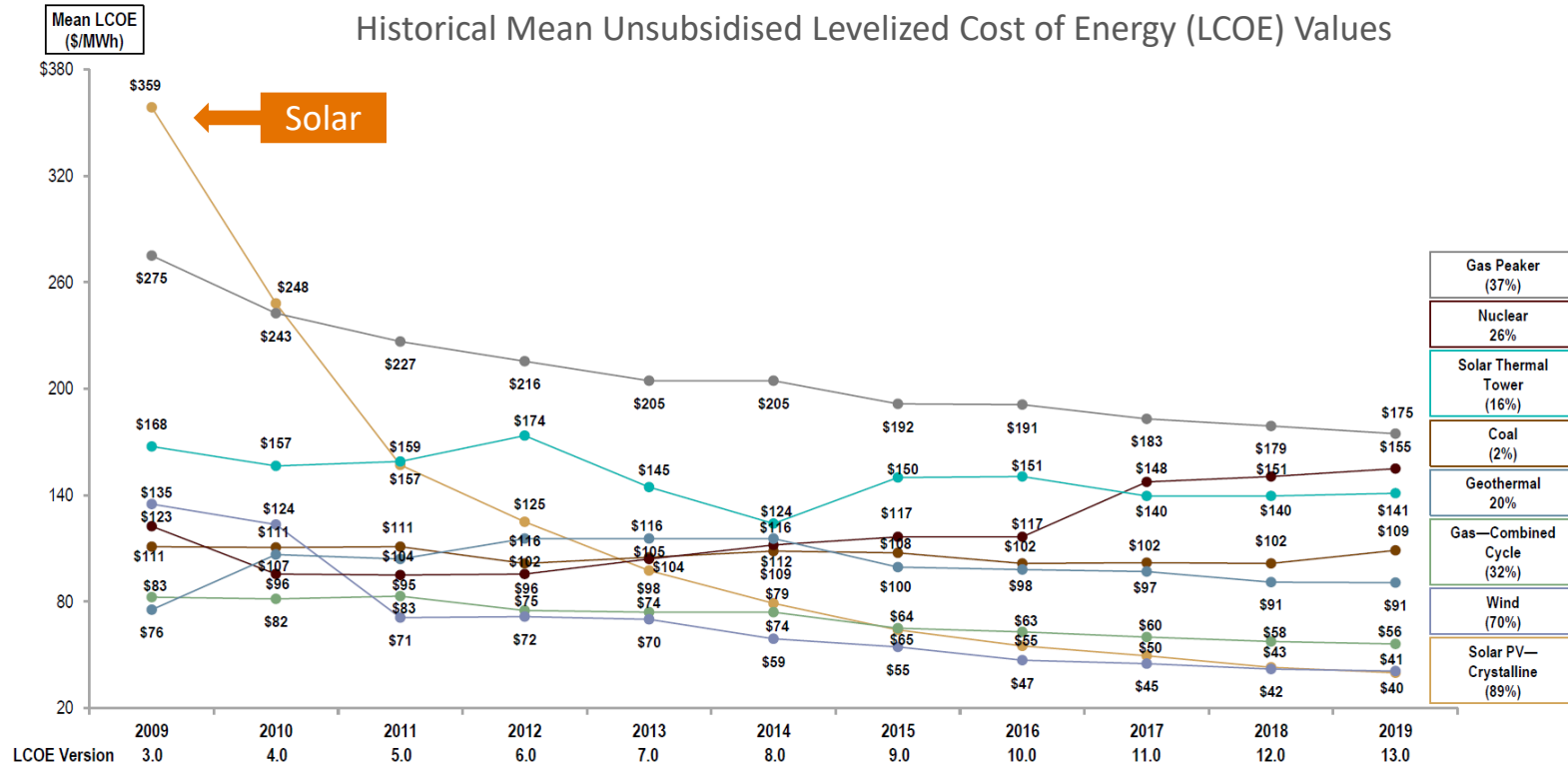
NEM generation capacity (utility scale)



Source: Australian Electricity Regulator

The generation mix has changed rapidly towards renewables in recent years. While coal still dominates, the majority is expected to retire by 2040

The changing energy mix



The cost to produce a unit of energy with a solar photovoltaic (PV) system has reduced dramatically over the past decade

Challenges created by the renewables build out

- **Displacement of traditional generation**

Renewables are typically “dispatched” first due to a low marginal cost of generation

- **Increased variability of generation**

Solar and wind generation is intrinsically variable which creates a greater demand for balancing generation

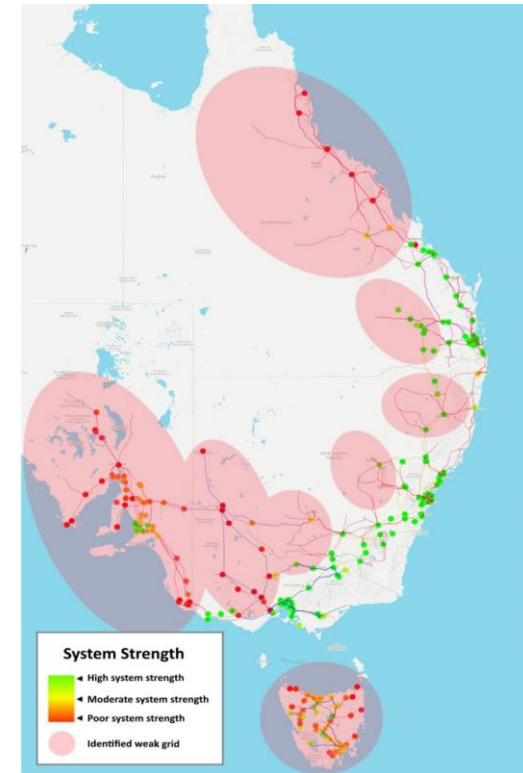
- **Grid instability**

Stability is vital for the operation of an electricity grid. Traditional generation intrinsically provides characteristics that increase stability, solar and wind do not

- **Grid capacity constraints**

Remote areas where a lot of new generation is being installed has limited capacity to transmit electricity

Identified and emerging weak grid areas



Source: National Transmission Network Development Plan, December 2018 (AEMO)

The network was designed around traditional generation - the change in generation mix creates challenges for the whole system

Consequences of the build out for renewables

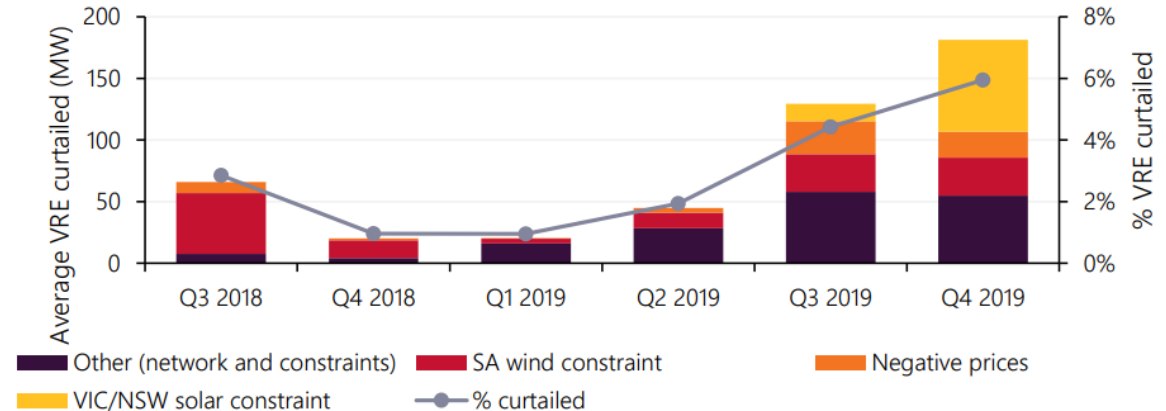
- **Curtailment of generation**

Limiting the amount certain generators produce

The amount being curtailed has grown



Average NEM variable renewable energy curtailment



Source: Quarterly Energy Dynamics Q4 2019 (AEMO)

- **Marginal loss factor (MLF) decreases**

MLFs attempt to measure transmission losses by a generator. Solar is particularly impacted as solar generation is very correlated in any given region

- **Tightening connection standards, connection delays and contractor insolvency**

New requirements have been introduced for generators as an attempt to avoid some of the issues outlined above. This has led to substantial delays to the commissioning of many new facilities

Grid related challenges have become increasingly apparent as the level of renewables has increased

Solutions to grid related issues

- **Grid strengthening and reconfiguration**

Transmission needs to be added or strengthened (such as interconnectors between states) and additional grid support added for stability

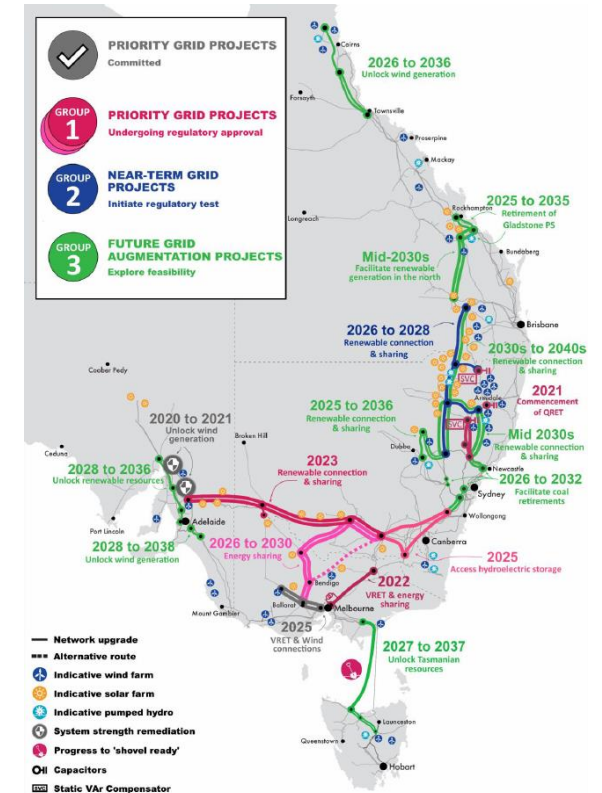
- **Central planning**

To avoid the *ad hoc* fixes made to date, there needs to be a central plan for developing the network in a holistic manner. Steps to this end have occurred with the grid operator's (AEMO's) integrated system plan

- **Government support/intervention**

Government intervention could help if used to address to bottlenecks that slow grid development. Current regulatory processes for transmission are extremely slow

Development paths for the NEM



Source: Draft 2020 Integrated System Plan (AEMO)

Fixing the problems facing the NEM is like rebuilding an airplane mid-flight

Australian government and renewable energy

- **The key Federal legislation is the Renewable Energy Target (RET) scheme**

Less valuable now that the 2020 target has been met and remains flat until the scheme expires in 2030

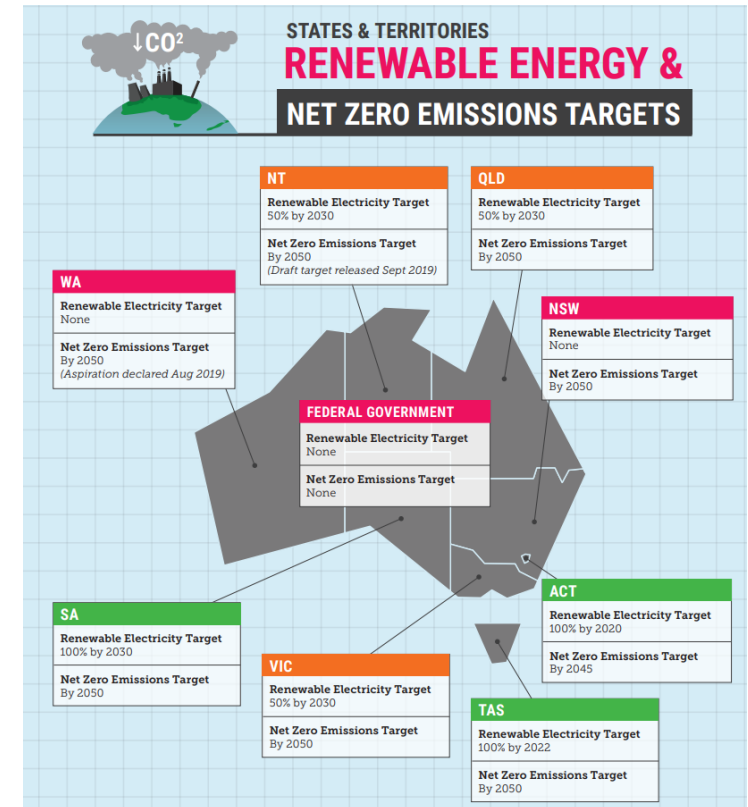
- **Individual states also have renewable energy targets, but these are largely aspirational**

- **Government has been involved in the energy transition in other ways**

For example, intervention or legislation relating to grid development

- **Policy uncertainty has been a key challenge for renewables in Australia**

Climate and energy policy has been a key battleground in Australia politics



Source: State of Play: Renewable Energy Leaders and Losers, Climate Council

Direct government support for renewables is currently limited, though moves to support grid development is gaining pace and should be a focus

Conclusion

- Infrastructure **managers and investors** in the Australian renewables sector **need to exercise caution** and ensure they are across all the technical challenges
- The disruption caused by the **changing energy mix could also provide investment opportunities** for the right investors
- The issues are surmountable, and renewables will eventually make up most of our energy mix
- Regulatory regimes and government intervention are part of the overall environment renewables investors operate within – these can have positive or negative implications.
- How does this compare to other markets such as the US?



Source: Powering Australian Renewables

Frontier is undertaking research of renewables themselves, the challenges, and integrating this fundamental research into our analysis of managers and opportunities

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