The cost of no renewables

The unaffordable alternative

March 2025

Clean Energy Investor Group

About CEIG

The Clean Energy Investor Group (CEIG) represents domestic and global renewable energy developers and investors, with more than 16GW of installed renewable energy capacity across more than 76 power stations and a combined portfolio value of around $38 billion. CEIG members' project pipeline is estimated to be more than 46GW across Australia. It is an investor body, representing the unique perspective of clean energy investors to regulators, policy makers and the broader energy sector.

In the spirit of reconciliation, the Clean Energy Investor Group acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea and community.

We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today.

Key findings

Finding 1. Renewables push prices down, without them, wholesale prices could cost up to $80/MWh more, and household electricity bills 22% (or $417) higher

Finding 2. Without renewables, the generation shortfall is mainly filled with expensive OCGT gas generation

Finding 3. Increasing the grid's reliance on fossil fuel plants would strain ageing infrastructure

Finding 4. Greater reliance on ageing fossil fuel generators risks reliability of supply

Finding 5. Without renewables, more gas must be diverted away from manufacturing & industry uses

Finding 6. Using fossil fuels rather than renewables increases total system costs

Executive summary

The coal fleet is ageing and needs to be replaced

- Mostly developed by State Governments in the 1970s and 80s, coal is now old and unreliable
- Only about 12% of coal capacity in the National Energy Market (NEM) is less than 25 years old (3 out of 24GW).
- Outages and reliability issues tend to increase after 40 years.
- A significant transformation of the electricity grid is therefore inevitable as the coal fleet retires.

Firmed renewables provide least cost replacement for the grid

- Renewables with transmission and firming, in the form of battery storage assets and peaking gas, has consistently been shown to be the cheapest way of meeting current and future electricity demand through numerous editions of the Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP).
- This is borne out in the global investment data. In 2023, almost 91% of new global capacity came from solar (428 GW) and wind (118 GW)[1], with this record expected to be broken in 2024.

Costs and risks increase without renewables

- This report demonstrates that renewables have been essential for delivering the bulk of the energy transition at least cost.
- Our analysis is a backcast of 2024 and models counterfactual scenarios where renewables are replaced by coal and gas generation.
- The results show that without renewables:
  - prices would be higher
  - would put pressure on the ageing coal fleet to fill a large gap
  - there would be a higher risk of blackouts
  - more gas would need to be diverted away from manufacturing & industry uses
  - total energy system costs would go up

[1] IEA, October 2024

Rationale behind this analysis

- Built in the 1970s and 80s, Australia's coal fleet is ageing, increasingly prone to outages, and expensive to maintain. The grid transformation isn't a choice—it's inevitable.
- As part of that energy transition, renewables are often misunderstood in terms of their impact on electricity prices.
- CEIG has modelled counterfactual scenarios for 2024 where consumer demand is met by coal and gas plants, rather than renewables.
- Whilst no one is calling for a grid without renewables, our modelling is a way to isolate the full downward impact that renewables have on power prices.
- This report also highlights the potential consequences of a reduced renewable energy future, should policies be implemented that create uncertainty or barriers to renewable energy investment
- Our analysis intends to complement recent reports, such as the Clean Energy Council's, *The Impact of a Delayed Transition on Electricity Bills*, prepared by Jacobs, which shows that clean energy is the cheapest pathway to lower energy bills for Australian households and small businesses.

Market modelling – inputs and assumptions

Inputs

- Data for demand, rooftop photovoltaic (PV), renewables generation, interconnector limits, coal outages, and monthly hydro generation: AEMO Market Management System (MMS) database for 2024.
- Fuel and prices:
  - Based on historical forecasts for gas and coal prices.
  - End of calendar year 2024 large-scale generation certificate (LGC) price from the Clean Energy Regulator (CER).
  - Thermal and hydro plants bids: based on historical bidding behavior from AEMO MMS database for 2024.
  - Renewables bid at negative LGC.
  - Battery storage assets bid to maximise opportunity costs of limited annual cycles subject to a minimum arbitrage level.
- Liddell extensions: generic coal outage probability, AEMO's 2024 Integrated System Plan (ISP).

Modelling approach

- Modelling of price, generation and reliability outcomes using a single year Plexos backcast model for 2024 (Scenario 1) with four counterfactuals (Scenarios 2-5).
- ISP-styled subregional model including intraregional flow constraints.
- Where removing existing renewables capacity resulted in unserved energy above the reliability standard, potential additional generation was considered from: existing mothballed generators, recently retired generators (Liddell and Torrens A) and new open-cycle gas turbines (OCGT) (in that order).
- For simplicity, no limit has been applied on the availability of gas for gas-powered generation (GPG).
- In Scenario 1, battery storage assets are restricted to 366 cycles per year.

Five scenarios

Scenario 1

2024 Base Case

- Backcast model-run to replicate actual NEM price outcomes in calendar year 2024.

Scenario 2

No Renewables

- As per Scenario 1, but with all utility renewable capacity and battery storage assets removed. The existing fleet runs at higher capacity to attempt to fill the gap.

Scenario 3

No Renewables w/ Replacement

- As per Scenario 2 but with additional OCGT capacity and 2 units of Liddell extended.

Scenario 4

No Renewables or Rooftop PV

- As per Scenario 2 but with rooftop PV generation removed as well.

Scenario 5

No Renewables or Rooftop PV w/ Replacement

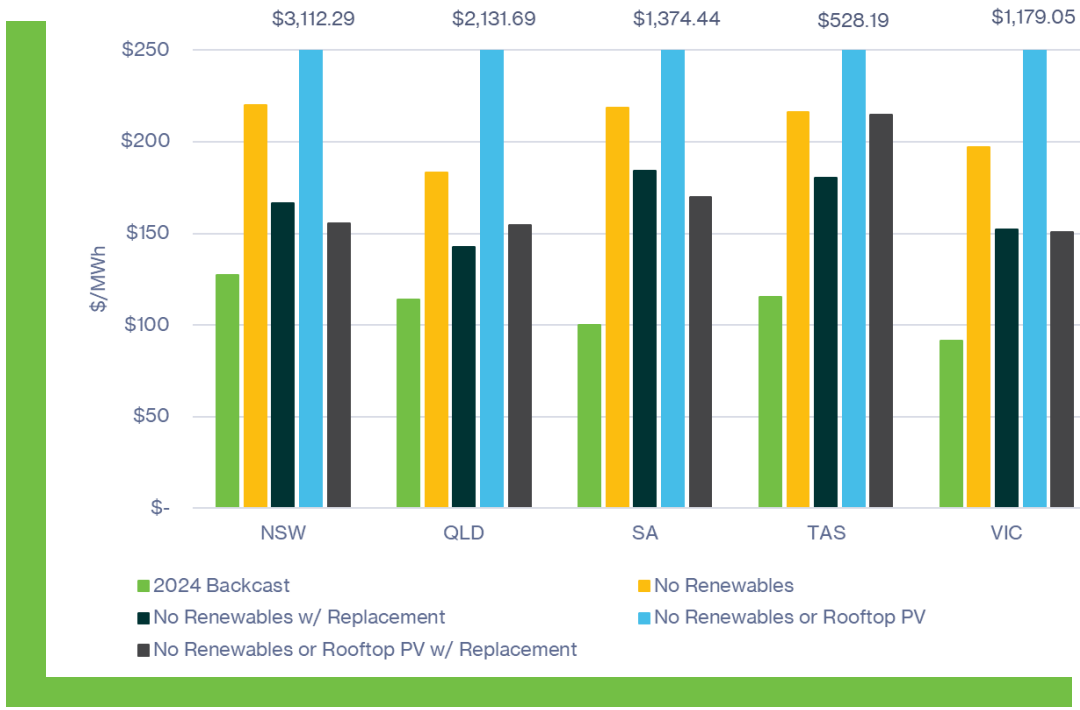
- As per Scenario 4 but with life extensions to all 4 units of Liddell and Torrens A and additional OCGT capacity in all mainland states.

Finding 1. Renewables are applying downward pressure on prices

Without renewables and battery storage assets, wholesale prices are significantly higher by $30-$80/MWh (Sc. 3), with an estimated impact on annual household electricity bills being $155-$417 higher (or 8-22%)[1].

This increases to $400-$3,000/MWh higher without rooftop PV as well (Sc. 5)

- In all scenarios without renewables (Sc. 2-5), wholesale prices are higher as ~40-70 TWh of generation must be replaced.
- Without renewables, more units of Liddell and Torrens A (Sc. 3) or new OCGT plants (Sc. 5) also increases prices significantly compared to the Base case (Sc 1).



[1] Based on assumptions from the AEMC price trends report.

Finding 2. Without renewables, the generation shortfall is mainly filled with expensive OCGT gas generation

Gas capacity factors

GPG is broadly of two types: mid-merit and peaking

Mid-merit (or combined-cycle gas turbine (CCGT)) is designed to run routinely with high-capacity factors. There are about 4 GW of this type currently installed in the NEM.

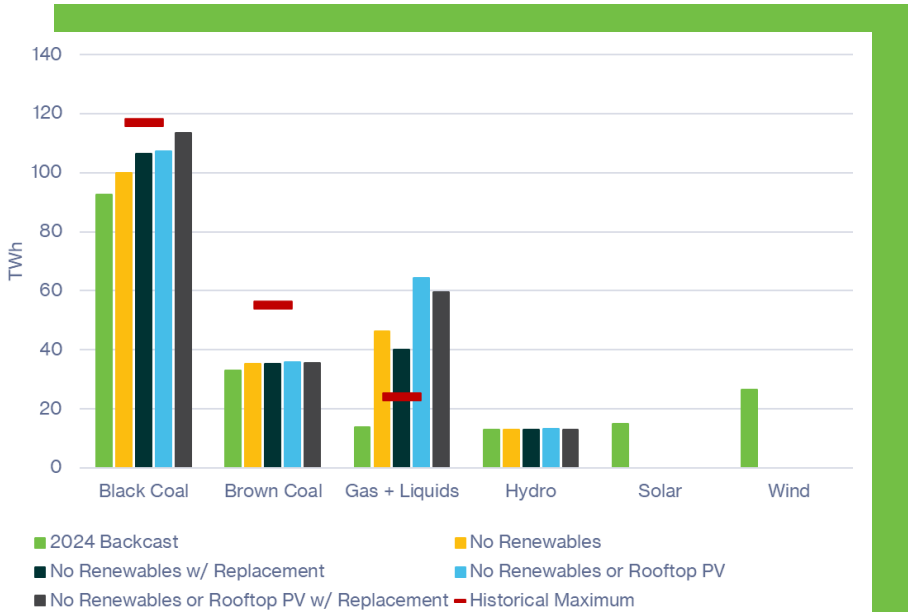
Peaking capacity (or OCGT) is less efficient but also less capital intensive to build so it's designed to run infrequently when prices are high. There are about 5 GW of this type in the NEM.

Peaking gas generators have historically operated with capacity factors below 10% (see chart).

Any scenario with growing gas generation would be heavily dependent on expensive-to-run OCGT plants to drastically increase output well above any historical levels.

Open Electricity

- Without renewables, more energy is supplied from black coal plants.
- However, additional peaking support is still necessary from new OCGT plants, and well over half the generation shortfall is filled with expensive OCGT gas generation.



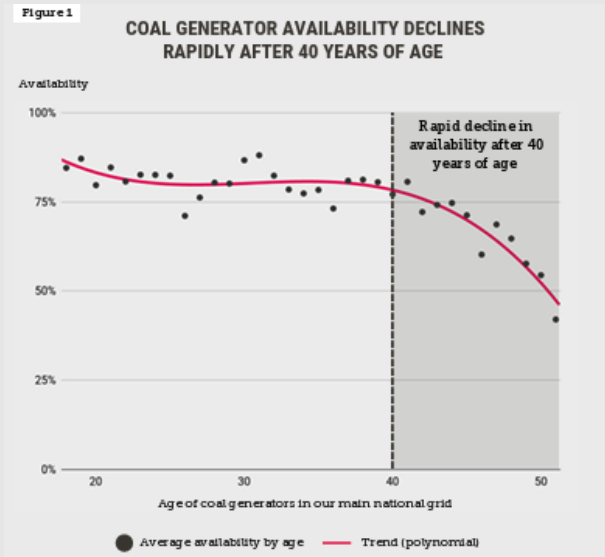
Finding 3. Increasing the grid's reliance on fossil fuel plants would strain ageing infrastructure

- The levels of increased coal and gas generation required to fill the gap from renewables would put enormous pressure on the ageing coal fleet. The largest coal generation year in the history of the NEM occurred in 2008-09 at 117 TWh of black coal and 55 TWh of brown coal, from significantly more plants.
- Likewise, the largest historical generation year for gas and liquids was 24 TWh in 2012-13.

Coal reliability

Historically, coal outage rates grow as facilities age.

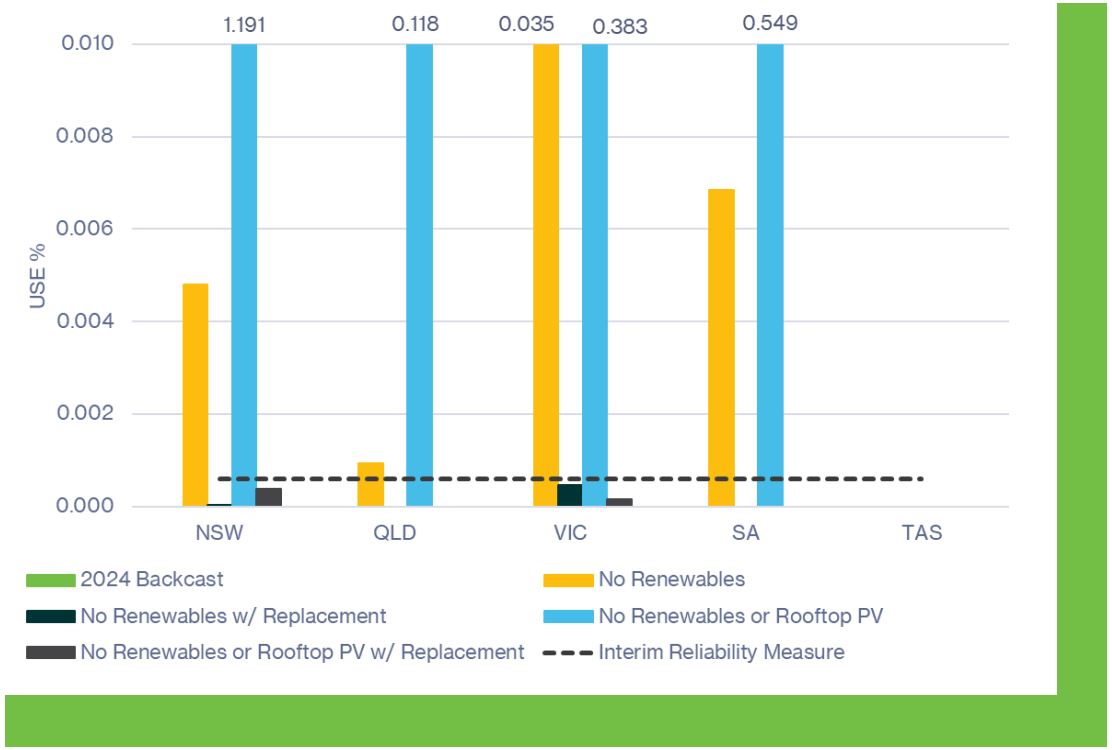
- Coal outages tend to increase from 40 years
- Among the oldest in the NEM are Gladstone (1976) and Vales Point (1978)
- The newest in Victoria is Loy Yang from 1985 (40 years) and in NSW is Mount Piper from 1993 (32 years).
- The newest coal plant in the NEM (and QLD) is Kogan Creek which was commissioned in 2007 (18 years).



Note: Availability refers to the amount of electricity supply offered by coal generators, as a share of their maximum total supply. Trend line based on a third-degree polynomial.

Climate Council - Lights out: Ageing coal and summer blackouts - January 2025

Finding 4. Greater reliance on ageing fossil fuel generators risks reliability of supply



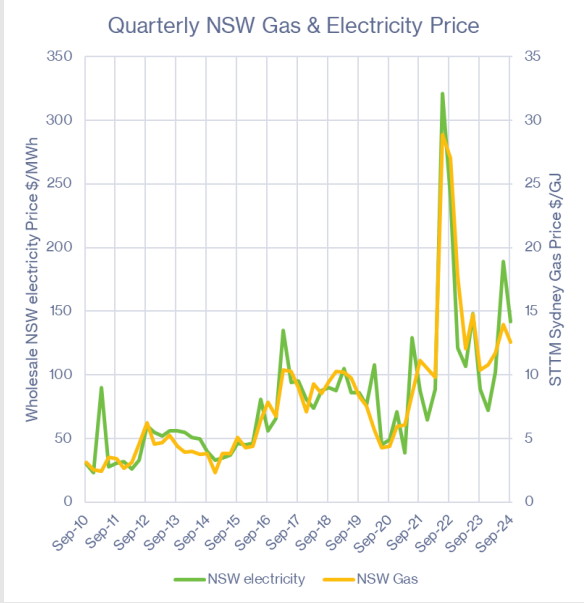
- Without renewables, the Interim Reliability Measure of 0.006% unserved energy would have been breached in all mainland states.
- It is assumed Liddell and Torrens A can continue past their original retirement dates if needed to reduce unserved energy.
- However, if those old plants fail, the reliability standard is not met.

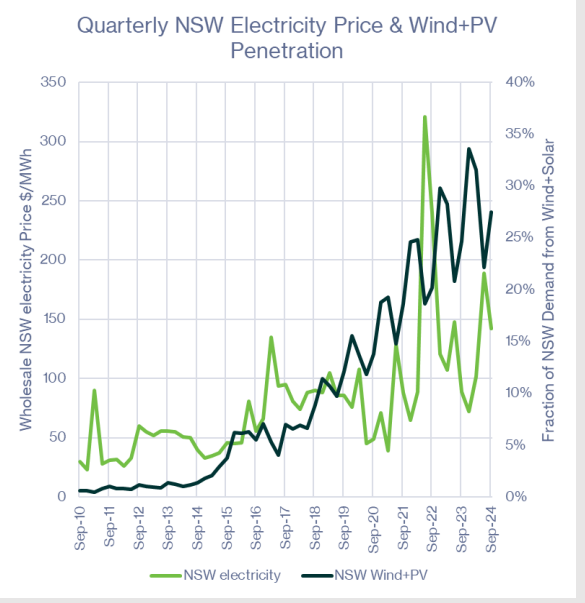
Finding 5. Without renewables, more gas must be diverted away from manufacturing & industry uses

- Without renewables, the energy system uses more gas to fill the gap.
- This diverts gas away from industry and places upward pressure on gas prices.
- In a gas-restricted economy, the focus should be on minimising unnecessary gas consumption.
- As most additional gas is needed south of Queensland, this is also likely to place significant strain on the existing north-to-south gas pipeline and might require new southern gas fields or import terminals.

Gas price drive electricity prices

- Since gas frequently acts as the price-setter in the NEM (either directly, or via shadow bidding by other dispatchable technologies), wholesale electricity prices have historical been highly correlated with gas prices.
- Renewables tend to only set negative prices, and cannot behave strategically, so the correlation with renewable penetration is poor.

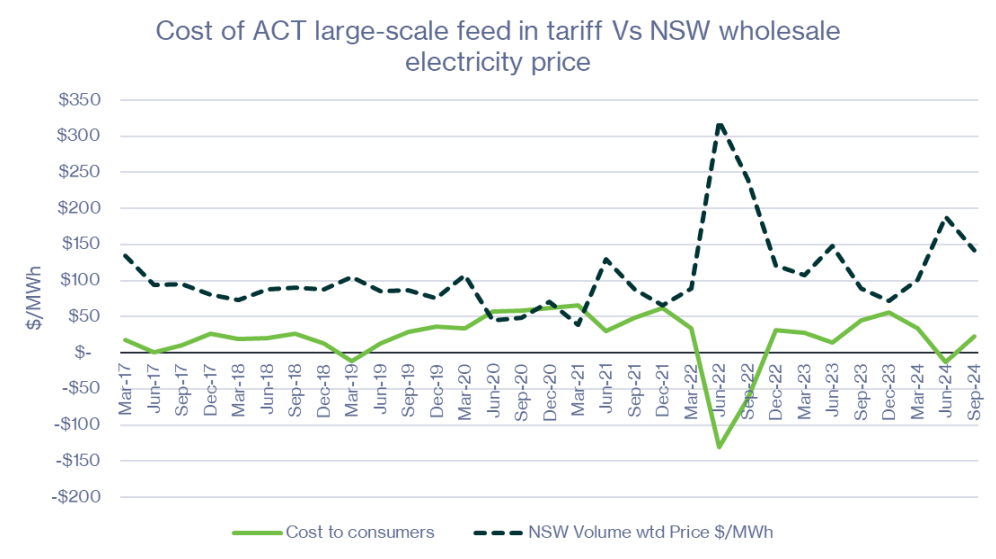




Finding 6. Using fossil fuels rather than renewables increases total system costs

Wind & solar PPAs are great hedges

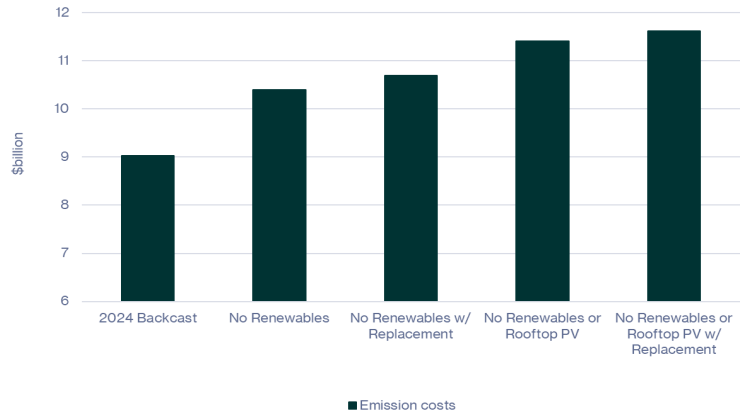
The ACT Government met most of its 100% Renewable target using Contracts for Difference (CfDs) with utility wind and solar projects. The resulting cost of the CfDs is negatively correlated to the electricity price, demonstrating that renewables can be a valuable hedge against volatile wholesale electricity prices



With less capacity and competition, prices are more frequently being set by bids that are above short-run marginal costs (SRMC).

This leads to an increase in total system costs, including:

- Without renewables, fuel and variable operating costs almost double.
- Emission costs also increase by ~$3b using the Australian Energy Regulator (AER) value of emissions reduction.



AER - Valuing emissions reduction - Final guidance and explanatory statement - May 2024

Conclusion

- Our modelling shows that without renewables and battery storage assets, wholesale electricity prices in 2024 would have been **higher by $30-$80/MWh**, with greater risks of blackouts.
- Running a grid using fossil fuels rather than renewables would **increase total system costs, weaken energy security,** and place greater **strain on ageing coal and gas infrastructure.**
- A system reliant on coal and gas would also **divert more gas away from manufacturing and industry,** pushing costs even higher.
- **Renewables, backed by transmission, batteries, and peaking gas, provide the most affordable and stable replacement for retiring coal.**

Appendix

Price setting in the NEM

Fossil fuels generally set prices and renewables do not

- Wholesale prices in the NEM are set by the marginal unit.
- This is very rarely a renewable facility, and when it is, the price is almost always negative.
- Coal and gas are much more instrumental in positive price setting.
- As such, there is a very strong correlation between gas and electricity prices whereas renewable generation acts as a good hedge.

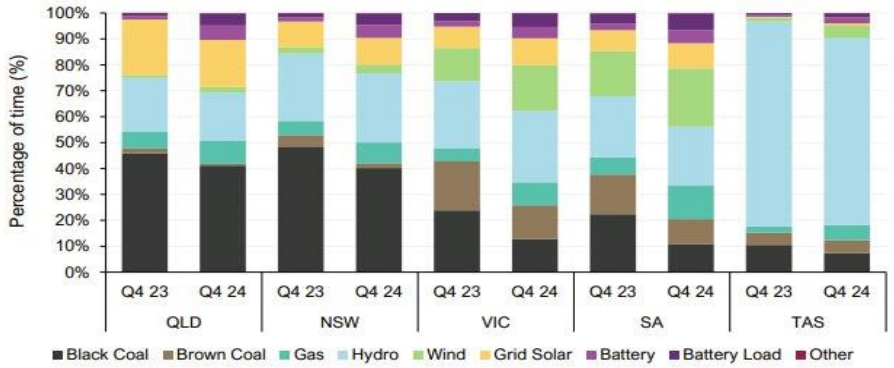
The NEM operates on the principle of marginal price setting – all generators get paid the price of the marginal generator. As such, that marginal generator, and perceptions about its costs and behaviour, are crucial to driving wholesale electricity prices.

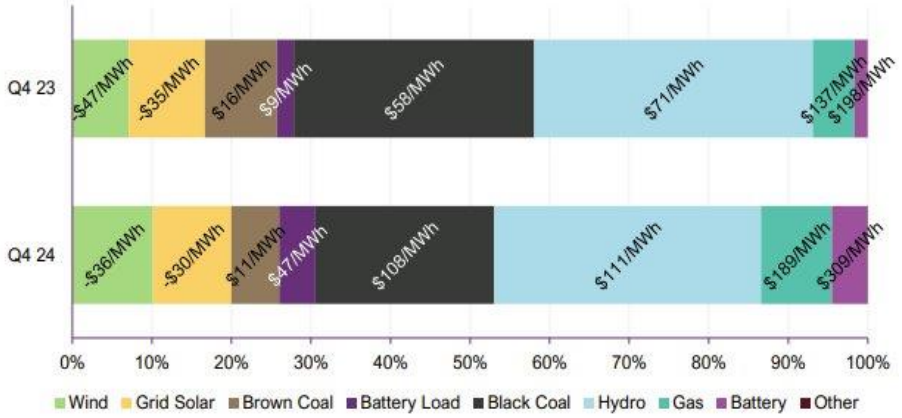
Superficially, it seems that gas is only responsible for a small amount of price setting (both charts[1] show percent of intervals where prices were set by fuel type).

However, through the exercise of market power in a concentrated market it is common practice for coal and hydro to shadow-bid gas. That is, they offer some capacity at values just below gas, so they are dispatched ahead of it. As such, gas is crucial to determining the price outcome in most positive intervals[2].

Wind and solar, in comparison, have historically only set prices at negative values as they tend to offer all their capacity at either the negative of the LGC price or their power purchase agreement.

[1] AEMO QED Q4 2024
[2] Nolan, Gilmore, and Munro, Griffith University, 2022





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