Battery Penetration and Wholesale Price formation in NEM: Emerging Evidence and Possible Implications

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Context

- Increasing renewable penetration necessitates flexible, dispatchable energy technologies to stabilise intermittence and demand volatility.
- The penetration of batteries in the NEM has increased rapidly and is expected to be 18GW by 2027, from 2GW in 2024
- Batteries add diversity to the class of conventional flexible generation like Gas Powered Generation and Hydo with higher flexibility and bi-directional flows, capable of being marginal generators (Fig 1,2)
- Marginal or price setting generator exerts a disproportionate influence on market prices and profitability relative to its volumetric contribution
- We evaluate the effect of increasing battery penetration on the price setting dynamics in NEM

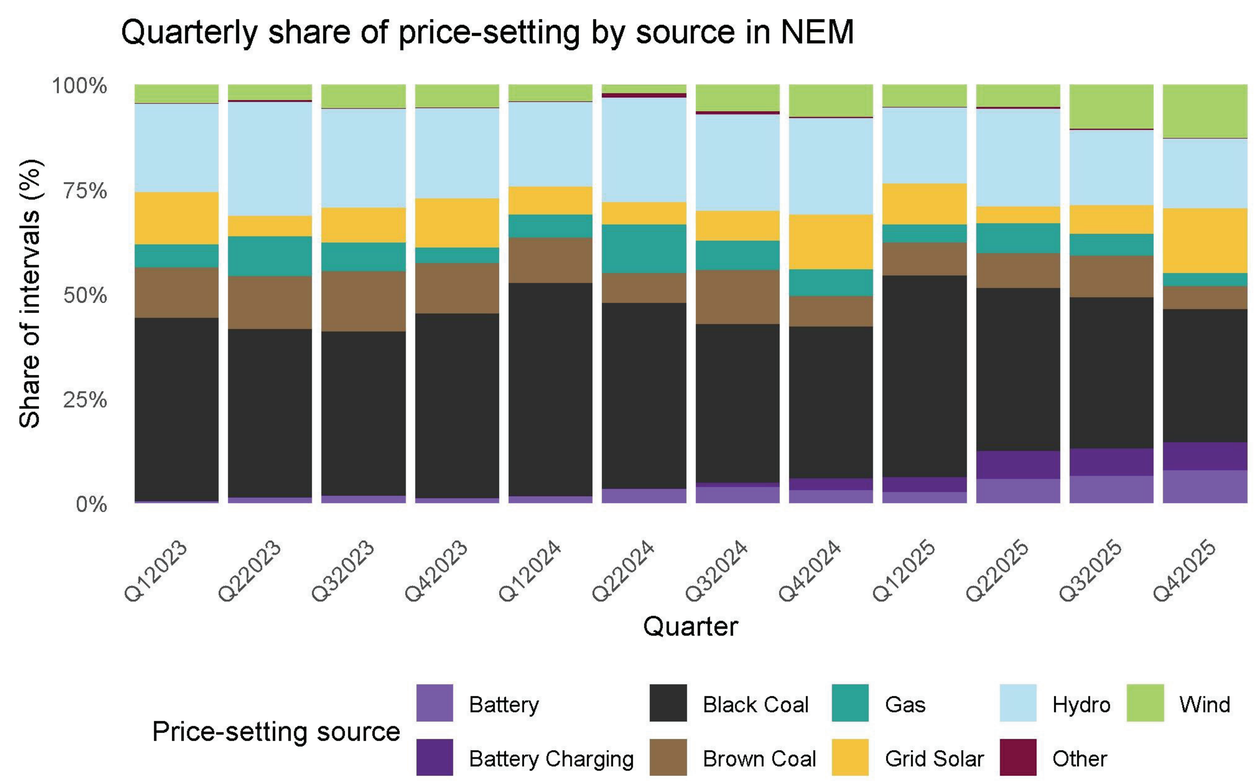

Figure 1: The proportion of price setting by source in NEM for last two years. The price setting frequency of **batteries has increased from less than 1% to 8% in Q4 2025**. During the same period, the energy supplied increased from 34GWh to 254 GWh across NEM. The increase is common across regions.

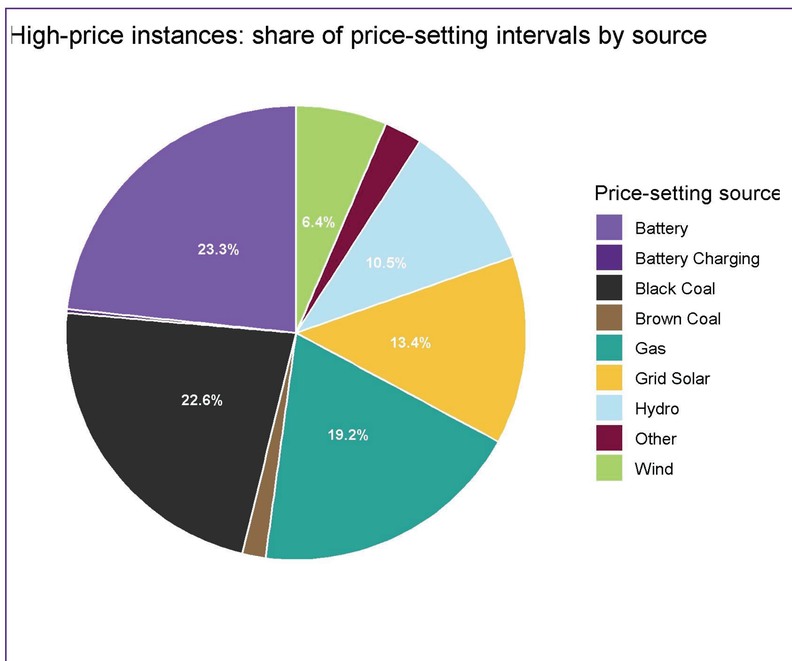

Figure 2: Batteries had the **highest price setting frequency for high price instances across NEM in the period 2023-2025**, indicating their efficiency in flexibility and utilisation of high price instances

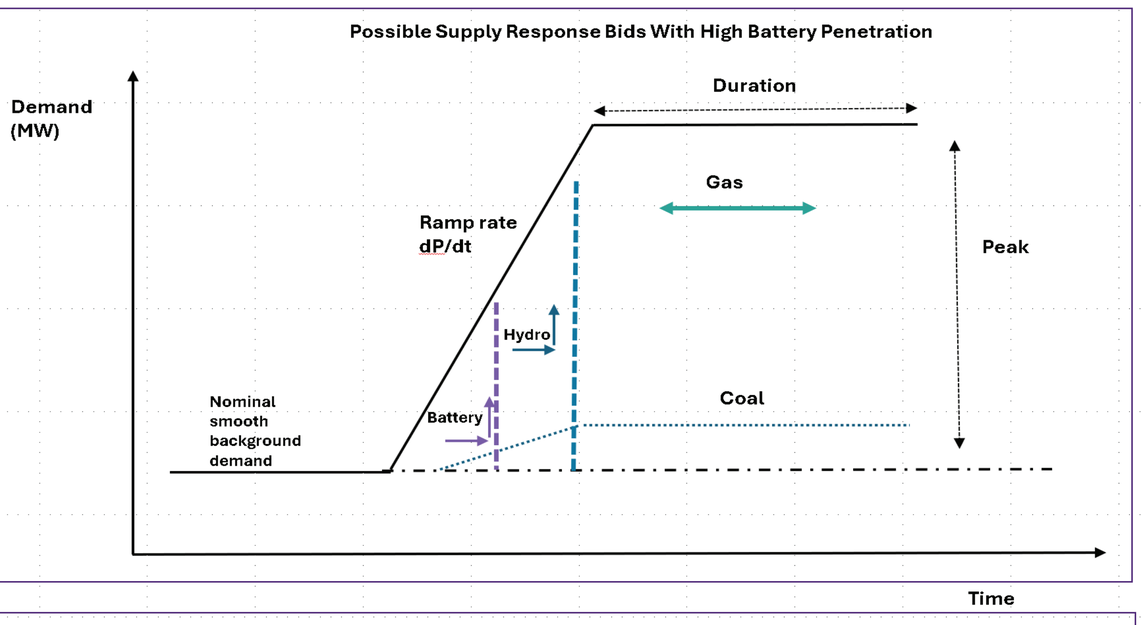

Figure 3: The figure represents a stylised version of sources responding to an unforeseen demand increase in NEM. With increasing capacity Batteries would be ideally placed to absorb the demand, followed by hydro (including pumped hydro). The energy supply space for GPGs is squeezed out. Increasing flexibility in coal could also squeeze the energy to be supplied by GPGs from the base

How do GPGs bid?

P_{bid} can be expressed as

$$P_{bid} = \left(\frac{Cap \text{ x } CRF \ + FOM}{8760 \text{ x } CF}\right) + HR \text{ x } FC + VOM$$

P_{bid} theoretical optimal bid price
Cap overnight capital cost, $/kWh capacity
CRF capital recovery factor
CF Capacity factor
FOM Fixed O&M, VOM Variable O&M ($/MWh)
HR Heat Rate (GJ/MWh)
FC Fuel Cost ($/GJ)

At ***Low Capacity Factors***,
- Capital dominates the LRMC
- Fuel share is small
- Bid is insensitive to fuel price changes

At ***High capacity factors***,
- Fuel price becomes significant
- Bid becomes sensitive to fuel prices

The "**squeezing out**" as shown in Figure 3 will
- Reduce capacity factor of GPGs further
- Restrict GPG operation to sparsely occurring high magnitude events

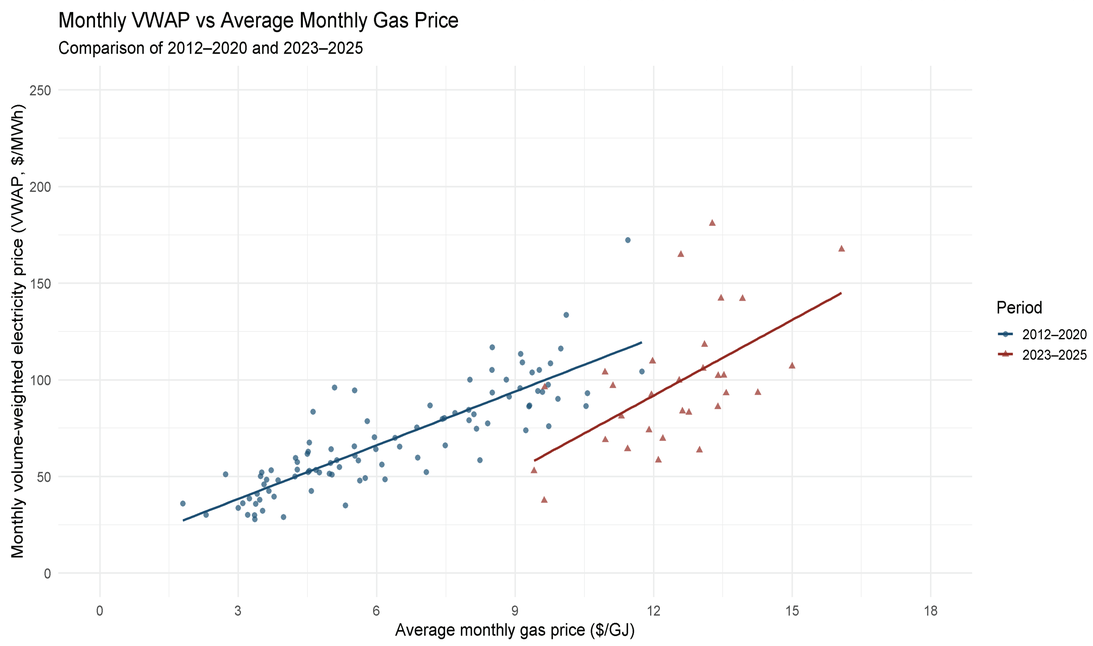

Figure 4: The figure plots the relationship between gas prices and volume weighted electricity prices in NEM. Due to shadow pricing of gas-powered units by coal and hydro generators, the historic correlation between gas prices and electricity prices have been high. Post 2023, we see a **change in the relationship**, indicating a disassociation from input costs.

Implications

The disassociation of GPG bids and input prices

- While bids in competitive markets reflect profitability rather than input costs, competition typically anchors offers to operating costs.
- We observe an increasing disassociation between gas prices and electricity prices in the NEM.
- The growing penetration and price-setting role of batteries—by reducing and destabilising GPG capacity factors—appears to weaken the link between fuel costs and bid prices (Fig 4).

Role of gas as a price marker in NEM

- Evidence from 2012 – 2022 indicates a strong correlation between electricity and gas prices
- It has been found to be caused by ***shadow pricing*** where coal and hydro generators shadow GPG bids to maximise profitability
- The emergence of batteries as the marginal generator could change this role of GPG bids as the de-facto price market in NEM

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