Reframing the Energy Infrastructure Challenge

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Our impossible problem

It is no secret that the Australian (and global) energy market is undergoing a structural shift to renewable energy.

The popular response is that we must build everything, everywhere all at once…

…with limited skilled resources

…with limited global manufacturing capacity

…with limited time

…with current technologies (at current prices)

An easy solution sounds impossible - and it almost certainly is.

What if we have a choice?

When everything looks like a nail, you probably only have a hammer to work with.

We worry about solving the problem with our current tool set, efficiencies and technologies. Even if there was 'one right answer', if you don't have the people to deliver (and even if you do have the money) it is not a plan that will work.

- Could we focus only on the 'Big Stuff' that we need and can deliver right now?
- Could we split the task between 'Big and Small Stuff' to make use of a different and proven skilled workforce?
- Could we reduce the labour and time intensity of our solutions?
- Could we make storage a consumer appliance that can be safely plugged in by the customer to free even more skilled electrical labour up?

Everyone in energy has their speciality and tends to think at the utility scale, whilst the distribution networks are increasingly thinking at the customer scale, *and customers are increasingly going off grid* (which is the worst case for everyone).

My rose-coloured glasses…

Historically, coal fired generation was built near the coal fields (because it's easier to push electricity down a line than send coal trains).

We built the high voltage transmission lines in the middle of nowhere to get the power from the power stations to the people.

We built the lower voltage local distribution networks to supply power around our cities to residential, commercial and industrial customers.

…and the system served us well for 70 years.

We have had to make some adjustments along the way - rooftop solar is the biggest generator in the NEM and it's still growing rapidly. Renewables projects have become viable due to their much cheaper, less volatile and inflation busting 'fuel' costs. They were also built near the good solar and wind resources – just like our coal stations.

…so we should do that then, right?

Sure. But we need to build the extra transmission network to bring that power to the people because (climate drivers aside) world energy prices (gas and coal) have been too high and too volatile over recent years to continue with them as our core generation technologies.

The grandfather technologies of generation

Hydro-electric power is one of the oldest and most proven generation technologies with whole states powered exclusively by hydroelectric generators. They are massive civil, environmental and mechanical engineering projects with long lives, high reliability and high costs. They work best in parts of the world with favourable topography, reliable precipitation and, ideally, spring-summer snow melts to regulate the filling of the reservoir over months and years.

We built the Snowy Mountains System in the post war era when we were electrifying our cities. We didn't have the workforce to do it – so we brought in the skills from around the world to help – and a lot of them stayed and formed much of the vibrant migrant culture that we still value today. It was nation building and has earned a fond place in our national social and engineering history.

We built out our coal power stations and transmission networks under the various State Electricity Commissions through the 1950s to the 2000s. Since we established the NEM in 1998, the private sector has built peaking gas plant,

wind, solar and batteries to meet demand - in response to the energy price signals given by the wholesale market.

The decade long surplus that evaporated

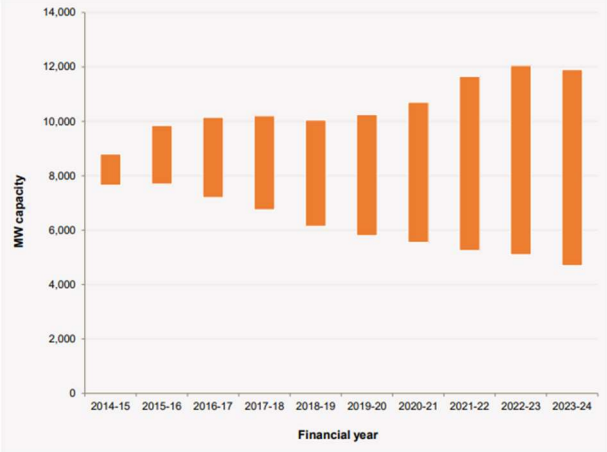
Alongside a surplus of generation emerging in the 2010s, growth in NEM demand flattened and substantial coal capacity was withdrawn to balance supply and demand – Munmorah, Hazelwood, Wallerwang, Swanbank B, Playford. Muja, Northern.

In its 2014 Electricity Statement of Opportunities AEMO opened with the statement:

"*For the first time in the National Electricity Market's (NEM) history, as a result of decreasing operational consumption, no new capacity is required in any NEM region to maintain supply-adequacy over the next 10 years.*"

AEMO's 2014 analysis, based on their forecasts at the time indicated that we would maintain an operating surplus of between 5,000 and 12,000 MW by in 2023-24:

Figure 6: Surplus capacity in the NEM



...into the shifting sands in competitive markets

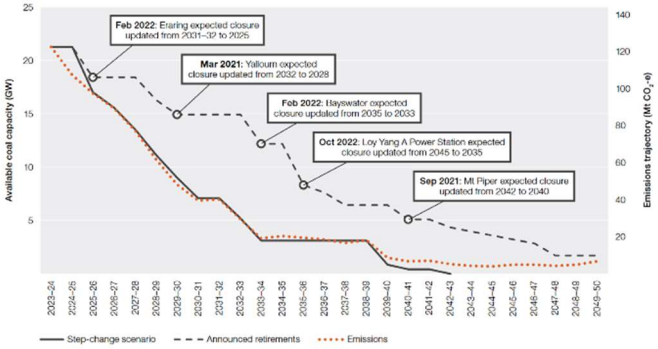
AEMO subsequently opened its 2015 Electricity Statement of Opportunities with the statement:

"The 2014 Electricity Statement of Opportunities (ESOO) reported surplus generation capacity of 7,400 MW in the National Electricity Market (NEM) by 2023–24.

The market has responded in the past year by notifying its intent to withdraw approximately 4,550 MW of capacity (about half the surplus) by 2022."

Most of our remaining large coal generators are scheduled to retire over the coming years - Eraring, Vales Point, Mt Piper, Loy Yang A, Yallourn and Bayswater.

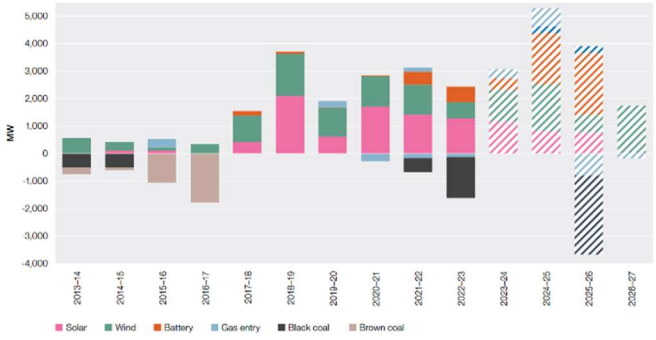
Figure 1.6 Forecast coal retirements and links with emissions



Note: The 'emissions' line shows the forecast emissions trajectory from the 'step change' scenario.
Source: AER analysis, AEMO data.

These are expected to be offset by investment in renewables, gas and batteries – as shown in the graph below from the AER's *2023 State of the Energy Market*.

Figure 3.23 New generation investment and plant withdrawal



Note: Capacity includes scheduled and semi-scheduled generation, but not rooftop solar capacity. New entry and exit are by registered capacity, except for solar which uses maximum capacity. Committed investment and closures from 30 June 2023 are shown as shaded components. These include Eraring power station in 2025.
Source: AER; AEMO (data).

Whilst it's easy to be cynical about the underlying commercial motives, these historical retirements have created the 'space' in the market for the remarkable boom in renewable and storage that we saw from 2017 onwards.

Battery Storage - the new kids on the block.

Big batteries only became a 'thing' globally about 6 years ago in 2017 when the original 100MW/129MWh Hornsdale Power Reserve (aka the Tesla SA Big Battery) was commissioned in South Australia.

It has done incredibly well providing frequency control services, contracted backup supply reserve and trading part of its capacity in the NEM alongside Neoen's Hornsdale wind farm output. Since then, our people have:

- Advised Greenspot on the value of a **500MW/1GWh Wallerawang** battery project as part of their industrial renewal project – the BESS component was was subsequently divested to Shell Energy.
- **Advised Nexif, Pacific Hydro, Sunshine Coast Council** and others on the value of integrating batteries into their diverse generation, retail and load portfolios.
- Provided an **independent review of a 700MW/2.8GWh battery** for a state-owned-corporation, where a primary risk and market

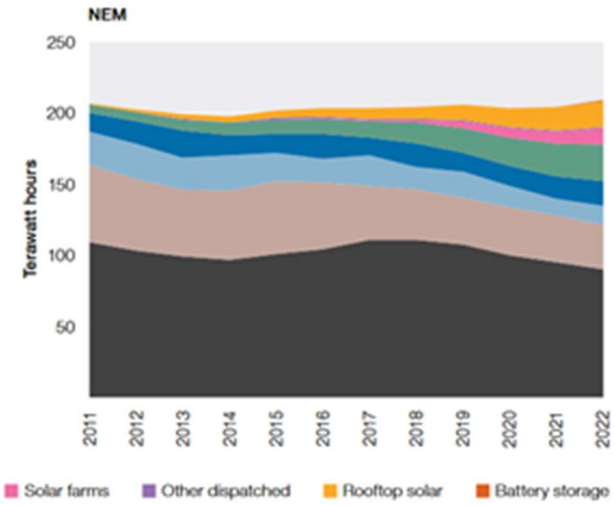
interaction was the impact of a privately developed 1GW/4GWh battery about 4km down the road.

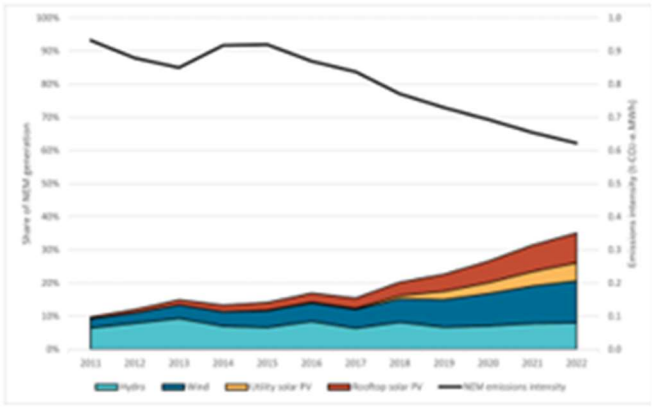
And we have also seen starts on Akaysha's Waratah Super Battery on the old Munmorah power station site (850MW/1.7GWh), the Victorian Big Battery (300MW/0.45MWh), the Origin Energy Eraring battery (700MW/2.8GWh) and the Qld Government owned generators (1,000MW/2GWh) across coal station sites.

What was our problem again?

Despite all of the headlines to the contrary, things are not hopeless, and we are making meaningful progress on our energy transition. Over the past 10 years we have:

- **Reduced the NEM emissions intensity almost 30%** from 0.866 t/MWh in 2012 to 0.612 t/MWh.
- Reduced our total consumption in the NEM by about 7.5% against a 16% increase in the Australian population from June 2012.
- Tripled the share of renewables in the NEM – with utility scale solar only contributing meaningfully since 2018.
- Seen **rooftop solar grow to contribute more capacity than Black Coal** across the NEM and rooftop + utility solar contribute more capacity than black + brown coal in FY23.





So, when you have a look at:

- How much battery storage has been deployed so quickly in Australia;
- The ability for batteries to complement renewables and support networks; and
- The **potential for customer batteries to contribute massively more** than the Big Batteries. (given our solar penetration rates) …

… you can see that **if 20% of ~9m NEM customers** put in **~5kw/15kWh batteries, we would add another 8,500MW of generation and 25.5GWh of storage.**

This equates to around 55% of NSW maximum demand or over 80% of Queensland/Victoria's for over 3 hours.

Delivered by our existing solar installers and not the resource constrained transmission/generation skillsets.

But what about safety …and EVs…and prices

We have safer and more durable Lithium Iron Phosphate (LiFePO4) battery cells already in the market that do not have the ethical cobalt concerns or the same chemical volatility as Nickel Manganese Cobalt (NMC / Li-ion).

AEMOs ISP also expects battery cell prices to halve by 2030….and electric vehicles are crossing important pricing and market acceptance thresholds right now.

Our take on the future

Qubist advises renewable developers, generator, networks, regulators and government on all aspects of energy infrastructure, asset strategy, market and business transition.

We can see opportunity for our clients in the big, the small and the novel. Our focus is on the business dollars, the common sense and we understand the technical volts and amps.

The world is changing and the solution to 'impossible' will be found by people who view solutions differently.