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Impact of Merchant Battery Energy Storage on Electricity Prices: The Case of Australia

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Abstract

Whether merchant arbitrage acts as a counter force to the "merit order effect" of solar and wind is important, but little is explored in the Australian National Electricity Market (NEM). This study fills this gap by studying the impact of charging and discharging stand-alone Battery Energy Storage Systems (BESS) on spot electricity prices considering their rapid recent growth in the wholesale electricity market. Australia is a global leader in BESS, and this study context is also relevant to other countries decarbonizing their energy mix. We use 5-minute wholesale price data between 2024 and 2025 and apply Quantile Regressions with instrumental variables. We find that stand-alone BESS has impact on spot-prices, but the effect is asymmetric: charging BESS increases the spot price, while discharging them decreases the spot price and thus driving self-cannibalisation. The net impact of charging and discharging on the electricity prices on consumer prices can be negative, especially under large scale penetration of BESS. The findings also offer some policy recommendations.

Keywords

electricity, storage, batteries, BESS, Australia, arbitrage

JEL Classification

L50, L94, Q28

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Abstract

Whether merchant arbitrage acts as a counter force to the "merit order effect" of solar and wind is important, but little is explored in the Australian National Electricity Market (NEM). This study fills this gap by studying the impact of charging and discharging stand-alone Battery Energy Storage Systems (BESS) on spot electricity prices considering their rapid recent growth in the wholesale electricity market. Australia is a global leader in BESS, and this study context is also relevant to other countries decarbonizing their energy mix. We use 5-minute wholesale price data between 2024 and 2025 and apply Quantile Regressions with instrumental variables. We find that stand-alone BESS has impact on spot-prices, but the effect is asymmetric: charging BESS increases the spot price, while discharging them decreases the spot price and thus driving self-cannibalisation. The net impact of charging and discharging on the electricity prices on consumer prices can be negative, especially under large scale penetration of BESS. The findings also offer some policy recommendations.

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1. Introduction

The transition toward deep decarbonization of the electricity sector is characterized by a fundamental shift from dispatchable thermal generation to variable renewable energy sources (RES). The penetration of zero-marginal-cost generation from wind and solar depresses the spot prices during periods of high output from RES and reduced demand in markets designed based on marginal cost pricing under unform price auctions (Khezr and Nepal 2021). This leads to increased occurrence of negative prices and volatility (Jamasb et al. 2024). Thus, the deployment of Battery Energy Storage Systems (BESS) has emerged not merely as a technical requisite for grid stability due to their fast response times, but also as a source of both demand and supply in the marketplace.

The primary economic mechanism through which BESS interacts with the spot markets is by temporal arbitrage, i.e. charging during periods of low electricity prices coinciding with periods of high RES in-feed and discharging during peak demand and higher electricity prices. This creates additional demand during off-peak hours (i.e. raising price floors) and displaces expensive peaking plants during high-demand hours (i.e. lowering price ceilings) (Zafirakis et al. 2016). BESS fall into two main categories. First, behind-the-meter BESS is usually coupled with small photovoltaic installations to store energy during hours of excess solar production instead of supplying to the grid and avoid using grid power during peak hours (afternoon/evening) by utilising stored energy to reduce household electricity prices from the grid (Lotfabadi et al. 2025). Second, utility scale BESS[1] are connected to the distribution or transmission network and may have diverse purposes. They firm up RES by storing production to reduce the need for conventional generators in peak time as well as providing ancillary services (e.g., balancing services, voltage control, or system restart services), retail services such as charging of EV stations, or network services such as managing grid congestion (Bashi et al. 2022).

The integration of grid-scale BESS is rapidly growing globally due to their declining costs and increased market acceptance. They are developed under private-public partnerships involving the private sector and different government levels. Such partnerships are necessary in capital risk allocation as BESS technologies still face relatively high capital costs, making investments risky while the uncertainty in revenues and the regulatory framework cannot be underestimated (Poudineh and Apostolopoulou 2024). However, in Australia, many BESS have been developed as merchant projects. The Australian National Electricity Market (NEM) is experiencing a rapid rise of RES and BESS where BESS capacity is predicted to grow from 2.3 GW in 2024 to 18 GW in 2035 (BloombergNEF 2025).

The importance of BESS in the NEM stems from the dual role of grid stabilization and financialization as a strategic financial asset base. BloombergNEF (2025) estimates that

[1] These baterries are also known as front-of-the-meter batteries (FTMBs).

utility-scale BESS in the NEM earned A$165.4 million (US$104 million) in revenue from arbitrage in 2024 which was a record high and more than triple the revenue earned in 2023. Australia is also a globally significant case for the analysis of impact of storage on spot prices due to its unique position as a leading adopter of decentralized energy technologies and its rapid transition toward a high-RES grid. Electricity prices in the NEM are extremely volatile favouring BESS participation owing to a combination of factors such as a complex mix of high-RES penetration, extreme weather, aging infrastructure involving conventional power plants and their subsequent retirements and interconnected regional markets.

The Australian NEM is currently undergoing a structural transformation where aging coal-fired generation is being displaced by RES, leading to high price volatility and frequent periods of negative spot prices (AEMO 2025). The proactive implementation of innovative policy frameworks such as the Capacity Investment Scheme (CIS) makes the Australian market a critical reference point for evaluating regulatory responses to the "missing money" problem in evolving energy-only markets landscapes, i.e. a situation where revenues from spot market are insufficient to cover investments (Joskow 2008). The CIS is an Australian Government revenue underwriting and reverse auctions for contracts-for-difference scheme to accelerate investment in RES, such as wind and solar, and clean dispatchable capacity such as BESS (Australian Government 2025a). It provides a long-term revenue safety net that decreases financial risk for investors and ensures more RES and BESS projects are built. The Australian government in 2025 undertook a review of its wholesale electricity market (i.e. the 2025 NEM review) against this backdrop (Nelson et al. 2025). Australia's rapid deployment of BESS also offers lessons of experience for other countries in demonstrating that effective integration of large-scale BESS into power grids can accelerate RES adoption and the associated environmental benefits while enhancing grid security and financial opportunities.

The literature on BESS has focused on capturing several dimensions such as environmental impacts of BESS supply chain (Llamas-Orozco et al. 2023); the BESS's lifespan (Casals et al. 2019; Kebede et al. 2023); grid-scale economic viability of BESS based on size and technologies (Yang et al. 2024); the capitalization on price spreads between off-peak and on-peak intervals (Walawalkar et al. 2007; Zafirakis et al. 2016; Antweiler 2021); bidding strategies and potential market power from BESS operation (Williams and Green 2022; Khezr and Menezes 2025; Lv et al. 2026); co-optimization or arbitrage with ancillary services (Kim et al. 2023); use of second-life BESS for grid-scale solutions (Mohanty et al. 2026); and long-term techno-economic profitability studies on utility scale BESS (Grimaldi et al. 2024). Some studies analyse whether the current market designs provide sufficient long-term investment signals for storage (Newbery et al. 2018). Other authors analyse the impact of BESS on the Australian Frequency Control Ancillary Services (FCAS) and find they significantly lower FCAS costs (Rangarajan et al. 2023). However, to our knowledge, empirical assessment of charging and discharging BESS as an energy arbitrage mechanism in the Australian NEM electricity market has received little attention.

This study aims to explore the following research proposition around whether BESS induces an asymmetric merit-order effect in the electricity markets either in the 5-minute price and its volatility by testing for the actual impacts of arbitrage on the Australian spot prices. These results are highly significant because of their welfare implications in terms of prices for customers. Electricity is also the main input for heavy industrial processes. Studying the impact of BESS on spot prices of traded energy is of global relevance as the penetration of variable RES is on the rise while the closure of ageing thermal generation continues.

Analyzing the impact of BESS on wholesale price formation and volatility in Australia is a high-value policy contribution. The Australian NEM is a global "testbed" for capturing the dynamics of an energy-only market designs under extreme RES penetration. Unlike European or US markets with capacity payments or binding day-ahead auctions, the NEM's scarcity pricing relies on extraordinary spot price volatility—with a market price cap exceeding AUD $20,000/MWh—to signal investment scarcity. This research tests the "efficiency hypothesis" of BESS in its purest form: determining whether merchant arbitrage successfully acts as a countervailing force (i.e. increasing demand when prices are low and increasing supply when prices are high) to the "merit order effect" of solar and wind (i.e. always pushing down prices due to zero marginal cost). This analysis is critical for policymakers, as it reveals whether the current market design can smoothly transition from thermal-based inertia to BESS-based flexibility. The findings are relevant for electricity markets like the NEM which are becoming more weather dependent, more energy constrained, less dispatchable and less scheduled systems.

We use 5-minute data between 2024 and 2025 provided by the National Electricity Market Review secretariat of the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). We use the Quantile Regression (QR) for modelling spot electricity prices, which provides a semi-parametric formulation of the predictive distribution and coefficients values at different quantile levels (Koenker and Bassett Jr 1978). QR is a foundational technique in power system studies due to its efficiency in mapping conditional probability distributions (Maciejowska 2020; Westgaard et al. 2021; Do et al. 2024; Mwampashi and Nikitopoulos 2026). Mwampashi and Nikitopoulos (2026) examine the impact of RES on the Australian electricity market using QR, but for the 2011–2022 period.

The remainder of the paper is organized as follows. Section 2 describes the role of BESS in the power systems. Section 3 introduces the Australian case. Section 4 explains the dataset and model specification used in this study. Section 5 presents the results. Section 6 concludes and offers policy recommendations.

2. BESS in the Decarbonising Power Systems

Electricity must be consumed at the same time as produced implying that supply needs to instantaneously balance demand in real-time spot market. On one side, electricity demand follows hourly and seasonal patterns with peak loads at 10h and 20h, while peak solar production is around noon, but zero in the evening. Moreover, meteorological phenomena are variable - solar production is lower on rainy days, while wind power output varies with depressions or anticyclones. The variability and intermittency of RES require using more costly conventional technologies. As a result, spot electricity prices are minimum during peak solar production, but maximum at evening peak demand. Higher penetration of RES occurs when demand cannot absorb all RES output. This phenomenon is increasingly common in spring and autumn, when solar radiation is at its maximum, but demand is moderate because temperatures are neither cold nor extremely hot.

In liberalised wholesale electricity markets, this can lead to zero-negative prices, when some producers pay the market operator to keep generating rather than stop their production. There are a variety of reasons why producers may be willing to pay to keep generating: specific technologies incur costs to start, ramp up or down at short notice; some generators compensate their revenue loss by subsidies or selling RES certificates while some generators operate to avoid financial penalties (Davi-Arderius and Jamasb 2026).

In this context, BESS offers a solution by storing energy during periods of RES oversupply and releasing it during periods of RES scarcity. The underlying business model is to charge during hours with zero or negative spot prices and discharge during peak prices, known as arbitrage. The spread between the discharge revenue minus the operating costs and its energy efficiency constitutes the net BESS revenue (Zafirakis et al. 2016).[2] Energy arbitrage works both for large-scale BESS and smaller residential systems, but economies of scale, decreasing manufacturing costs and lower network charges at high voltage make the development of large-scale BESS economically attractive (International Energy Agency 2025). Karaduman (2021) find that arbitrage revenues can diminish with the penetration of more BESS in markets. NREL forecasts that capital costs for BESS will decrease from almost 500 A$/KWh (2023) up to 255 A$/KWh in 2030 and 159 A$/KWh in 2050 (Cole and Karmakar 2023).

However, this strategy faces certain technical limitations. The power system requires a minimum volume of synchronous rotating generation (nuclear, gas or coal) to ensure grid stability and security, which limits the percentage of demand covered by BESS.[3] There are technical solutions to overcome these operational limitations, such as the installation of Static Synchronous Compensators (STATCOMs), use grid-forming power electronics,

[2] In a BESS, the ratio between the output energy over the input energy sets its efficiency, also known as Round-Trip Efficiency (RTE). As reference, 80% of efficiency in hydro pumping storage, and 90% in utility-scale storage (Energy Information Administration (EIA) 2021; Lazard 2024).

[3] BESS are made of inverted-based resources (IBR) whose operation is slightly different from the rotating synchronous generation in thermal plants. These operational constrains do not apply to hydro pumping storage, as rotating synchronous generators (Davi-Arderius et al. 2025).

etc. Some of these are not yet commercially mature solutions involve additional costs, especially in the case of grid-forming power electronics (Lin et al. 2020; Bahrani et al. 2024).

The role of BESS in the power system also goes beyond simple economic arbitrage. BESS can modulate their charging and discharging in a very short time, which is essential for the provision of ancillary services such as balancing services responsible for ensuring the balance between demand and generation, reactive energy for voltage control, or black start service to restore the system after a blackout. This represents a complementary business case for BESS. Other revenue drivers include capacity payments, providing retail services like powering Electric Vehicle (EV) charging stations and contractual arrangements such as tolling agreements implying that BESS assets can unlock their true value by accessing a variety of revenue streams. A tolling agreement is essentially a lease agreement where an off-taker pays a fixed fee in exchange for full operational control overtrading of the BESS and the market revenue it generates[4].

The International Energy Association (IEA) expects that the capacity of behind the meter and utility scale BESS will grow from 33 and 54 GW (2023) up to 203 and 1,001 GWh (2030), respectively on the Net Zero Emissions scenario (International Energy Agency 2024). Similarly, IRENA reports BESS as a key enabler to cover RES power supply-demand gaps and foster integration of RES. In recent years, several countries have implemented economic subsidies for BESS. Among others, reduction on taxes under the Inflation Reduction Act in the US[5], diverse funding programs in Germany[6]; reduced VAT on BESS installations in the UK[7]; specific subsidies for grid-scale BESS projects in Japan[8]; regional subsidies for flow BESS across China[9]; tax credits for clean technologies in Canada[10]; or specific subsidies for stand-alone BESS in Spain[11].

In Australia, the increased demand for BESS is due to commitment to ambitious green energy targets by the Australian states and territories, government incentives such as the RES Target providing financial incentives and supportive legislation for BESS. Off-grid and fringe-of-grid BESS-based electrification policies as well as innovative private sector financing models such as portfolio financing for the development of new RES assets has also led to the rapid deployment and integration of BESS in the power system and establishing Australia as the market leader in BESS.

[4] The owner hands the "keys" over to the off-taker for a period (usually 5–10 years) after which the owner takes control. https://www.dentons.com/en/insights/alerts/2025/november/6/offtake-agreements-for-bess-projects-structuring-the-next-wave

[5] https://pv-magazine-usa.com/2025/07/10/what-the-budget-bill-means-for-energy-storage-tax-credit-eligibility/

[6] https://lghomebatteryblog.eu/electricity-storage-subsidies-in-germany/

[7] https://www.capture.energy/blog/government-grants-and-tax-reductions-for-battery-storage

[8] https://japanenergyhub.com/news/fy2024-meti-grid-scale-storage-subsidy-results/

[9] https://www.zhenergy.net/article/a488

[10] https://bxenergysystems.com/blog/how-to-use-canadas-30-clean-technology-tax-credit-to-fund-your-battery-storage-project/

[11] https://www.ess-news.com/2024/12/16/spain-allocates-e150m-for-2-82-gwh-of-grid-scale-standalone-batteries/

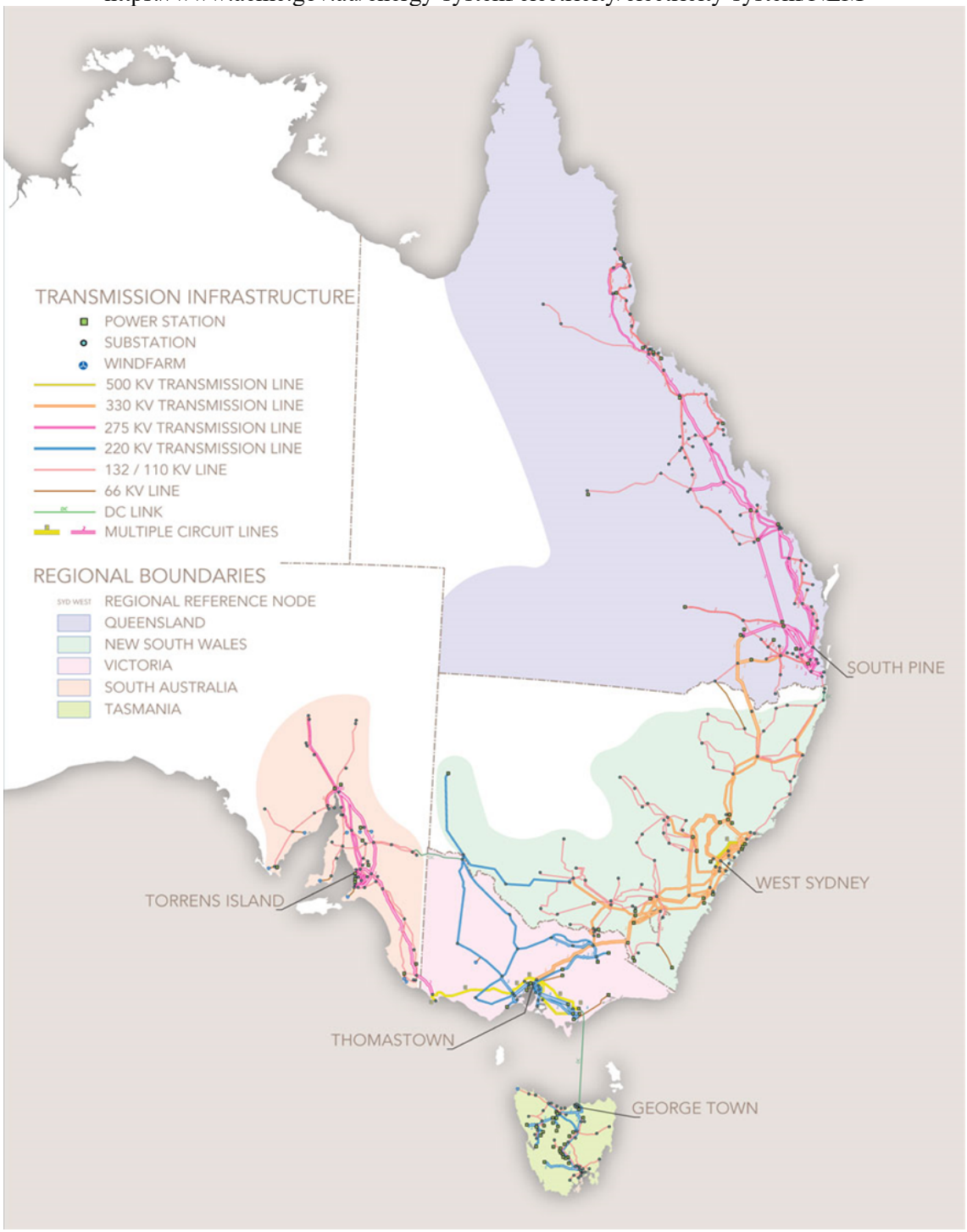
3. The Australian Case

The Australian Government's 'Powering Australia Plan' was launched in 2021 to reduce emissions by boosting RES. This plan commits to a 43% reduction in emissions by 2030 (below 2005 levels) and Net Zero by 2050, with a recently announced interim target of 62% to 70% by 2035 (Australian Government 2025b). The RES target which called upon an additional 33 GW of capacity from green sources annually from 2020 to 2030 ignited the early growth in the BESS market. Since 2012, nearly all grid-scale investment in generation has been in RES, i.e. wind and solar. Between 2014 and 2024, more than 6.6 GW coal-fired and gas-powered capacity left the market. Over the same period, around 18.5 GW of large-scale wind and solar capacity and 18.2 GW of rooftop solar capacity came online (AER 2026a) . The 'Powering Australia Plan' also includes a commitment to build 400 community BESS across the economy and contribute to the resource adequacy requirements. Since 2024, every Australian state and territory government has set targets to achieve net zero emissions by 2050 or sooner which has contributed to the fast-growing BESS capacity.

According to the Australian Energy Regulator, price volatility in the NEM has increased significantly compared with 2020 in response to the interplay between intermittent generation sources and fluctuating demand. Around the same time, grid-scale wind and solar resources increased their share from 0 to 23% from 2008 to 2023 (Leslie and Billimoria, 2025). The number of hours with negative prices is increasing year over year due to hours with a surplus of production spurred by continuous RES growth (AER 2026b). Reduced grid-based demand (driven in large part by more rooftop solar and BESS), and generators offering electricity at negative prices to guarantee dispatch since the market operator Australian Energy Market Operator (AEMO) dispatches the generators with the lowest generation offers first is experienced.

The NEM physically interconnects the electricity transmission networks of the five eastern Australian states as shown in Figure 1. The NEM is one of the world's longest interconnected power systems located on Australia's east coast serving the states and territories of Queensland (QLD), New South Wales (NSW), Victoria (VIC), Australian Capital territory, South Australia (SA), and Tasmania. It commenced as a wholesale market for electricity in December 1998 with Tasmania eventually joining in 2005 and therefore the NEM becoming fully operational. The market possesses about 40,000 km of transmission lines and cables while serving more than 85% of Australia's population (AEMO 2025).

Figure 1. The five states in the Australian NEM.
Source: AEMO (AEMO 2026)
https://www.aemc.gov.au/energy-system/electricity/electricity-system/NEM



The five states in the NEM each operate their own bidding price zone (i.e. zonal or regional pricing) with the regional market clearing at different prices. Ideally, regional prices are reflective of the different demand and generation patterns including limited interconnection capacity between each state. The NEM is a gross pool arrangement implying all generators across the system sell into the same "spot" market and remains an energy-only market. Therefore, generators are only paid only for the electrical energy

they produce with no separate payment for being available to provide capacity or an explicit capacity market. There is no forward energy market in the NEM being a mandatory gross pool but there are bilaterally traded forward and futures contracts used as financial derivatives by generators and retailers to hedge against spot price volatility risks while the AEMO operates the entire market via a single 5-minutely spot market. A market for FCAS exists to maintain grid stability which combined with the energy only market is expected to generate adequate revenues for new generation investments.

Therefore, wholesale price volatility is an inherent feature of the NEM guided by the scarcity pricing principles with high price caps and floors (ranging from -A$ 1,000/MWh to over A$20,300/MWh until June 2026 and will increase thereafter), 5 minutes dispatch and no capacity market. The high price caps are also expected to provide better market signals for new and fast-start generation capacities, such as BESS (AEMO 2026).

3.1. Generation Mix

Table 1 illustrates the capacity by technology. Rooftop solar represents the largest share of the energy mix at 25% (25,000 MW), followed by black coal at 16% (16,435 MW). RES, including wind (14%) and solar (12%), contribute significantly to the total capacity, while transitional or peaking fuels such as gas (13%) and brown coal (5%) maintain a smaller footprint. Biomass and BESS account for the smallest portion of the projected portfolio at 0.7% (400 MW). Traditional power sources, such as coal, gas and hydro, are dispatchable, i.e. they can be turned on and off as required. However, there are differences on how quickly it can be turned on and off or ramped up and down since output from RES changes quickly. Coal plants require many hours to turn on and can only ramp up and down slowly, which makes them less suited to balance out RES fluctuations.

Conversely, gas and hydropower need minutes for ramping up or down. BESS can adjust their outputs in minutes or seconds, which makes them a relevant enabler for further integration of RES in the system (AER 2026a, b). Likewise, in terms of generation supply mix, the NEM relied on coal for around 52% of power supply and followed by wind (16%), rooftop solar (13%) and grid solar (8%). BESS supplied less than 1% in the supply mix in 2025.

Table 1. Generation capacity by technology and share of the energy in Australia in 2025. Source: Own elaboration based on (AEMO 2026).

Technology	Capacity (MW)	Share of generation mix
Black Coal	16,435	38.50%
Brown Coal	4,820	13.40%
Gas / Liquids	12,794	4.50%
Hydro	8,027	5.80%
Wind	14,016	15.60%
Solar farms	12,217	8.20%
Rooftop Solar	25,000	13.20%
BESS	5,764	0.70%
Biomass	400	0.20%
Other	152	

Regarding the BESS development, the Australian Government's 'Cheaper Home Batteries Program' which was launched on 1 July 2025 provides a 30% discount on BESS systems for a wide range of applicants, including households, businesses, and community facilities like town halls or sports centres. This initiative was designed to support both consumers with pre-existing solar installations and those looking to invest in a completely new solar-plus-battery setup. The program was funded by the Australian Government and is therefore structured to prevent any additional costs from being passed on to the consumer. Furthermore, the program was designed to be compatible with other jurisdictional BESS incentives, effectively allowing eligible customers to stack support from multiple schemes to maximize their savings (Australian Government 2025c).

Tables 2 and 3 illustrate the diverse energy generation landscape across Australia's NEM and its constituent states as of December 31, 2024.[12] To facilitate a better comparison of installed capacity for each technology across states, we calculate its ratio of installed capacity to average hourly demand, as a proxy for its theoretical demand coverage.[13] Rooftop solar holds the top position in installed capacity in NEM, VIC, and NSW, but its participation on the demand coverage in SA is twice than the rest. The state-level data reveals significant regional variations in energy mix. For instance, thermal technologies are present in all regions, but with heterogeneous ratios: it ranges between 140 and 180% in NSW, QLD and VIC, but 233% in SA. BESS capacity ranges between 505 and 730 MW in 2024, while 928 and 1711 MW in 2025, but there's also an heterogenous role in its demand coverage in SA is several times higher than the rest of states.

[12] No generation data by region was found by late 2025.

[13] This indicator enables us to identify a potential impact of a technology on the electricity markets. For instance, a technology with a significantly high ratio can exert a greater influence on electricity markets than one with a very low ratio. We acknowledge that this ratio does not show the actual demand coverage, which would require using the average energy production from each technology.

Table 2. Generation capacity by technology (MW) and state in 2024. Percentages show the ratio of capacity over annual average electricity demand in each state.

Technology	NSW		QLD		SA		VIC	
Coal	8,305	111%	8,130	131%	0	0%	4,820	102%
Gas / Liquids	2,361	31%	3,387	54%	2,970	233%	2,400	51%
Hydro	2,532	34%	726	12%	0	0%	2,219	47%
Wind	2,655	35%	1,006	16%	2,361	185%	4,131	87%
Solar farms	4,402	59%	3,536	57%	693	54%	1,220	26%
Rooftop Solar	7,466	100%	6,739	108%	2,554	200%	4,966	105%
BESS	360	5%	505	8%	716	56%	780	16%
Other	21	0%	0	0%	113	9%	0	0%
Average demand (MWh)	7,497		6,221		1,275		4,733	

Table 3. Generation capacity by technology (MW) and state in 2025. Percentages show ratio of the capacity over annual average electricity demand in each state.

Technology	NSW		QLD		SA		VIC	
Coal	8,345	111%	8,130	130%	0	0%	4,820	99%
Gas / Liquids	2,302	31%	3,567	57%	3,098	233%	2,400	49%
Hydro	2,532	34%	726	12%	0	0%	2,267	46%
Wind	2,826	38%	2,380	38%	2,752	207%	5,358	110%
Solar farms	5,406	72%	3,964	64%	728	55%	1,355	28%
Rooftop Solar	7,960	106%	7,580	122%	2,850	215%	5,730	117%
BESS	928	12%	1115	18%	931	70%	1711	35%
Other	0	0%	0	0%	0	0%	0	0%
Average demand (MWh)	7,497		6,231		1,328		4,881	

Source: Generation mix from “NEM January 2026 Generation Information” (AEMO 2026) and rooftop solar from (Clean Energy Council 2026).

3.2. The Capacity Investment Scheme

Revenue certainty is difficult to achieve without additional financial contracts in an energy-only wholesale electricity market like the NEM. Energy-only markets have no explicit mechanism for pricing capacity and therefore suffer from structural revenue deficit to cover fixed costs and investments in new capacities. This is commonly known as the ‘missing money’ problem (Joskow 2008; Simshauser 2019). To address this problem, in early 2023 the Australian government introduced a revenue underwriting scheme through the Capacity Investment Scheme (CIS) to accelerate investment in RES (wind, solar, etc.) as well as clean dispatchable capacity such as BESS (especially long duration batteries). The aim is to provide a long-term revenue safety net that decreases financial risk for investors while ensuring more RES projects get built. As an out-of-market contract, CIS provides long-term revenue certainty for new projects. These contracts are tendered with individual project developers and provide guaranteed floors

on energy market revenues, including a clawback on revenues above an agreed cap (Australian Government 2025a). CIS includes a two-way Contracts-for-Differences (CfD) support mechanism: (i) when earnings fall below a limit, the government compensates the shortfall, but (ii) when profits exceed a threshold, the owner should share part of the profits with the government.

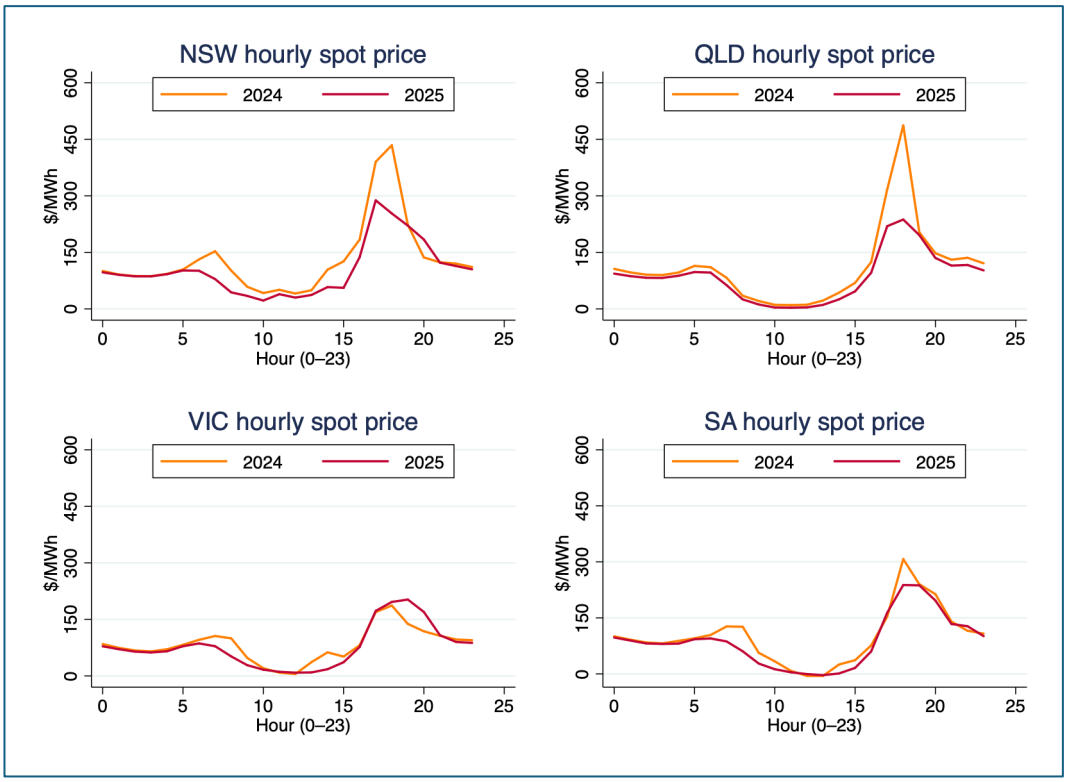
On November 2023, an expansion of CIS was announced by the Australian Government to target a total of 32 GW of new capacity nationally. On 29 July 2025, the CIS capacity was uplifted to 40 GW. This raised targets from: 23 GW to 26 GW of RES generation capacity 9 GW to 14 GW of clean dispatchable capacity. The expanded CIS will be rolled out from 2024 to 2027. Auctions for both generation and dispatchable capacity will continue to be held regularly from 2024 – 2027 and will support about A$73 billion in investment in the sector (Australian Government 2025a). However, the sample period of our study (2024-2025) does not include any CIS-awarded operational BESS. Billimoria and Simshauser (2023) have further argued that storage contract design is complex and that simple contract forms can create incentive incompatibility unless interactions with storage operation and investment are carefully analysed.

4. Data

The 5-min dataset for this study (1.1.2024-31.12.2025) has been compiled from the AEMO (AEMO 2026). Supplementary market performance data and historical context were cross-referenced with AER (2026a). Tables A1, A2 and A3 show the summary statistics of the variables used in our study. The original regulator data has a five-minute frequency.

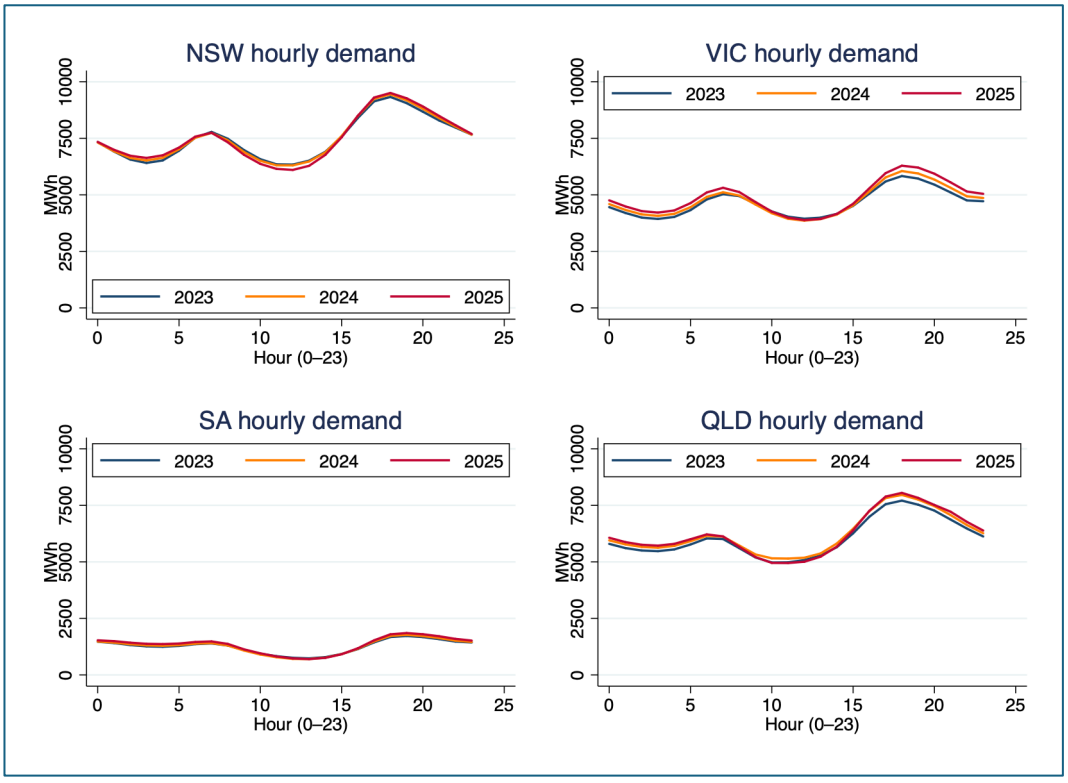
The structural entrenchment of the "duck curve" across the NEM exhibits that high solar penetration drives midday prices toward zero between 10:00 and 14:00, effectively in South Australia and Victoria (Figure 2). This price depression creates a significant arbitrage spread against the evening peaks (17:00–20:00), which is volatile across both the 2024 and 2025 horizons. The data shoes that the potential economic viability of BESS is increasingly driven by cycling against predictable, solar-driven intraday differentials rather than solely relying on stochastic events and scarcity. Moreover, electricity demand is stable and inelastic, with negligible deviation between the 2024 and 2025 profiles across all states (Figure 3). This contrasts with the volatility observed in spot prices, isolating the "duck curve" phenomenon as a dominant supply-side shock driven by RES generation rather than a mere function of shifting consumption patterns. The decline in grid-based electricity demand during mid-day hours has been driven by the significant growth in rooftop solar installations across residential areas (Figure 4). Conversely, demand for electricity has increased during the early morning and early evening periods, in part due to population growth (AER 2026b).

Figure 2. Average hourly spot price by state.



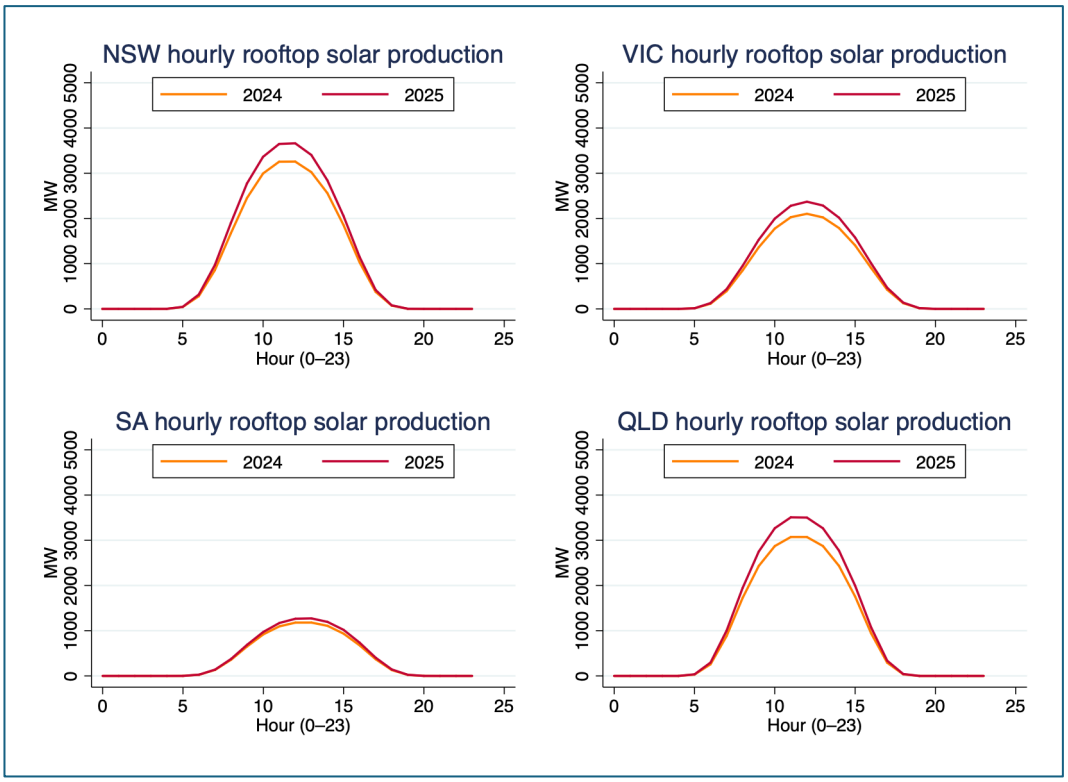
Source: Own elaboration

Figure 3. Average hourly electricity demand by state.



Source: Own elaboration

Figure 4. Average hourly rooftop solar production by state.

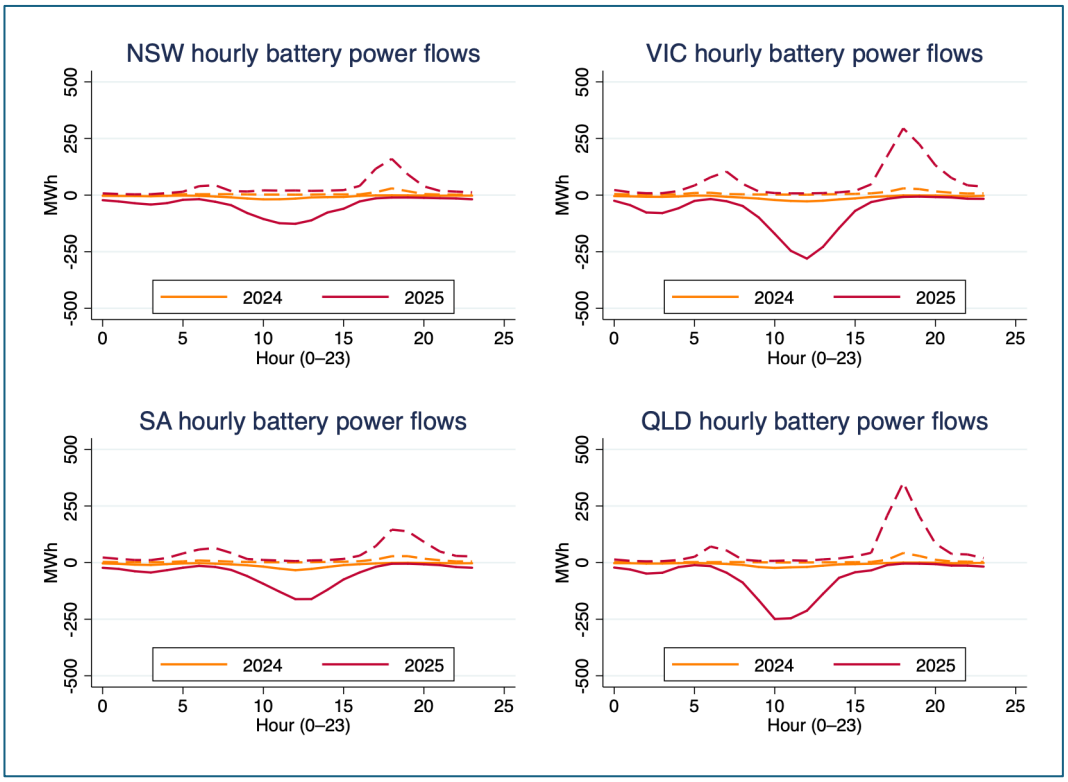


Source: Own elaboration

Figure 5 depicts the hourly dispatch profiles of BESS, revealing a pronounced bimodal operation strategy that mirrors the arbitrage spreads identified in Figure 2. The transition from 2024 (orange) to 2025 (red) demonstrates a significant intensification of this behavior; midday charging loads (negative MWh) deepen substantially between 10:00 and 14:00 to absorb surplus RES generation, while evening discharge peaks (positive MWh) nearly double in amplitude across Victoria (VIC) and Queensland (QLD). This aggressive scaling of the charge-discharge cycle confirms that BESS assets are successfully capturing the deepening intraday value pool, effectively shifting energy from periods of "cannibalized" pricing to intervals of peak scarcity.

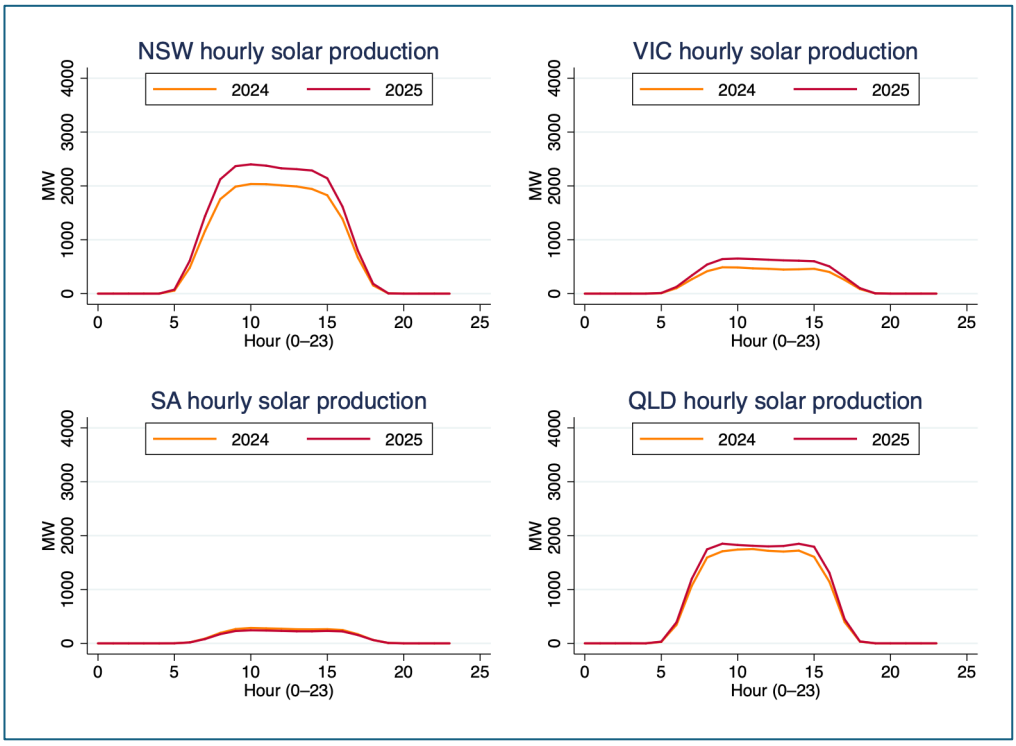
Figure 6 illustrates the supply-side driver of the previously observed price suppression: a systemic increase in solar production, most notably in New South Wales (NSW) where peak noon output rises between 2024 and 2025. This additional injection of zero-marginal-cost energy during the 10:00–14:00 window directly correlates with the deepening of the "duck curve" troughs, confirming that the expanding solar fleet is the primary cause of intensifying the arbitrage spreads that BESS assets are seeking to exploit.

Figure 5. Average hourly energy from BESS by state.
Dashed lines mean discharging, while solid lines charging.



Source: Own elaboration

Figure 6. Average hourly solar production by state.



Source: Own elaboration

Table 4 summarizes the regional energy BESS between 2024 and 2025, showing a massive surge in both charged and discharged energy across all state. In 2025, total stored and exported energy was 2,036 GWh and 1,629 GWh, respectively. However, it is important to highlight that BESS cycle efficiency (Round-Trip Efficiency) ranges from 73% to 80%m which implies that 20% of the stored energy in BESS is lost in the arbitrage process (Luo et al. 2015).

Table 4. Total charged and discharged energy in BESS by state (in GWh).
Source: Own elaboration.

	NSW		QLD		SA		VIC		**TOTAL**	
	2024	2025	2024	2025	2024	2025	2024	2025	**2024**	**2025**
Discharge	41	282	50	470	61	347	67	529	**219**	**1,629**
Charge	56	396	60	567	82	433	86	641	**284**	**2,036**
Efficiency	73%	71%	84%	83%	74%	80%	79%	83%	**77%**	**80%**

5. Model Specification

The empirical specification involves a two-fold process: an analysis of the conditional relationships among variables using binned scatter plots, and QR estimates to identify the asymmetric determinants of electricity prices.

5.1. Conditional Relationship

We use binned scatter plots, namely "binscatters", to non-parametrically visualize the conditional relationship between electricity prices and BESS operations. These plots provide a flexible, data-driven method to approximate the conditional expectation function (CEF) without imposing a strict functional form and isolate noisy (Chetty et al. 2014; Cattaneo et al. 2024). This procedure allows us to inspect the functional form of the conditional relationship between BESS dispatch and spot prices, effectively illustrating how the marginal impact of BESS operations have shifted between 2024 and 2025 across the NEM regions.[14] The binned scatter plots have been used to make scatter plots with very large datasets because they group variables into equal sized bins (Elliott et al. 2021; Chakraborti and Shimshack 2022; Kuchler et al. 2022; Lee et al. 2026).

The construction of binned scatter plots follows a standard procedure based on the Frisch-Waugh-Lovell theorem (Frisch and Waugh 1933):

- For BESS discharging, the procedure first residualizes the dependent (SP_t^s) and independent ($DBESS_t^s$) variable against the specified controls ($Techn_t^s$) to isolate their direct relationship.

[14] The binned scatter plots have been made with the “binscatter” package in Stata (Stepner 2013).

$$[Techn_t^s] = [DPUMP_t^s; RSOL_t^s;\ SOL_t^s; WIND_t^s;\ HYD_t^s;\ BIO_t^s;\ GAS_t^s;\ COAL_t^s;\ DIESEL_t^s; OTH_t^s] \quad (1)$$

- For BESS charging, the procedure is the same but the specified control to isolate the direct relationship is the total electricity demand ($TDEM_t^s$).
- The residualized independent variable is then partitioned into equal-sized bins (typically percentiles), and finally the conditional means of both variables within each bin are plotted.[15]

5.2. Quantile Regression

As shown in Table A4, the Jarque Bera test statistics reject the null hypothesis of a normal distribution ($p < 0.01$) for all variables, primarily driven by extreme leptokurtosis and positive skewness (Jarque and Bera 1980). In order to investigate the asymmetric determinants of the Australian spot electricity prices, this study employs a QR framework (Koenker and Bassett Jr 1978; Koenker and Xiao 2006). QR extends the traditional hypothesis that the effect of independent variables on endogenous variables is constant across all market states, i.e. the mean-based estimations, with the analysis of the conditional distribution of the dependent variable.

The application of QR is relevant to the analysis of electricity markets since the integration of intermittent RES alters the traditional merit-order effect. For instance, Maciejowska (2020) assess the asymmetric impact of wind and solar on electricity prices; Uribe et al. (2022) assess the relationship between electricity and natural gas prices in Europe; Westgaard et al. (2021) analyses the electricity market in California and assess the effects of gas prices, allowance prices, load, solar, and wind; Kaur et al. (2024) model the asymmetric, long-run relationships between wholesale electricity prices and external shocks (such as input prices and geopolitical crises); and Do et al. (2024) quantify the return connectedness between eleven key European markets, as well as the natural gas and carbon markets. In the electricity markets, the 99th percentile (stress test) in QR shows the scenario that occurs 1% of the time, while 1st percentile (baseload floor) in QR shows the minimum price threshold also known as the cannibalization effect of RES.

To analyse electricity prices, QR is robust for examining distributional effects across the price spectrum including tails, rather than focusing solely on the conditional mean. In our case, we consider Instrumental Variables (IV) and employ a Two-Stage Residual Inclusion (2SRI) approach within a QR framework, which enable us to account for the potential endogeneity of BESS operations (Chernozhukov and Hansen 2005; Terza et al. 2008). This approached been applied in previous studies (Ma et al. 2019; Nie et al. 2021; Ankrah Twumasi et al. 2022). 2SRI process follows a two-stage procedure to control for the endogeneity of our explicative variables:

[15] To avoid the representation of extreme values in the binned scatterplots, we use the logs of the independent and control variables.

- **First Estimation:** We use auxiliary regression for the endogenous variables using a set of IV. In all cases, we use the lagged observations of these variables as IV. This approach relies on the assumption of sequential exogeneity, where past observations of electricity market variables are informative of contemporaneous dispatch decisions but are uncorrelated with current structural shocks (Arellano and Bond 1991). The strength of these IV is verified through the F-tests to ensure are valid. We extract the residuals from this first-stage estimations, namely the "Correction Factor", which capture the portion of the endogenous regressors that is uncorrelated with the structural error term (Wooldridge 2015).
- **Second Quantile Regression:** We estimate the QR and include residuals from first estimation as additional regressors.

We perform four models. In the supply price model, endogenous variables correspond to the 5-minute spot price (SP_t^r) and explicative variables correspond to production from each technology in each of the four states: Queensland, Victoria, New South Wales and South Australia. QR model for each τ quantile and s state is represented in Equations 2 and 3:

$$Q_{SP_t^s}(\tau|X) = \widehat{\beta_0}(\tau) + \sum_{j=1}^{k} \widehat{\gamma_j}(\tau) Supply_t^s +$$

$$+ \sum_{m=1}^{11} \widehat{\Omega_m} \cdot M_t^m + \sum_{d=1}^{6} \widehat{a_m} \cdot DOW_t^d + \alpha(\tau)\hat{v}_{it} + \epsilon_\tau \quad (2)$$

$$[Supply_t^s] = [DBESS_t^s;\ DPUMP_t^s;\ RSOL_t^s;\ SOL_t^s; WIND_t^s\ HYD_t^s;\ BIO_t^s; GAS_t^s;$$
$$COAL_t^s;\ DIESEL_t^s; OTH_t^s] \quad (3)$$

Explanatory variables include the production from each technology in the relevant state: discharging BESS ($DBESS_t^s$), discharging hydro pumping plants ($DPUMP_t^s$), rooftop solar ($RSOL_t^s$), solar (SOL_t^s), wind ($WIND_t^s$), hydropower (HYD_t^s), biomass (BIO_t^s), fired-gas plants (GAS_t^s), coal ($COAL_t^s$), diesel ($DIESEL_t^s$), and others (OTH_t^s). $\hat{v}_{it}$ represent the Correction Factor, i.e. the estimated residuals from the first-stage reduced-form regression of the endogenous regressor on the instruments.

In the demand price model, endogenous variables correspond to the 5-minute spot price (SP_t^r) and explicative variables correspond to the different demand drivers in each of the four s states. QR model for each τ quantile is represented in Equations 4 and 5.

$$Q_{SP_t^s}(\tau|X) = \widehat{\beta_0^s}(\tau) + \sum_{j=1}^{k} \widehat{\boldsymbol{\gamma_j^s}}(\tau) Dem_t^s$$

$$+ \sum_{m=1}^{11} \widehat{\Omega_m^s} \cdot M_t^m + \sum_{d=1}^{6} \widehat{\alpha_m^s} \cdot DOW_t^d + \alpha(\tau)\hat{v}_{it} + \epsilon_\tau^s \quad (4)$$

$$[Dem_t^s] = [CBESS_t^s;\ TDEM_t^s] \quad (5)$$

Explanatory variables include the different demand drivers of demand: charging BESS ($CBESS_t^s$) and total electricity demand ($TDEM_t^s$).[16]

In the supply volatility model, endogenous variables correspond to the daily volatility of the 5-minute spot price (VSP_t^s) and explicative variables correspond to the daily average production from each technology in each of the four states (Equation 3). QR model for each τ quantile is represented in Equation 6.

$$Q_{VSP_t^s}(\tau|X) = \widehat{\beta_0}(\tau) + \sum_{j=1}^{k} \widehat{\gamma_j^s}(\tau) Supply_t^s$$

$$+ \sum_{m=1}^{11} \widehat{\Omega_m} \cdot M_t^m + \sum_{d=1}^{6} \widehat{\alpha_m^s} \cdot DOW_t^d + \alpha(\tau)\hat{v}_{it} + \epsilon_\tau^s \quad (6)$$

In the demand volatility model, endogenous variables correspond to the daily volatility of the 5-minute spot price (VSP_t^r) and explicative variables correspond to the different demand drivers in each of the four states (Equation 4). QR model for each τ quantile is represented in Equations 7.

$$Q_{VSP_t^s}(\tau|X) = \widehat{\beta_0}(\tau) + \sum_{j=1}^{k} \widehat{\gamma_j^s}(\tau) Dem_t^s$$

$$+ \sum_{m=1}^{11} \widehat{\Omega_m} \cdot M_t^m + \sum_{d=1}^{6} \widehat{\alpha_m^s} \cdot DOW_t^d + \alpha(\tau)\hat{v}_{it} + \epsilon_\tau^s \quad (7)$$

In all the models, we perform QR for the following quantiles: 0.01, 0.05, 0.10, 0.25, 0.50, 0.75, 0.90, 0.95, 0.99. The dummy variables for the months and day of the week correspond to M_t^m and DOW_t^d, respectively.[17] In the supply and the demand electricity prices we perform an estimate for each year, but in the volatility model we perform a single estimation for the whole period.[18]

As shown in Table A.4, Augmented Dickey-Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests present a conflicting diagnosis of stationarity: ADF test strongly rejects the null hypothesis of a unit root (Dickey and Fuller 1979; Kwiatkowski et al. 1992). Conversely, the KPSS test rejects its null hypothesis of stationarity. Thus, we should differentiate variables to ensure that the 5-minutes dataset is stationary.

[16] The demand price model and the demand volatility model do not include data on charging hydro pumping because of data unavailability.

[17] In all models, we estimated the conditional quantile estimations including the first lag of the endogenous variable, but they provided explosive coefficients in the extreme quantiles. This is because quantile estimates with autoregression cannot capture temporary explosive dynamics (Koenker and Xiao 2006). As solution, we do not include the lagged endogenous variable and all our estimations are made with the qreg2 function in Stata (Parente and Silva 2016).

[18] In the demand and supply volatility models we use the average daily values of the explicative variables. We estimate two independent regressions for each year, but almost all coefficients are not significant due to the reduced number of observations. As solution, we perform an estimation for the whole period.

Finally, the standard errors are clustered at daily level to account for potential intra-day serial correlation and heteroscedasticity inherent in high-frequency 5-minute electricity market data.[19] This ensures robust statistical inference against unobserved shocks within the same trading day (Parente and Silva 2016).

6. Results

In this section we document the conditional relationship and the QR to estimate the impact of explicative variables in the electricity prices. QR estimations provide a comprehensive framework for analysing the impacts of explicative variables in electricity prices in each quantile. The highest quantiles (Q99) correspond to the peak demand hours and when the system is using the most expensive technologies (highest 1% prices), while the lowest quantiles (Q1) correspond to the lowest demand hours and when there is a maximum RES production (lowest 1% prices).

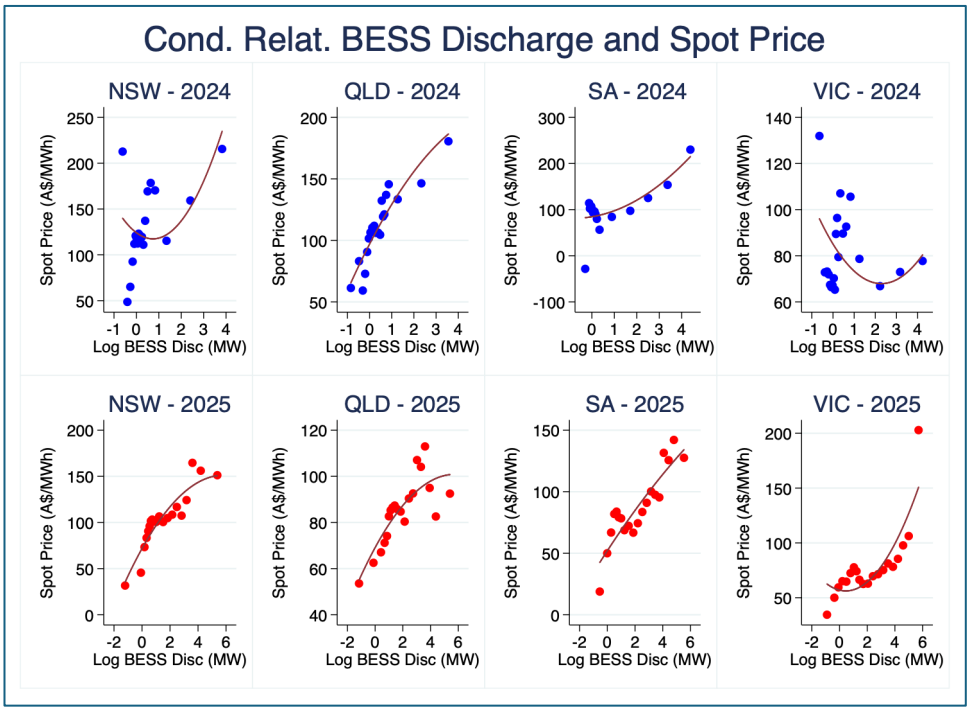
6.1. Impact of discharging BESS on electricity prices

We first analyse the conditional relationship between BESS discharge and spot electricity prices with the binned scatter plots in each state. In Figure 7, each dot represents the average (mean) value of the independent variable (BESS Discharge) and dependent variable (Electricity Price) within a specific subgroup or "bin" of the data, and after accounting for the production from generation technologies.

Across all regions, we find dots follow positive trend where higher BESS discharge volumes correspond to higher spot prices. This confirms a standard market behaviour: utility-scale BESS discharge during periods of peak wholesale prices, i.e. high demand and RES scarcity to maximise revenues. In all graphs, the maximum power in 2025 (bin values in x-axis) exceed the highest values recorded in 2024, showing the larger volumes of BESS operating in 2025.

[19] Clustering standard errors at daily level means that we define seasonal blocks of 288 observations (288×5 minutes=24 hours). This accounts for intra-day error dependence without imposing restrictive parametric bandwidth assumptions (Parente and Silva 2016).

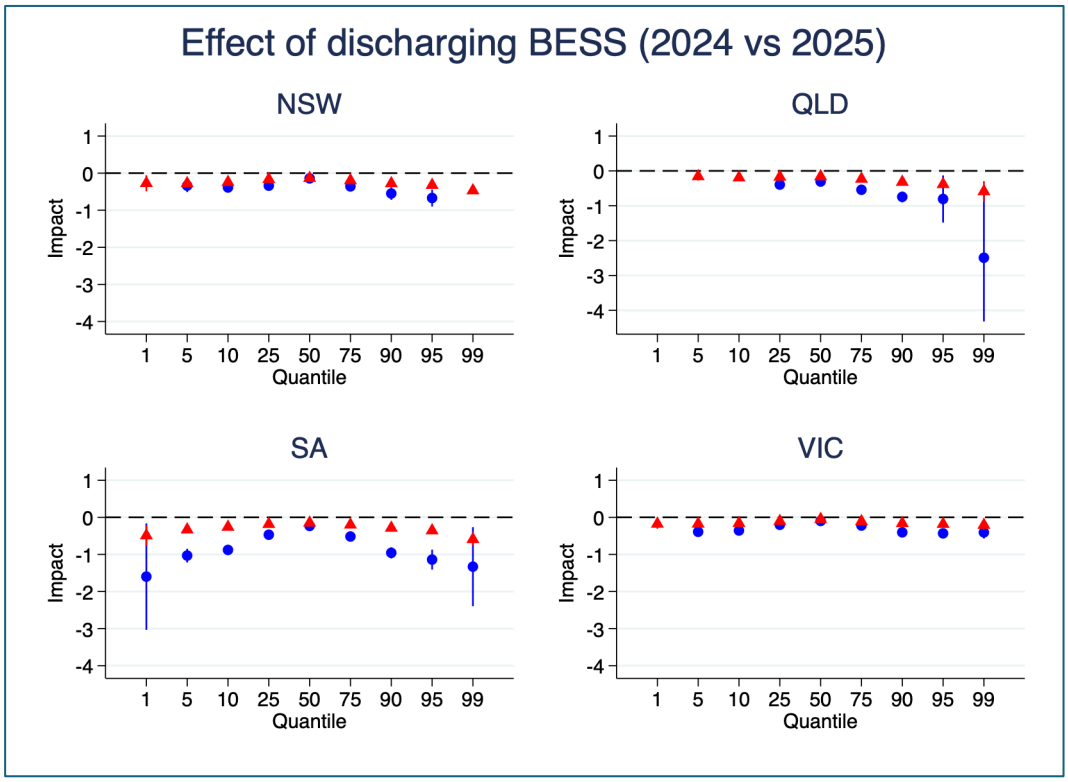
Figure 7. Conditional relationship between BESS discharging and electricity price by region (2024 vs. 2025).



Second, we use the supply price model to quantify the impact of discharging BESS in each quartile of the electricity prices for each year and state with (detailed results for all technologies are shown in Tables B.1-B.8). As shown in Figure 8, discharging BESS decreases the prices during the peaks, especially in the highest quartile (Q95 and Q99). We find some interesting results when we compare the detailed impacts of discharging BESS across states. First, discharging BESS dampens the electricity prices, especially when we move to the highest quartiles (Q99). In SA, a similar effect is observed in the lowest quartiles, which may be explained because BESS also discharge during these lower prices (Figure A1). This can be attributed to the rise of the non-scheduled generation dispatch as the growth of behind-the-meter resources has reduced system visibility and thereby distorting allocative efficiency of price signals (Nelson 2026).

Second, the impact of discharging BESS on prices in the highest quantiles reduced in 2025 compared to 2024, i.e. the red values are closer to Y=0 than the blue values, consistent with patterns in Figure 8. As shown in Table 5, discharging 1MWh from BESS changes electricity price from -0.671 to -0.323 A$/MWh in NSW (Q95), from -2.492 to -0.589 A$/MWh in QLD (Q99), from -1.331 to -0.593 A$/MWh in NSW (Q99), and from -0.407 to -0.209 A$/MWh in VIC (Q99). This evidences that higher BESS volumes (Tables 2-3) dampen the impact of BESS discharging in the prices, Third, we do not find that the different demand coverage ratios of BESS (Tables 2-3) explain differences on the BESS impacts in 2025. For example, the impact of discharging BESS in SA (70% coverage in 2025) is -0.593 A$/MWh. This is very similar to QLD, where despite a lower coverage ratio (18% in 2025), the impact is -0.589 A$/MWh.

Figure 8. Impact of discharging 1MWh from BESS in the prices (A$/MWh) for each state. Blue and red dots correspond to the significant coefficients for 2024 and 2025, respectively.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8. The vertical lines extending from each point represent the confidence intervals for the estimated coefficients.

Table 5. Impact of discharging 1MWh from BESS in the highest quantiles of prices (A$/MWh). Source: Tables B.1 to B.8.

	NSW		QLD		SA		VIC	
Year	**Q95**	**Q99**	**Q95**	**Q99**	**Q95**	**Q99**	**Q95**	**Q99**
2024	-0.671	n/s	-0.806	-2.492	-1.140	-1.331	-0.433	-0.407
2025	-0.323	-0.470	-0.384	-0.589	-0.357	-0.593	-0.183	-0.209

Note: n/s means no significant values.

The impact of each technology on the spot prices also provides interesting results (Tables B.1 to B.8 include the results, while the figures corresponding to the impact of generation technologies on the spot price are in the Appendix C):

- **Pumped Hydro** (Figure C.1): Pumped hydro discharging in QLD follows similar patterns as BESS discharging and decreases the electricity prices in the highest quantiles. Conversely, the impact on NSW is the opposite and which might be due to technical reasons such as meeting minimum generation constraints, system security obligations, or contracted ancillary services required by the AEMO in order to maintain voltage control, manage network constraint and engage in frequency regulation but requires future research.
- **Rooftop solar** (Figure C.2): The production decreases the electricity prices in the highest quantiles by lowering the demand for grid-based electricity during lower quantiles and creating an oversupply of cheap energy that flattens traditional price

curves in the higher quantiles. Higher production in the upper quantiles displaces more expensive technologies and therefore inhibiting wholesale prices.

- **Solar** (Figure C.3): Increased photovoltaic generation is associated with higher prices in QLD, SA and VIC in 2024. However, in 2025, it reduces prices for NSW and VIC in the highest quantiles. The correlation with higher prices in the upper quantiles in VIC and NSW is similar to BESS discharging which characterises extreme peak pricing periods due to structural grid dynamics (Deng et al. 2025).
- **Wind** (Figure C.4): Wind production decreases electricity prices in NSW and QLD primarily through the merit order effect as wind displaces expensive fossil-fuel generators out of the bid stack (Mwampashi et al. 2021). The interconnector between these two physically interconnected states also underwent expansion and upgrade in 2022 and thus minimising congestion and the curtailment of wind energy. However, wind production increased prices in SA and VIC. This is because SA holds the highest proportional share of generation from wind to meet its demand and is exposed to wind drought causing the state's electricity prices spike dramatically (Gilmore et al. 2025). There are also significant transmission constraints across the interconnectors physically connecting these two states which can result in counter-price flows.
- **Coal** (Figure C.5): Coal generation as a baseload technology in the NEM has increased the averaged prices for 2024 and 2025 especially prices in the upper quantiles across NSW, QLD and VIC. Aging infrastructure, frequent unplanned outages, and high international fuel cost of coal are the underlying drivers of this increase. For VIC, the impact of coal generation on electricity prices in negative for the lowest quintile in 2024 as coal generators find it difficult to instantly shut down while there is already a lot of cheap solar in the grid. VIC generates around 52% of its electricity from coal while coal's average share in the NEM as a whole is just around 50%.
- **Gas** (Figure C.6): Gas generation as a peakload technology has a share in the NEM which is just around 16%. Increased generation from gas is associated with increasing prices across all of NSW, VIC, SA and QLD while the price impacts are low and negative across the lower quantiles in NSW and QLD. Both NSW and QLD have operational combined-cycle gas turbines (Darling Downs in QLD or Tallawarra in NSW) which are highly flexible implying that these plants keep running at minimum stable generation even in the middle of the day. In SA, gas-fired electricity provides grid stability in the middle of the day considering that over 75% of its electricity in SA is sourced from renewables (mostly wind and solar) and therefore gas generation driving higher prices.
- **Biomass** (Figure C.7): The share of bioenergy (or biomass) in the NEM is only 0.2% to 0.4% of total generation across the NEM depending on seasonal conditions and provides a minor stabilizing effect on peak electricity prices in NSW. Biomass plants are also economically and technically unfavorable for switching off during short periods of low or negative wholesale prices and hence further contribute to lower prices during these periods such as in NSW and QLD.

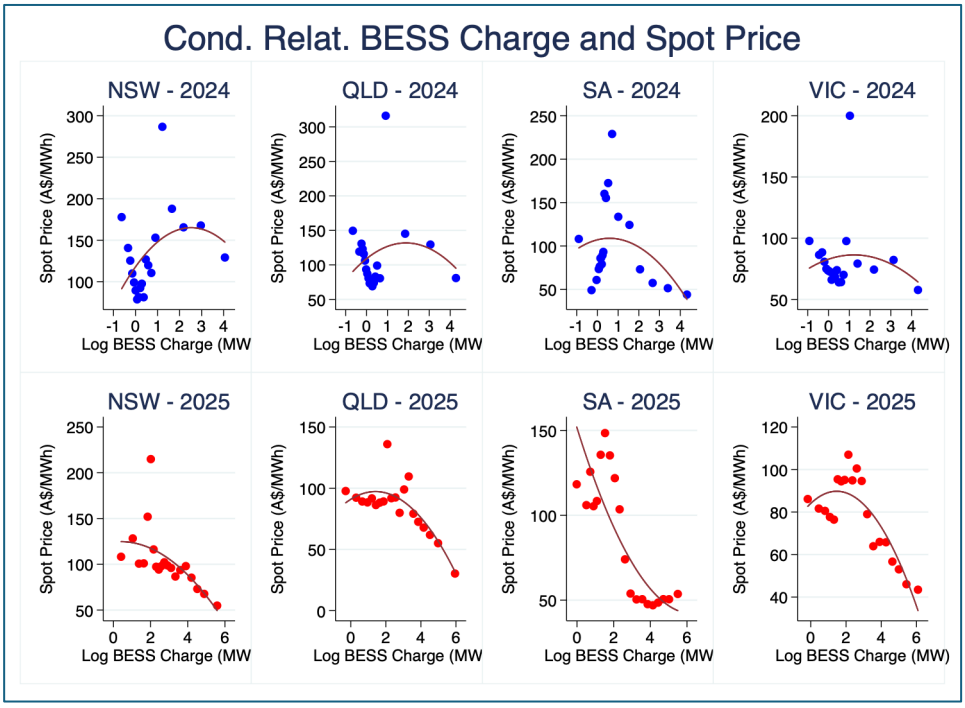
- **Diesel** (Figure C.8): The share of diesel and other liquid fuels in the NEM is close to 1% but plays a fundamental role in states like SA and NSW during peak demand (i.e upper quantiles) or low-renewable supply periods. As a source of back-up power, increased diesel-based electricity generation is associated with higher electricity prices following the merit order effects.

6.2. Impact of charging BESS on electricity prices

We also document the conditional relationship between BESS charge and spot prices across four major Australian regional markets. Figure 9 illustrates the conditional binned scatterplots of the relationship between BESS charging and electricity prices in each region for 2024 and 2025. By incorporating total electricity demand as a control variable, these graphs filter out the underlying market demand distortions, isolating the conditional price impact of BESS operations. Each dot represents the average (mean) value of the (log) independent variable (BESS Charge) and dependent variable (electricity price) within equal-sized subgroup or "bins" of the data.

Across all regions, we find a negative trend where higher BESS charge volumes correspond to lower spot prices. This confirms that utility-scale BESS charge during periods of low demand and surplus of RES. As for discharging BESS, the maximum power in 2025 (bin values in x-axis) exceed the highest values recorded in 2024, showing the larger volumes of BESS operating in 2025.

Figure 9. Conditional relationship between BESS charging and price by region (2024 vs. 2025).



Note: Dots with negative values in the X-axis do not mean negative charging values but correspond to the adjusted impacts once total demand is controlled for.

In the demand price model, we analyse the impact of charging BESS on the electricity prices. Since discharging BESS represent an additional supply of electricity, charging means an additional electricity demand (detailed results for all technologies are shown in Tables B.9-B.16). In this case we find that charging BESS increases the electricity prices, i.e. the opposite effect for discharging BESS.

When we compare the detailed impacts of charging BESS in states and quantiles, we also find interesting results (Figure 10). First, the impact of charging BESS is greater at the extreme quantiles (Q1 and Q99), while it is minimal at the median (Q50). However, note that BESS are mostly charged in the lowest quantiles (Figure A2). Second, the impact of charging BESS on prices in the lowest quantiles reduced in 2025 relative to 2024, i.e. the red values are closer to Y=0 than the blue values, as found when discharging BESS. As shown in Table 6, charging 1MWh of BESS changes price from +0.396 to +0.137 A$/MWh in QLD (Q5), from +0.396 to +0.279 A$/MWh in SA (Q5), and from +0.361 to +0.151 A$/MWh in VIC (Q5). Third, the state with the highest demand coverage ratios of BESS, SA (Tables 2, 3) has the highest impact on prices in the lowest quantiles (despite its impact decreased in 2025). This evidences that very high volumes of BESS have a significant impact on the electricity prices.

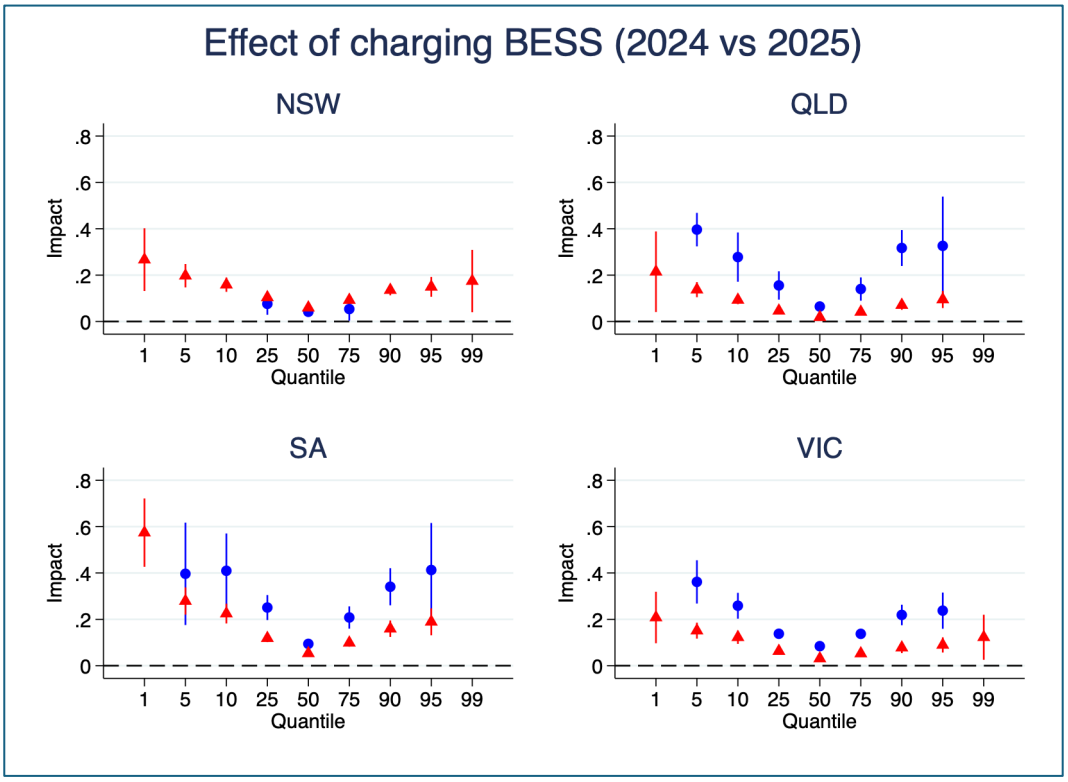
Table 6. Impact of charging 1MWh in BESS in the lowest quantiles of prices (in A$/MWh). Source: Tables B.9-B.16.

	NSW		**QLD**		**SA**		**VIC**	
Year	**Q5**	**Q1**	**Q5**	**Q1**	**Q5**	**Q1**	**Q5**	**Q1**
2024	n/s	n/s	+0.396	n/s	+0.396	n/s	+0.361	n/s
2025	+0.197	+0.267	+0.137	+0.215	+0.279	+0.574	+0.151	+0.208

Note: n/s means no significant values.

The impact of total electricity demand on prices in each region is shown in the Figure C.9. We find that the impact of the total electricity on the prices follow a U-shape, with minimum effects on the median quantile (Q50). The impact is also maximum in the highest quantile (Q99) in all regions, confirming the merit order effect during hours of more expensive generation.

Figure 10. Impact of charging 1MWh in BESS on electricity prices (A$/MWh) for each state. Blue and red dots correspond to the significant coefficients for 2024 and 2025, respectively.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.9-B.16. The vertical lines extending from each point represent the confidence intervals for the estimated coefficients.

6.3. Net effects of BESS on electricity prices

Based on the results from sections 6.1 and 6.2, we calculate the net effect of BESS on electricity prices as the sum of the impacts of charging and discharging 1 MWh, taking their respective signs into account.[20] This allows us to observe the overall effects on the consumer prices. As in the previous sections, impacts depends on when (quartiles) BESS operators charge and discharge BESS. As observed in Figures A.1 and A.2, although there are clear patterns, we cannot assume that all BESS operate exclusively within a specific quantile. Therefore, we calculate a matrix considering the possible combinations of quantiles when charging and discharging BESS.

Figures 11-14 illustrate highly relevant impact patterns on consumer prices. First, the price impacts are negative in many of the cases and show positive impacts on consumer prices. However, looking at the cells with the most frequent quantiles (black boxes in Figures 11-14), net impacts are negative in some cases. For instance, the net impacts in SA when BESS are charged in Q1 range from +0.345 to +0.100 A$/MWh, indicating that the greater the share of BESS in covering demand (Tables 2,3), the greater is the negative

[20] In our calculations we consider 80% efficiency of BESS for 2025 found in Table 4 (Zafirakis et al. 2016). Therefore, only 80% of all the charged energy is later discharged. We are not considering other (indirect) costs for BESS which may affect their business plans such as time of use tariffs, charges or taxes.

impact on prices, i.e. higher electricity prices. However, this effect is not very clear in Q5. Consequently, we can infer that there may be a critical threshold beyond which the positive impact for electricity prices turns negative.

Figure 11. Total (net) effects (in A$/MWh) of charging and discharging BESS (+1MWh) on the electricity for NSW in 2025 considering the quartile when BESS is discharged and charged.

NSW	Quantile for charging BESS								
Quantile for discharging BESS	**1**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**99**
1	0.049	-0.021	-0.059	-0.114	-0.158	-0.126	-0.082	-0.069	-0.044
5	0.046	-0.024	-0.062	-0.117	-0.161	-0.129	-0.085	-0.072	-0.047
10	0.072	0.002	-0.036	-0.091	-0.135	-0.103	-0.059	-0.046	-0.021
25	0.134	0.064	0.026	-0.029	-0.073	-0.041	0.003	0.016	0.041
50	0.158	0.088	0.050	-0.005	-0.049	-0.017	0.027	0.040	0.065
75	0.109	0.039	0.001	-0.054	-0.098	-0.066	-0.022	-0.009	0.016
90	**0.044**	**-0.026**	**-0.064**	-0.119	-0.163	-0.131	-0.087	-0.074	-0.049
95	**0.009**	**-0.061**	**-0.099**	-0.154	-0.198	-0.166	-0.122	-0.109	-0.084
99	**-0.109**	**-0.179**	**-0.217**	-0.272	-0.316	-0.284	-0.240	-0.227	-0.202

Note: Cells with higher values are highlighted in red, while those with lower values are shown in green. Black box highlights the most frequent values: charging in the lowest quantiles and discharging in the highest quantiles. Non-significant coefficients are considered as zero. Source: Tables B.2 and B.10

Figure 12. Total (net) effects (in A$/MWh) of charging and discharging BESS (+1MWh) on the electricity for QLD in 2025 considering the quartile when BESS is discharged and charged.

QLD	Quantile for charging BESS								
Quantile for discharging BESS	**1**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**99**
1	0.215	0.137	0.093	0.046	0.018	0.041	0.071	0.095	0.000
5	0.089	0.011	-0.033	-0.080	-0.108	-0.085	-0.055	-0.031	-0.126
10	0.061	-0.017	-0.061	-0.108	-0.136	-0.113	-0.083	-0.059	-0.154
25	0.076	-0.002	-0.046	-0.093	-0.121	-0.098	-0.068	-0.044	-0.139
50	0.086	0.008	-0.036	-0.083	-0.111	-0.088	-0.058	-0.034	-0.129
75	0.029	-0.049	-0.093	-0.140	-0.168	-0.145	-0.115	-0.091	-0.186
90	**-0.041**	**-0.119**	**-0.163**	-0.210	-0.238	-0.215	-0.185	-0.161	-0.256
95	**-0.092**	**-0.170**	**-0.214**	-0.261	-0.289	-0.266	-0.236	-0.212	-0.307
99	**-0.256**	**-0.334**	**-0.378**	-0.425	-0.453	-0.430	-0.400	-0.376	-0.471

Note: Cells with higher values are highlighted in red, while those with lower values are shown in green. Black box highlights the most frequent values: charging in the lowest quantiles and discharging in the highest quantiles. Non-significant coefficients are considered as zero. Source: Tables B.4 and B.12

Figure 13. Total (net) effects (in A$/MWh) of charging and discharging BESS (+1MWh) on the electricity for SA in 2025 considering the quartile when BESS is discharged and charged.

SA	Quantile for charging BESS								
Quantile for discharging BESS	1	5	10	25	50	75	90	95	99
1	0.181	-0.114	-0.168	-0.274	-0.340	-0.294	-0.234	-0.204	-0.393
5	0.308	0.013	-0.041	-0.147	-0.213	-0.167	-0.107	-0.077	-0.266
10	0.365	0.070	0.016	-0.090	-0.156	-0.110	-0.050	-0.020	-0.209
25	0.426	0.131	0.077	-0.029	-0.095	-0.049	0.011	0.041	-0.148
50	0.456	0.161	0.107	0.001	-0.065	-0.019	0.041	0.071	-0.118
75	0.413	0.118	0.064	-0.042	-0.108	-0.062	-0.002	0.028	-0.161
90	**0.345**	**0.050**	**-0.004**	-0.110	-0.176	-0.130	-0.070	-0.040	-0.229
95	**0.288**	**-0.007**	**-0.061**	-0.167	-0.233	-0.187	-0.127	-0.097	-0.286
99	**0.100**	**-0.195**	**-0.249**	-0.355	-0.421	-0.375	-0.315	-0.285	-0.474

Note: Cells with higher values are highlighted in red, while those with lower values are shown in green. Black box highlights the most frequent values: charging in the lowest quantiles and discharging in the highest quantiles. Non-significant coefficients are considered as zero. Source: Tables B.6 and B.14

Figure 14. Total (net) effects (in A$/MWh) of charging and discharging BESS (+1MWh) on the electricity for VIC in 2025 considering the quartile when BESS is discharged and charged.

VIC	Quantile for charging BESS								
Quantile for discharging BESS	1	5	10	25	50	75	90	95	99
1	0.066	0.009	-0.019	-0.079	-0.111	-0.090	-0.064	-0.052	-0.019
5	0.066	0.009	-0.019	-0.079	-0.111	-0.090	-0.064	-0.052	-0.019
10	0.081	0.024	-0.004	-0.064	-0.096	-0.075	-0.049	-0.037	-0.004
25	0.125	0.068	0.040	-0.020	-0.052	-0.031	-0.005	0.007	0.040
50	0.168	0.111	0.083	0.023	-0.009	0.012	0.038	0.050	0.083
75	0.120	0.063	0.035	-0.025	-0.057	-0.036	-0.010	0.002	0.035
90	**0.078**	**0.021**	**-0.007**	-0.067	-0.099	-0.078	-0.052	-0.040	-0.007
95	**0.062**	**0.005**	**-0.023**	-0.083	-0.115	-0.094	-0.068	-0.056	-0.023
99	**0.041**	**-0.016**	**-0.044**	-0.104	-0.136	-0.115	-0.089	-0.077	-0.044

Note: Cells with higher values are highlighted in red, while those with lower values are shown in green. Black box highlights the most frequent values: charging in the lowest quantiles and discharging in the highest quantiles. Non-significant coefficients are considered as zero. Source: Tables B.8 and B.16

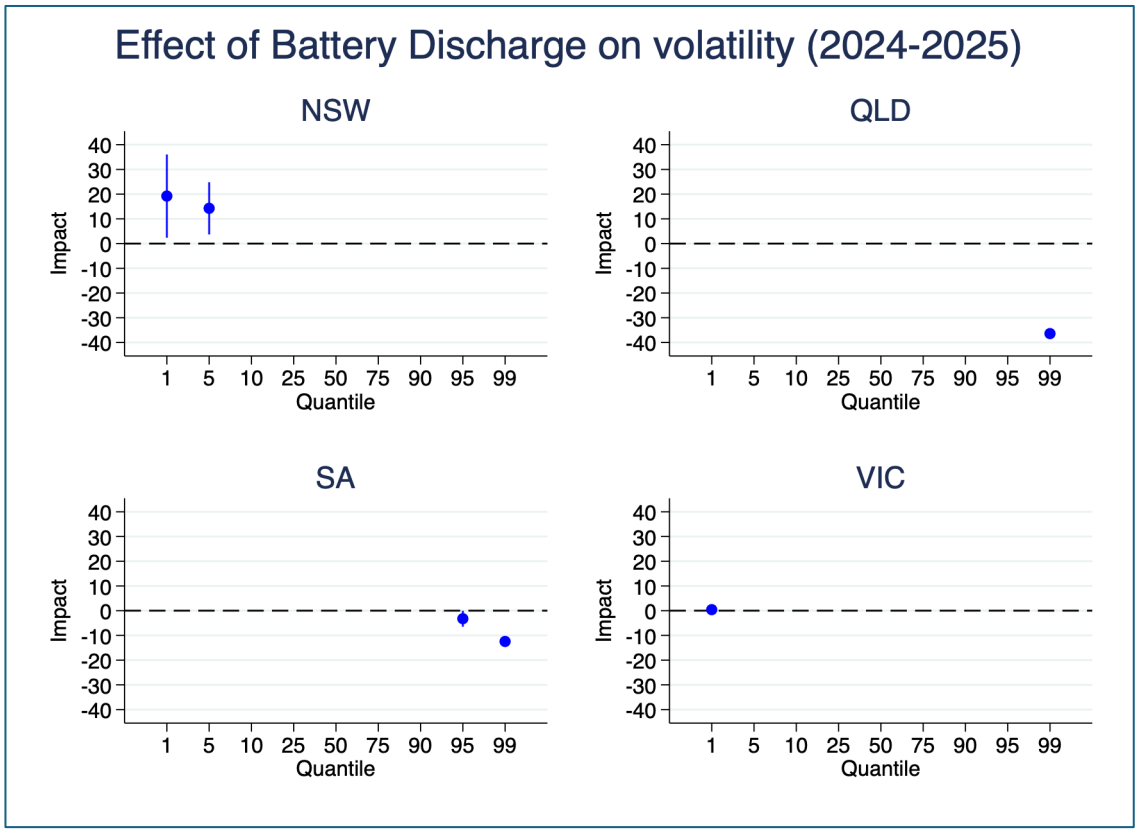
6.4. Impact of operating BESS on volatility of electricity prices

The supply volatility model analyses the impact of each technology and BESS on the volatility of prices. In this case, quantiles correspond to the daily volatility of prices: the highest quantiles (Q99) relate to the days with the highest standard deviation of the prices, while the lowest (Q1) to the opposite. In the days with the highest volatility (Q99 in Figure 15), discharging 1MWh from BESS clearly decreases the volatility (-36.411 in QLD; -

12.464 in SA) by dampening price spikes through the displacement of expensive and slow-starting gas and hydro peaking generators, but this effect is not significant in other regions. Both SA and QLD are exposed to high concentrations of solar generation from both commercial rooftop and utility-scale farms while facing specific structural constraints pertaining to transmission and interconnections that contributes to daily price swings. For instance, SA almost operates as an "island" with limited interconnector capacity to the rest of the NEM while QLD suffers from distinct regional transmission bottlenecks and high exposure to fast contingency FCAS constraints thereby creating localised price volatilities which the BESS can arbitrage on.

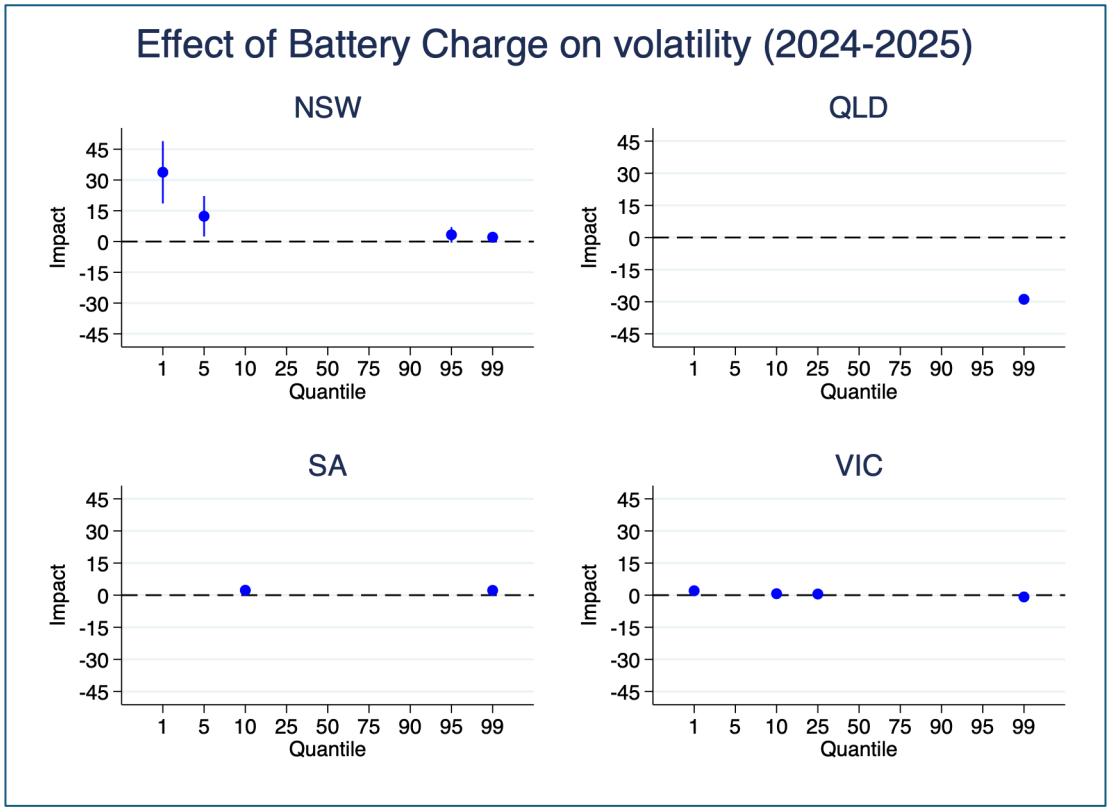
The demand volatility model analyses the impact charging BESS on the volatility of the electricity prices (Figure 16). We find that charging BESS slightly increases the volatility of the days with the highest volatility in NSW (+2.108) and SA (+2.218), but decreases in VIC (-0.843), and especially in QLD (-28.884). BESS contribute to a massive block of localized demand during midday solar valleys and shifts that energy into intense evening discharge peaks and therefore increasing volatility. QLD exhibits an exceptionally wide absolute gap between daytime RES supply and localized BESS charging capacity. SA and VIC are exposed to high penetrations of weather-driven wind and solar implying that intraday price cycling is intense and characterised by high price spreads. The BESS operators aggressively capture and benefit from these price spreads in SA and VIC.

Figure 15. Impact of discharging BESS (+1MWh) in the volatility of electricity prices (standard deviation) for each state.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17-B.20. The vertical lines extending from each point represent the confidence intervals for the estimated coefficients.

Figure 16. Impact of charging BESS (+1MWh) in the volatility of electricity prices (standard deviation) for each state.



Note: Dots correspond to significant coefficients ($p<0.1$) in Tables B.21-B.24. The vertical lines extending from each point represent the confidence intervals for the estimated coefficients.

6.5. Discussion of results

Since BESS are mostly discharged during time with the highest electricity prices -the highest quantiles- they reduce the electricity prices in all NEM regions, which evidence that they replace expensive technologies in the demand coverage. On the other hand, we find that charging BESS increases the electricity prices, especially in the lowest quantile when the prices are the lowest. However, both effects are dampened in 2025, which may be explained because market competition increases with the volumes of BESS. In other words, reduced volumes of BESS could exert some market power.[21] This is consistent with the lower arbitrage revenues when more BESS operate in the electricity markets (Karaduman 2021; Khezr and Menezes 2025; Mwampashi and Nikitopoulos 2026). Finally, we find that the impact in the region with the highest participation of BESS (SA) has the highest impact.

Our results also show a clear pattern of BESS operational consistency across different regions in the NEM by charging during the mid-day shoulder (i.e. when solar surplus

[21] Large thermal generators require some time to start up and shut down, as well as to ramp production up or down. Consequently, thermal plants may be incentivized to submit bids at lower prices to ensure they clear the market and avoid having to shut down in very short time. In contrast, BESS does not face this operational constraint and can submit higher bids, assuming the risk of not being cleared. However, validating this hypothesis requires additional data and analysis, which is out of the scope of this paper.

depresses prices) and discharge during the evening peaks (Daley 2026). This behavioral pattern has contributed to three cascading effects in terms of collapsing the average evening price peaks, displacing expensive technologies such as gas and hydro from their peaking role and raising the shoulder (i.e. time period between off-peak and peak) average electricity prices as BESS charging competes for cheap midday solar surplus. However, when analyzing the net effect of charging and discharging BESS, we find that the price impact can be negative for consumers. This is especially true if the share of BESS in demand coverage is high and they are consistently charged during the lowest-price hours**,** which correspond to hours with higher RES production. In sum, the timing of BESS charging and discharging has relevant impacts on consumer prices. From these results, a key regulatory policy recommendation can be highlighted: establishing regulatory signals or incentives that may influence when BESS charge or discharge must be properly assessed in-advance to avoid unforeseen impacts on electricity prices. Moreover, these time incentives may change in the future based on the BESS coverage ratio or the generation mix operating in each state.

Our results also support the 'cannibalisation' phenomenon underlying the rapid growth of BESS in the NEM which is characterised by the flattening of intraday electricity prices. BESS growth in the market between 2024 and 2025 have narrowed the price spreads (or gaps) needed for profit by raising daytime charging costs (i.e. lifting the price floor) and lowering evening peak prices (i.e. depressing the price ceiling). The flattening of the intraday prices results in a significant cannibalisation of energy trading revenues for BESS operators through revenue compression with the cannibalisation effect further compounded by the revenue reduction in ancillary markets. For instance, energy trading revenues exceeded FCAS revenues in value for BESS energy storage in 2024 for the first time with declining BESS revenue trends in the FCAS markets since 2020 (Hortop 2024). Finally, when we analyse the impact of BESS operations in the volatility of the electricity prices we find few significant impacts. In the future it would be interesting to assess price volatility from BESS with larger periods of time.

7. Conclusions and policy recommendations

Our study analyses whether merchant arbitrage successfully acts as a countervailing force to the "merit order effect" of solar and wind in the context of rapid growth of BESS in the Australian NEM during 2024 and 2025. Australia is world leader in terms of surpassing 1 GWh of utility-scale BESS capacity per million people while is currently the world's third largest market for utility-scale storage behind only China and the US. Our study supports the self-cannibalisation phenomenon where BESS charging increases the electricity prices while discharging decreases the prices and therefore flattening the 'duck curve' which leads to a squeezing of the arbitrage profit margins for merchant (or market driven) BESS. As private investment can stall due to self-cannibalisation, the results from our study findings gives rise to several policy recommendations. However, beneficial effects on consumer prices are diluted once BESS reach high participation.

The shift to providing long-term structural security to secure project financing for private developers is a must considering that self-cannibalisation erodes wholesale price spreads and therefore relying entirely on merchant revenue is untenable. Strengthening forward markets and introducing targeted mechanisms to support long-term investment while preserving market signals through the Electricity Services Entry Mechanisms (ESEM) as prescribed in the NEM review is highly important. The ESEM is the proposed investment mechanism after the expiry of the Capacity Investment Scheme (CIS) scheme in 2027. As in the CIS, the ESEM effectively features the reverse auction design but is inclined towards a more market-based (and less government-oriented) framework and therefore can be considered as an evolution of CIS. Regulators can guarantee a 'floor' revenue to the merchant BESS developers and protect them from market collapse while also capping excessive upside to protect consumers which has proven effective in pioneering countries like the UK.

Merchant developers can benefit from energy trading along longer-duration storage market as opposed to the quickly saturating ancillary and shorter-duration storage. Changing auction rules by specifically requiring longer duration storage (between 4 to more than 8 hours) in the TSOs administered grid tenders can encourage the private developers to engage in deep energy arbitrage. Our analysis focusses on stand-alone BESS with the results also supporting that grid congestions and constraints compound the local price cannibalisation effects especially under 'isolated' conditions. Therefore, mandating co-location by pairing storage directly with new utility-scale solar and wind farms through hybrid power purchase agreements can be effective as also prescribed in other electricity markets (Gousis et al. 2026; Tichý et al. 2026). Co-located BESS can therefore also absorb the curtailed renewable energy which would have been wasted due to grid constraints and therefore an important curtailment mitigation strategy to improve non-market value of BESS.

Improving market integration by accelerating the integration of regional grids to facilitate the inter-zonal flows of electricity as well as managing grid interconnections are necessary as the self-cannibalisation effects are pronounced across markets facing severe isolation.

Declaration of Generative AI and AI-assisted technologies in the writing

During the preparation of this work, the authors used Google Gemini to assist with the identification of relevant academic literature and the refinement of technical definitions. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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Appendix A – Dataset analysis

Table A.1. Summary statistics of data on electricity markets (N=210,528).

Variable	Description	Units	Mean	St. Dev.	Min	Median	Max
SP_t^{NSW}	Spot price in NSW	A$/MWh	117.19	591.97	-1,000.00	80.01	20,300.00
SP_t^{QLD}	Spot price in QLD	A$/MWh	98.20	403.64	-1,000.00	81.40	17,500.00
SP_t^{SA}	Spot price in SA	A$/MWh	93.43	490.85	-1,000.00	68.35	20,299.99
SP_t^{VIC}	Spot price in VIC	A$/MWh	80.01	364.80	-1,000.00	64.01	17,500.00
VSP_t^{NSW}	Volatility of prices in NSW		184.84	526.87	10.45	60.98	6201.36
VSP_t^{QLD}	Volatility of prices in QLD		138.23	363.19	11.01	65.61	4176.76
VSP_t^{SA}	Volatility of prices in SA		156.31	431.56	6.51	71.78	4117.82
VSP_t^{VIC}	Volatility of prices in VIC		91.27	321.04	6.98	59.13	4584.16

Table A.2. Summary statistics of data on generation technologies (N=210,528).
Note: BESS corresponds to utility-scale BESS

Variable	Description	Units	Mean	St. Dev.	Min	Median	Max
$DBESS_t^{NSW}$	Discharging BESS in NSW	MWh	18.45	59.77	0.00	0.06	877.44
$DBESS_t^{QLD}$	Discharging BESS in QLD	MWh	29.37	61.23	0.00	1.81	626.88
$DBESS_t^{SA}$	Discharging BESS in SA	MWh	23.24	56.24	0.00	0.42	677.58
$DBESS_t^{VIC}$	Discharging BESS in VIC	MWh	25.77	60.15	0.00	4.09	999.23
$DPUMP_t^{NSW}$	Pumping in NSW	MWh	19.04	47.74	0.00	0.00	247.26
$DPUMP_t^{QLD}$	Pumping in QLD	MWh	86.62	141.84	0.00	0.00	581.98
$RSOL_t^{NSW}$	Rooftop solar in NSW	MWh	1,049.59	1,466.28	0.00	25.63	5,864.44
$RSOL_t^{QLD}$	Rooftop solar in QLD	MWh	1,009.46	1,359.84	0.00	29.65	5,113.46
$RSOL_t^{SA}$	Rooftop solar in SA	MWh	379.49	529.84	0.00	7.95	1,959.82
$RSOL_t^{VIC}$	Rooftop solar in VIC	MWh	677.95	972.20	0.00	13.58	4,021.23
SOL_t^{NSW}	Solar in NSW	MWh	886.26	1,100.13	0.00	12.98	3,803.76
SOL_t^{QLD}	Solar in QLD	MWh	717.77	880.83	-0.78	6.88	3,269.87
SOL_t^{SA}	Solar in SA	MWh	104.12	153.12	0.00	0.65	590.29
SOL_t^{VIC}	Solar in VIC	MWh	232.00	301.92	-0.19	2.15	1,178.94
$WIND_t^{NSW}$	Wind in NSW	MWh	827.37	551.34	-0.09	735.47	2,562.02
$WIND_t^{QLD}$	Wind in QLD	MWh	414.26	291.34	0.00	359.45	1,731.92
$WIND_t^{SA}$	Wind in SA	MWh	770.24	517.59	0.00	692.29	2,230.35
$WIND_t^{VIC}$	Wind in VIC	MWh	1,349.25	983.13	-1.44	1,164.40	4,563.77

HYD_t^{NSW}	Hydropower in NSW	MWh	272.18	373.64	-6.55	106.42	2,543.29
HYD_t^{QLD}	Hydropower in QLD	MWh	81.54	32.69	-0.22	85.98	155.18
HYD_t^{VIC}	Hydropower in VIC	MWh	279.87	352.86	-7.09	118.34	1,931.58
BIO_t^{NSW}	Production from biomass plants in NSW	MWh	18.06	14.88	-31.66	20.35	54.33
BIO_t^{QLD}	Biomass plants in QLD	MWh	8.42	9.87	-6.30	7.80	35.80
GAS_t^{NSW}	Gas-fired plants in NSW	MWh	150.05	310.28	-11.49	0.18	2,278.58
GAS_t^{QLD}	Gas-fired plants in QLD	MWh	494.57	497.24	-0.32	257.88	3,090.35
GAS_t^{SA}	Gas-fired plants in SA	MWh	370.32	383.07	0.00	197.82	1,995.09
GAS_t^{VIC}	Gas-fired plants in VIC	MWh	143.19	312.70	-9.80	0.10	2,248.85
$COAL_t^{NSW}$	Coal in NSW	MWh	5,052.64	1,454.72	0.00	5,220.95	8,221.97
$COAL_t^{QLD}$	Coal in QLD	MWh	4,879.21	840.91	0.00	5,010.10	6,826.53
$COAL_t^{VIC}$	Coal in VIC	MWh	3,483.15	822.09	0.00	3,646.54	4,895.72
$DIESEL_t^{NSW}$	Diesel in NSW	MWh	0.07	1.06	0.00	0.00	21.00
$DIESEL_t^{SA}$	Diesel in SA	MWh	0.71	6.57	-0.60	0.00	117.95
OTH_t^{NSW}	Others in NSW	MWh	76.90	24.36	-2.90	77.55	199.27
OTH_t^{QLD}	Others in QLD	MWh	76.90	24.36	-2.90	77.55	199.27
OTH_t^{VIC}	Others in VIC	MWh	153.69	107.26	-1.01	135.20	675.94

Table A.3. Summary statistics of data on electricity demand (N=210,528).
Note: BESS corresponds to utility-scale BESS

Variable	Description	Units	Mean	St. Dev.	Min	Median	Max
DEM_t^{NSW}	Total demand in NSW	MWh	7,496.73	1,517.13	2,532.25	7,377.43	13,763.96
DEM_t^{QLD}	Total demand in QLD	MWh	6,225.90	1,151.95	2,656.48	6,116.72	11,159.32
DEM_t^{SA}	Total demand in SA	MWh	1,301.37	467.71	-311.10	1,377.04	3,326.91
DEM_t^{VIC}	Total demand in VIC	MWh	4,806.98	1,161.37	1,224.77	4,690.41	9,887.28
$CBESS_t^{NSW}$	Charging BESS in NSW	MWh	25.77	60.15	0.00	4.09	999.23
$CBESS_t^{QLD}$	Charging BESS in QLD	MWh	35.69	91.58	0.00	0.70	1,268.73
$CBESS_t^{SA}$	Charging BESS in SA	MWh	29.37	61.23	0.00	1.81	626.88
$CBESS_t^{VIC}$	Charging BESS in VIC	MWh	41.43	99.78	0.00	1.45	1,210.95

Figure A.1. Average BESS discharging energy in each quantile and state.

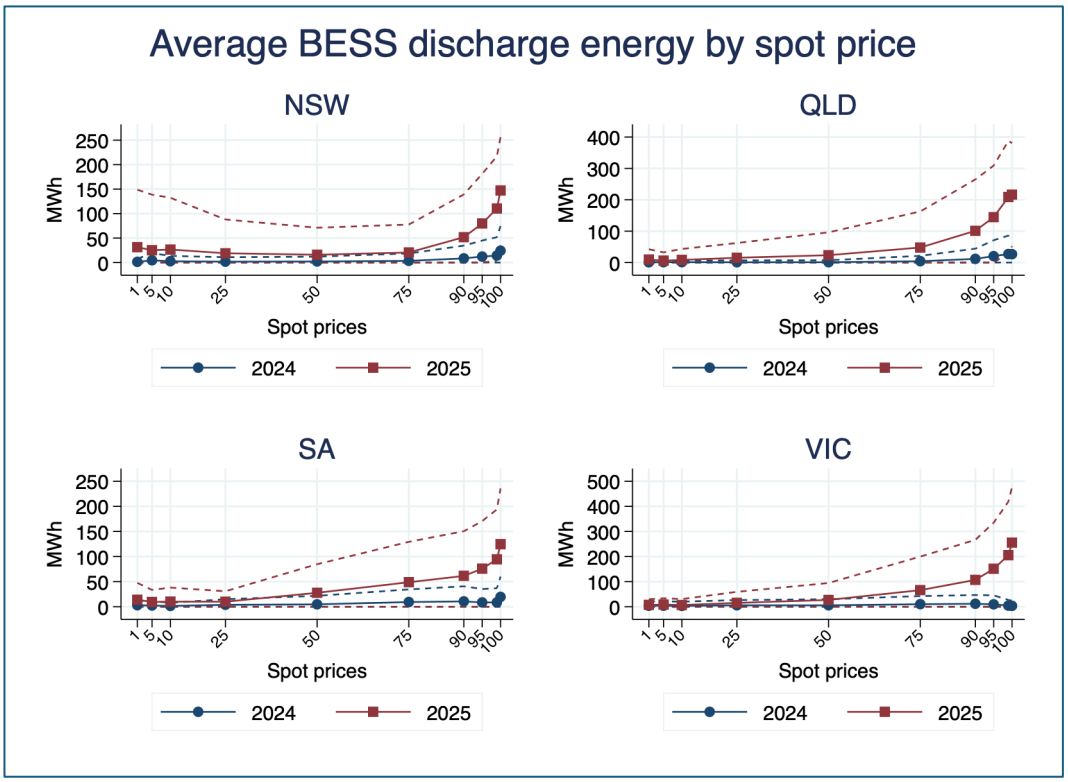
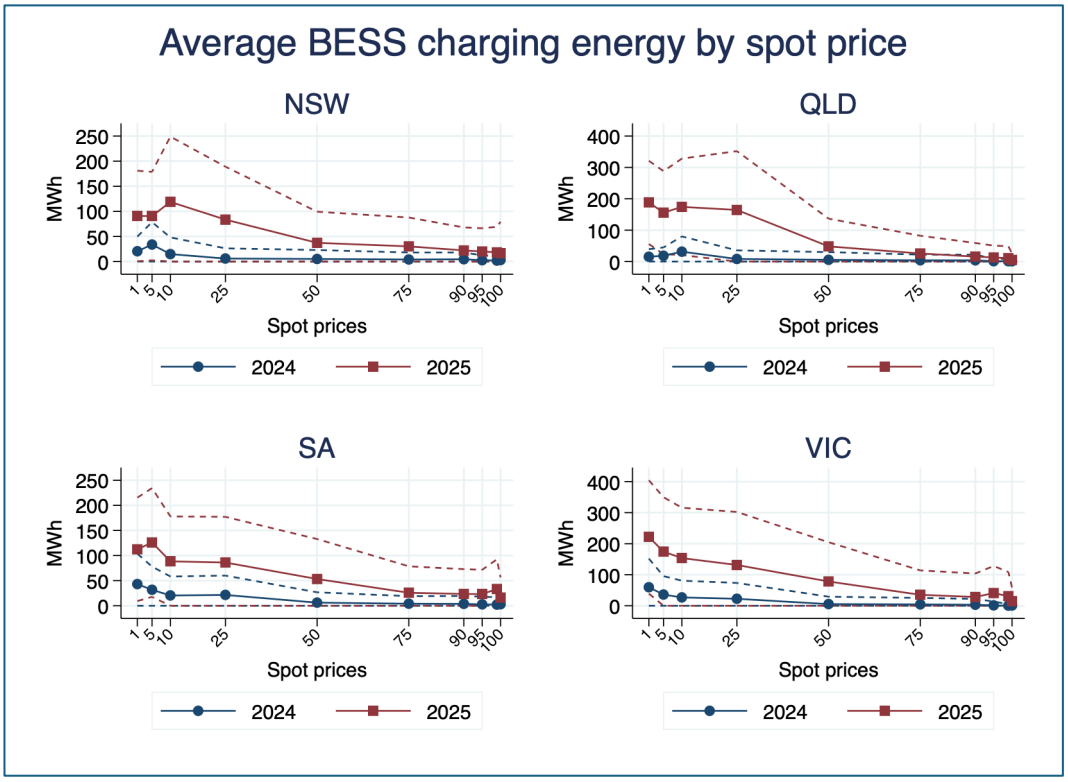


Figure A.2. Average BESS charging energy in each quantile and state.



Time-series properties of the dataset are evaluated using the Augmented Dickey-Fuller (ADF), Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and Jarque-Bera (JB) tests (Table A4) (Dickey and Fuller 1979; Jarque and Bera 1980; Kwiatkowski et al. 1992).

Table A.4. ADF, KPSS and JB Tests

Variable	ADF Stat	KPSS Stat	JB Stat	Skewness	Kurtosis
SP_t^{NSW}	-88.345***	1.346***	3.250017e+09***	23.86	609.81
SP_t^{QLD}	-87.051***	1.309***	9.835628e+09***	30.99	1060.08
SP_t^{SA}	-79.694***	4.002***	4.184602e+09***	24.70	691.91
SP_t^{VIC}	-64.093***	4.150***	1.700048e+10***	35.09	1393.37
VSP_t^{NSW}	-10.039***	0.103	70223.13***	6.15	49.41
VSP_t^{QLD}	-10.203***	0.102	94970.14***	6.83	57.14
VSP_t^{SA}	-11.279***	0.146	68457.65***	6.48	48.61
VSP_t^{VIC}	-11.611***	0.058	778082.84***	12.34	160.91
$DBESS_t^{NSW}$	-75.096***	4.312***	1.707853e+07***	5.61	45.67
$DBESS_t^{QLD}$	-57.211***	10.940***	9.736835e+06***	4.98	34.80
$DBESS_t^{SA}$	-65.032***	2.055***	3.000684e+06***	3.77	19.89
$DBESS_t^{VIC}$	-58.447***	5.465***	4.967211e+06***	4.32	25.17
$DPUMP_t^{NSW}$	-56.536***	4.661***	7.237471e+05***	2.76	10.22
$DPUMP_t^{QLD}$	-46.886***	2.449***	9.984595e+04***	1.54	4.37
$RSOL_t^{NSW}$	-74.996***	10.998***	5.230397e+04***	1.21	3.26
$RSOL_t^{QLD}$	-75.616***	5.069***	3.898556e+04***	1.04	2.68
$RSOL_t^{SA}$	-51.224***	16.147***	4.813367e+04***	1.17	3.03
$RSOL_t^{VIC}$	-65.426***	16.952***	6.214651e+04***	1.31	3.52
SOL_t^{NSW}	-31.409***	13.104***	2.854817e+04***	0.75	2.00
SOL_t^{QLD}	-31.342***	4.697***	2.770999e+04***	0.71	1.93
SOL_t^{VIC}	-30.902***	12.242***	3.402463e+04***	0.96	2.58
SOL_t^{SA}	-31.589***	4.629***	6.015635e+04***	1.30	3.36
$WIND_t^{NSW}$	-17.267***	3.039***	1.344239e+04***	0.55	2.45
$WIND_t^{QLD}$	-20.906***	26.306***	4.432037e+04***	1.02	3.93
$WIND_t^{SA}$	-18.743***	7.975***	1.307374e+04***	0.50	2.31
$WIND_t^{VIC}$	-16.034***	11.350***	1.897067e+04***	0.73	2.76
HYD_t^{NSW}	-49.680***	5.191***	6.833238e+05***	2.44	10.36
HYD_t^{QLD}	-33.778***	55.598***	-2.784246e+03	-0.52	3.87
HYD_t^{VIC}	-34.526***	8.646***	7.878466e+04***	1.37	4.22
BIO_t^{NSW}	-18.644***	108.122***	-2.050729e+03	-0.28	3.28
BIO_t^{QLD}	-14.755***	101.162***	2.239574e+04***	0.49	1.73
GAS_t^{NSW}	-36.516***	16.033***	7.678875e+05***	2.67	10.68
GAS_t^{QLD}	-32.857***	5.009***	1.742396e+05***	1.72	5.84
GAS_t^{SA}	-23.737***	39.585***	8.742586e+04***	1.43	4.34
GAS_t^{VIC}	-26.282***	34.708***	9.207993e+05***	2.84	11.53
$COAL_t^{NSW}$	-29.441***	39.897***	-4.316360e+03	-0.42	2.54
$COAL_t^{QLD}$	-29.621***	32.118***	-7.947670e+01	-0.34	2.33
$COAL_t^{VIC}$	-23.475***	61.918***	-9.364182e+01	-0.44	2.12
$DIESEL_t^{NSW}$	-97.853***	0.400*	7.563379e+08***	16.69	294.73
$DIESEL_t^{SA}$	-67.939***	3.775***	1.035924e+08***	10.05	109.80

OTH_t^{NSW}	-27.703***	30.089***	1.626345e+04***	0.68	2.88
OTH_t^{QLD}	-26.076***	99.245***	3.372250e+02***	-0.08	2.75
OTH_t^{VIC}	-21.099***	12.586***	1.461787e+04***	0.57	2.40
DEM_t^{NSW}	-30.455***	38.777***	5.258874e+03***	0.32	3.43
DEM_t^{QLD}	-31.479***	34.577***	2.060832e+03***	0.22	3.20
DEM_t^{SA}	-27.524***	32.500***	-8.222892e+03	-0.54	3.49
DEM_t^{VIC}	-29.739***	57.064***	4.673352e+03***	0.34	3.28
$CBESS_t^{NSW}$	-63.963***	5.113***	9.264139e+06***	4.65	34.14
$CBESS_t^{QLD}$	-50.028***	15.998***	5.571030e+06***	4.26	26.72
$CBESS_t^{SA}$	-59.893***	1.840***	1.282840e+06***	3.02	13.47
$CBESS_t^{VIC}$	-51.315***	6.462***	2.857278e+06***	3.67	19.49

Note: *, *, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively

Appendix B – Estimates

Table B.1. Estimates for supply price model for NSW in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	0.044	-0.338****	-0.388****	-0.339****	-0.143****	-0.359****	-0.550****	-0.671****	-0.667
	(0.409)	(0.089)	(0.057)	(0.030)	(0.023)	(0.043)	(0.087)	(0.117)	(0.463)
DPUMP	-0.356	-0.150	-0.061	0.036	0.020**	0.114****	0.264****	0.450****	0.699
	(0.970)	(0.130)	(0.076)	(0.028)	(0.010)	(0.021)	(0.063)	(0.131)	(0.537)
RSOL	0.417****	0.107****	0.055****	0.006**	-0.002****	-0.020****	-0.073****	-0.145****	-0.476****
	(0.065)	(0.016)	(0.010)	(0.003)	(0.000)	(0.003)	(0.008)	(0.018)	(0.051)
SOL	0.002	0.005	-0.004	-0.004*	-0.001*	-0.004*	-0.017****	-0.025***	-0.034
	(0.015)	(0.009)	(0.007)	(0.002)	(0.000)	(0.002)	(0.005)	(0.009)	(0.028)
WIND	-0.013	-0.064***	-0.072****	-0.041****	-0.006****	-0.036****	-0.065****	-0.088****	-0.221****
	(0.057)	(0.023)	(0.009)	(0.006)	(0.001)	(0.004)	(0.009)	(0.014)	(0.027)
HYDRO	-0.221****	-0.087****	-0.046****	-0.010**	-0.000	0.006	0.003	0.005	0.006
	(0.038)	(0.005)	(0.009)	(0.004)	(0.000)	(0.004)	(0.005)	(0.008)	(0.028)
BIO	-3.894****	-1.230****	-0.683****	-0.119	-0.005	-0.132**	0.139	0.196	0.545
	(0.913)	(0.312)	(0.205)	(0.076)	(0.015)	(0.063)	(0.201)	(0.269)	(1.146)
GAS	-0.259*	-0.127****	-0.074****	-0.023****	-0.002**	0.006	0.013	0.026	0.112*
	(0.134)	(0.015)	(0.011)	(0.006)	(0.001)	(0.006)	(0.011)	(0.020)	(0.063)
COAL	0.057****	0.045****	0.042****	0.034****	0.007****	0.043****	0.056****	0.057****	0.081****
	(0.017)	(0.011)	(0.006)	(0.002)	(0.000)	(0.002)	(0.005)	(0.011)	(0.016)
DIESEL	27.866**	26.030****	26.131****	25.715****	26.431****	25.981****	25.991****	26.595****	28.020****
	(11.888)	(1.132)	(0.673)	(0.933)	(0.944)	(1.900)	(0.699)	(0.753)	(5.266)
OTH	0.242	-0.040	-0.013	0.013	0.004*	0.045****	0.096**	0.172*	0.585
	(0.588)	(0.104)	(0.034)	(0.011)	(0.002)	(0.010)	(0.040)	(0.094)	(0.513)
FES	32.178	12.615****	6.200**	2.444***	-0.020	-2.135***	-6.602***	-11.509***	-27.733
	(24.453)	(3.639)	(3.113)	(0.922)	(0.053)	(0.708)	(2.092)	(4.448)	(21.070)
_cons	-129.531****	-52.627****	-29.216****	-8.269****	0.100	8.089****	30.918****	51.759****	122.508****
	(29.562)	(5.469)	(3.472)	(1.216)	(0.064)	(1.032)	(3.206)	(5.360)	(22.395)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105,374	105,374	105,374	105,374	105,374	105,374	105,374	105,374	105,374
MdF	31	31	31	31	31	31	31	31	31
rank	32	32	32	32	32	32	32	32	32

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom. Standard errors in parentheses.

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.2. Estimates for supply price model for NSW in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-0.273**	-0.276****	-0.244****	-0.166****	-0.136****	-0.197****	-0.279****	-0.323****	-0.470****
	(0.110)	(0.055)	(0.015)	(0.009)	(0.010)	(0.010)	(0.020)	(0.033)	(0.037)
DPUMP	-0.987	-0.255***	-0.137	0.037	0.141****	0.274****	0.498****	0.521***	0.832
	(1.001)	(0.092)	(0.087)	(0.041)	(0.028)	(0.055)	(0.085)	(0.165)	(0.747)
RSOL	0.193****	0.063****	0.024****	-0.001	-0.005****	-0.018****	-0.045****	-0.080****	-0.206****
	(0.043)	(0.011)	(0.006)	(0.002)	(0.000)	(0.002)	(0.006)	(0.013)	(0.032)
SOL	-0.019	-0.032****	-0.025****	-0.011****	-0.004****	-0.006****	-0.016****	-0.023****	-0.043****
	(0.021)	(0.004)	(0.003)	(0.002)	(0.000)	(0.001)	(0.003)	(0.007)	(0.012)
WIND	-0.109***	-0.059****	-0.054****	-0.032****	-0.010****	-0.030****	-0.047****	-0.065****	-0.157****
	(0.041)	(0.011)	(0.007)	(0.003)	(0.001)	(0.003)	(0.008)	(0.007)	(0.015)
HYDRO	-0.071****	-0.047****	-0.028****	-0.003*	-0.000	0.004*	0.005	0.004	0.001
	(0.015)	(0.005)	(0.006)	(0.002)	(0.001)	(0.002)	(0.004)	(0.006)	(0.018)
BIO	-0.511	-0.299	-0.338****	-0.091*	-0.026**	-0.023	0.063	0.106	0.553*
	(0.471)	(0.280)	(0.053)	(0.051)	(0.010)	(0.047)	(0.205)	(0.190)	(0.320)
GAS	-0.233****	-0.111****	-0.064****	-0.018****	-0.004**	0.008**	0.020***	0.041****	0.120****
	(0.035)	(0.013)	(0.010)	(0.003)	(0.001)	(0.004)	(0.008)	(0.011)	(0.029)
COAL	0.044	0.034****	0.028****	0.021****	0.005****	0.031****	0.053****	0.057****	0.090****
	(0.029)	(0.008)	(0.004)	(0.002)	(0.001)	(0.002)	(0.005)	(0.009)	(0.010)
DIESEL	15.600****	14.894****	13.968****	14.655****	14.351****	14.122****	13.493****	13.057****	15.460****
	(1.051)	(0.566)	(0.397)	(0.328)	(0.372)	(0.363)	(0.459)	(0.659)	(1.595)
OTH	-0.143	-0.096**	-0.012	0.006	-0.000	0.002	0.013	-0.010	0.108
	(0.253)	(0.041)	(0.025)	(0.010)	(0.002)	(0.008)	(0.018)	(0.033)	(0.182)
FES	26.219****	7.398****	5.003****	1.336****	0.005	-1.583****	-4.677****	-8.253***	-26.147****
	(7.863)	(2.049)	(0.888)	(0.284)	(0.056)	(0.424)	(1.242)	(2.728)	(5.272)
_cons	-85.433****	-30.852****	-19.355****	-4.986****	0.080	5.666****	19.503****	32.614****	81.973****
	(10.983)	(3.822)	(1.552)	(0.583)	(0.062)	(0.669)	(2.179)	(3.551)	(7.978)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105086	105086	105086	105086	105086	105086	105086	105086	105086
MdF	31	31	31	31	31	31	31	31	31
Rank	32	32	32	32	32	32	32	32	32

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.3. Estimates for supply price model for QLD in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	0.842	0.151	-0.209	-0.394****	-0.306****	-0.542****	-0.745****	-0.806**	-2.492***
	(1.661)	(0.429)	(0.145)	(0.057)	(0.035)	(0.053)	(0.078)	(0.345)	(0.932)
DPUMP	3.752**	1.765	0.844***	-0.138	-0.285****	-0.668****	-0.793****	-0.499	-2.417
	(1.779)	(1.180)	(0.279)	(0.124)	(0.054)	(0.092)	(0.204)	(0.884)	(2.978)
RSOL	0.623****	0.268***	0.132****	0.009	-0.024****	-0.075****	-0.161****	-0.206****	-0.587***
	(0.136)	(0.084)	(0.021)	(0.009)	(0.004)	(0.007)	(0.016)	(0.061)	(0.208)
SOL	0.104*	0.098***	0.065****	0.021****	0.004**	0.007***	0.014**	0.027	-0.062
	(0.059)	(0.031)	(0.008)	(0.003)	(0.002)	(0.003)	(0.007)	(0.023)	(0.077)
WIND	-0.073	-0.023	-0.027*	-0.029****	-0.018****	-0.040****	-0.069****	-0.062	-0.223*
	(0.102)	(0.052)	(0.016)	(0.007)	(0.003)	(0.006)	(0.014)	(0.044)	(0.129)
HYDRO	0.473	0.520****	0.461****	0.280****	0.177***	0.338****	0.500****	0.588****	0.927****
	(0.305)	(0.087)	(0.091)	(0.052)	(0.065)	(0.059)	(0.070)	(0.132)	(0.254)
BIO	-1.734	-1.367****	-0.570****	-0.096	0.003	-0.033	0.005	0.499	0.990
	(1.460)	(0.393)	(0.150)	(0.072)	(0.019)	(0.044)	(0.202)	(0.570)	(2.216)
GAS	-0.088*	0.081**	0.088****	0.076****	0.054****	0.106****	0.180****	0.229****	0.373****
	(0.052)	(0.032)	(0.013)	(0.005)	(0.004)	(0.004)	(0.009)	(0.020)	(0.068)
COAL	0.165	0.204****	0.150****	0.071****	0.026****	0.052****	0.070****	0.088***	0.022
	(0.107)	(0.037)	(0.010)	(0.004)	(0.002)	(0.003)	(0.008)	(0.027)	(0.069)
OTH	0.553****	0.197****	0.091***	0.008	-0.008	-0.004	0.045	0.033	0.138
	(0.161)	(0.049)	(0.032)	(0.013)	(0.005)	(0.010)	(0.055)	(0.109)	(0.133)
FES	49.720****	13.916****	7.156***	2.338***	0.053	-2.515****	-8.281****	-16.288***	-47.062****
	(13.497)	(3.322)	(2.451)	(0.843)	(0.051)	(0.627)	(2.300)	(5.714)	(11.320)
_cons	-149.58****	-52.306****	-29.944****	-8.397****	0.041	8.805****	31.224****	57.596****	149.263****
	(25.693)	(4.834)	(3.407)	(1.207)	(0.088)	(1.007)	(3.352)	(6.502)	(15.128)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105375	105375	105375	105375	105375	105375	105375	105375	105375
MdF	30	30	30	30	30	30	30	30	30
Rank	31	31	31	31	31	31	31	31	31

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.4. Estimates for supply price model for QLD in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-0.124	-0.158***	-0.193****	-0.174****	-0.161****	-0.232****	-0.320****	-0.384****	-0.589****
	(0.137)	(0.059)	(0.027)	(0.014)	(0.011)	(0.017)	(0.033)	(0.059)	(0.150)
DPUMP	1.268***	0.350**	0.043	-0.143***	-0.230****	-0.362****	-0.374***	-0.354	-0.624
	(0.478)	(0.171)	(0.097)	(0.049)	(0.027)	(0.060)	(0.119)	(0.221)	(0.579)
RSOL	0.258****	0.095****	0.043****	0.000	-0.019****	-0.040****	-0.075****	-0.119****	-0.184****
	(0.035)	(0.015)	(0.007)	(0.004)	(0.002)	(0.004)	(0.009)	(0.017)	(0.055)
SOL	0.031	0.018**	0.007*	0.001	-0.005****	-0.006***	-0.006	-0.006	-0.055
	(0.023)	(0.008)	(0.004)	(0.002)	(0.001)	(0.002)	(0.005)	(0.009)	(0.036)
WIND	-0.075***	-0.033**	-0.024***	-0.022****	-0.016****	-0.022****	-0.028***	-0.035****	-0.019
	(0.028)	(0.014)	(0.007)	(0.003)	(0.001)	(0.003)	(0.009)	(0.009)	(0.032)
HYDRO	0.431****	0.355****	0.253****	0.159****	0.135****	0.153****	0.227****	0.305****	0.370****
	(0.071)	(0.023)	(0.013)	(0.015)	(0.015)	(0.011)	(0.013)	(0.022)	(0.084)
BIO	-2.096***	-0.574*	-0.324****	-0.113**	-0.004	-0.011	0.092	-0.173	0.994
	(0.738)	(0.337)	(0.094)	(0.047)	(0.018)	(0.050)	(0.141)	(0.237)	(1.034)
GAS	-0.078**	-0.027**	0.013	0.028****	0.031****	0.064****	0.114****	0.146****	0.281****
	(0.031)	(0.013)	(0.010)	(0.003)	(0.002)	(0.004)	(0.008)	(0.013)	(0.038)
COAL	0.136****	0.118****	0.091****	0.057****	0.030****	0.053****	0.073****	0.072****	0.064*
	(0.030)	(0.007)	(0.004)	(0.002)	(0.002)	(0.002)	(0.004)	(0.007)	(0.038)
OTH	0.774****	0.213***	0.121***	0.035***	-0.000	-0.003	-0.002	0.050	0.039
	(0.114)	(0.065)	(0.041)	(0.013)	(0.005)	(0.012)	(0.032)	(0.072)	(0.198)
FES	7.222	1.580	0.849	0.528*	0.032	-0.839***	-0.984	-1.330	-9.149*
	(7.045)	(1.965)	(1.374)	(0.306)	(0.043)	(0.294)	(1.478)	(2.107)	(5.407)
_cons	-42.560****	-18.004****	-10.937****	-3.829****	-0.029	4.373****	11.462****	18.146****	44.762****
	(7.446)	(2.571)	(1.658)	(0.394)	(0.060)	(0.420)	(1.726)	(2.560)	(9.061)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,087	105,087	105,087	105,087	105,087	105,087	105,087	105,087	105,087
MdF	30	30	30	30	30	30	30	30	30
Rank	31	31	31	31	31	31	31	31	31

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom; DE: Density Estimate. Standard errors in parentheses

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.5. Estimates for supply price model for SA in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-1.599**	-1.032****	-0.880****	-0.470****	-0.233****	-0.518****	-0.959****	-1.140****	-1.331**
	(0.732)	(0.095)	(0.059)	(0.037)	(0.024)	(0.034)	(0.077)	(0.137)	(0.543)
RSOL	0.533***	0.124****	0.029*	-0.031****	-0.021****	-0.097****	-0.240****	-0.344****	-0.701****
	(0.185)	(0.024)	(0.016)	(0.004)	(0.001)	(0.005)	(0.014)	(0.029)	(0.136)
SOL	0.203***	0.122****	0.101****	0.051****	0.024****	0.046****	0.089****	0.098****	0.258****
	(0.068)	(0.017)	(0.010)	(0.004)	(0.002)	(0.004)	(0.011)	(0.013)	(0.052)
WIND	0.435****	0.171****	0.110****	0.038****	0.009****	0.030****	0.060****	0.084****	0.192***
	(0.064)	(0.016)	(0.009)	(0.003)	(0.001)	(0.003)	(0.007)	(0.016)	(0.070)
GAS	0.145***	0.175****	0.177****	0.112****	0.044****	0.119****	0.218****	0.264****	0.302****
	(0.054)	(0.015)	(0.013)	(0.006)	(0.004)	(0.006)	(0.008)	(0.013)	(0.047)
DIESEL	2.533****	1.645****	1.372****	1.046****	1.043****	1.111****	1.357****	1.535****	2.226****
	(0.180)	(0.319)	(0.154)	(0.139)	(0.149)	(0.153)	(0.167)	(0.137)	(0.253)
FES	-17.815	1.704	1.994	0.847	-0.061*	-1.482**	-3.271	-1.913	25.178
	(18.110)	(8.623)	(3.479)	(0.798)	(0.031)	(0.599)	(2.915)	(14.721)	(46.520)
_cons	-53.493**	-29.534***	-17.922****	-4.875****	0.106*	5.832****	20.002****	30.491**	41.461
	(25.295)	(9.627)	(4.093)	(0.921)	(0.057)	(0.790)	(3.151)	(14.551)	(53.127)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105380	105380	105380	105380	105380	105380	105380	105380	105380
MdF	25	25	25	25	25	25	25	25	25
Rank	26	26	26	26	26	26	26	26	26

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.6. Estimates for supply price model for SA in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-0.491****	-0.333****	-0.261****	-0.185****	-0.148****	-0.201****	-0.286****	-0.357****	-0.593****
	(0.139)	(0.019)	(0.011)	(0.007)	(0.006)	(0.008)	(0.012)	(0.031)	(0.080)
RSOL	0.139*	0.017	-0.011	-0.025****	-0.028****	-0.084****	-0.161****	-0.197****	-0.283**
	(0.081)	(0.028)	(0.016)	(0.005)	(0.001)	(0.005)	(0.013)	(0.026)	(0.142)
SOL	0.086	0.090****	0.067****	0.034****	0.016****	0.029****	0.058****	0.070****	0.057*
	(0.121)	(0.018)	(0.009)	(0.003)	(0.002)	(0.003)	(0.008)	(0.017)	(0.033)
WIND	0.222****	0.117****	0.071****	0.023****	0.005****	0.017****	0.043****	0.081****	0.140***
	(0.025)	(0.011)	(0.007)	(0.002)	(0.001)	(0.002)	(0.008)	(0.012)	(0.045)
GAS_	0.171***	0.191****	0.183****	0.135****	0.113****	0.133****	0.183****	0.216****	0.230****
	(0.065)	(0.018)	(0.010)	(0.008)	(0.006)	(0.007)	(0.008)	(0.017)	(0.052)
DIESEL	2.074****	1.077****	0.900****	0.806****	0.766****	0.764****	0.948****	1.120****	2.086****
	(0.140)	(0.085)	(0.155)	(0.092)	(0.051)	(0.062)	(0.065)	(0.103)	(0.315)
FES	-16.368	-5.527	1.125	0.871	0.027	-1.488***	-0.272	10.343	22.405
	(14.948)	(7.490)	(3.586)	(0.707)	(0.074)	(0.473)	(2.922)	(11.824)	(36.768)
_cons	-70.057***	-24.496***	-17.731****	-4.552****	-0.033	5.364****	17.670****	19.785	71.321*
	(26.831)	(8.128)	(4.030)	(0.840)	(0.084)	(0.778)	(3.454)	(12.325)	(42.226)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,092	105,092	105,092	105,092	105,092	105,092	105,092	105,092	105,092
MdF	25	25	25	25	25	25	25	25	25
Rank	26	26	26	26	26	26	26	26	26

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.7. Estimates for supply price model for VIC in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-0.284	-0.392****	-0.357****	-0.203****	-0.099****	-0.223****	-0.406****	-0.433****	-0.407****
	(0.258)	(0.057)	(0.036)	(0.020)	(0.011)	(0.019)	(0.027)	(0.054)	(0.084)
RSOL	0.221****	0.036***	0.002	-0.013****	-0.011****	-0.041****	-0.125****	-0.181****	-0.456****
	(0.054)	(0.014)	(0.010)	(0.003)	(0.001)	(0.003)	(0.007)	(0.012)	(0.036)
SOL	0.224****	0.107****	0.076****	0.033****	0.016****	0.024****	0.044****	0.053****	0.059***
	(0.025)	(0.008)	(0.005)	(0.003)	(0.001)	(0.003)	(0.007)	(0.011)	(0.019)
WIND	0.087****	0.052****	0.040****	0.025****	0.012****	0.022****	0.023****	0.021**	0.003
	(0.026)	(0.005)	(0.003)	(0.001)	(0.001)	(0.001)	(0.004)	(0.010)	(0.016)
HYRO	-0.024	0.014*	0.023****	0.025****	0.009****	0.034****	0.049****	0.046****	0.046**
	(0.024)	(0.009)	(0.004)	(0.003)	(0.001)	(0.003)	(0.004)	(0.005)	(0.019)
GAS	0.010	0.025	0.062****	0.062****	0.028****	0.085****	0.118****	0.107****	0.127*
	(0.072)	(0.030)	(0.016)	(0.008)	(0.005)	(0.007)	(0.013)	(0.015)	(0.077)
COAL	-0.022***	0.036***	0.029****	0.022****	0.004****	0.023****	0.045****	0.051****	0.015
	(0.007)	(0.011)	(0.007)	(0.003)	(0.001)	(0.003)	(0.005)	(0.012)	(0.014)
OTH	0.002	-0.015	-0.034	-0.029****	-0.019****	-0.059****	-0.154****	-0.217****	-0.442****
	(0.351)	(0.054)	(0.030)	(0.008)	(0.002)	(0.006)	(0.022)	(0.039)	(0.054)
FES	-35.332	7.959*	5.445**	1.381**	-0.035	-1.643****	-4.584***	-7.369*	15.584
	(39.650)	(4.421)	(2.385)	(0.614)	(0.045)	(0.486)	(1.469)	(3.959)	(72.989)
_cons	-30.096	-37.377****	-21.398****	-5.324****	0.111*	5.786****	21.529****	35.376****	42.332
	(40.577)	(5.359)	(2.841)	(0.761)	(0.065)	(0.721)	(2.120)	(4.683)	(72.821)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105378	105378	105378	105378	105378	105378	105378	105378	105378
MdF	27	27	27	27	27	27	27	27	27
Rank	28	28	28	28	28	28	28	28	28

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table B.8. Estimates for supply price model for VIC in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-0.177***	-0.177****	-0.159****	-0.104****	-0.050****	-0.110****	-0.162****	-0.183****	-0.209***
	(0.067)	(0.025)	(0.016)	(0.007)	(0.005)	(0.007)	(0.019)	(0.030)	(0.064)
RSOL	0.067*	0.003	-0.020**	-0.020****	-0.010****	-0.036****	-0.077****	-0.099****	-0.172****
	(0.034)	(0.013)	(0.008)	(0.003)	(0.001)	(0.003)	(0.007)	(0.011)	(0.031)
SOL	0.026	-0.010	-0.006	0.004*	0.002***	-0.000	-0.016***	-0.034****	-0.063****
	(0.036)	(0.013)	(0.006)	(0.002)	(0.001)	(0.002)	(0.006)	(0.010)	(0.016)
WIND	0.040	0.033****	0.028****	0.017****	0.005****	0.015****	0.020****	0.015***	-0.009
	(0.029)	(0.005)	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)	(0.005)	(0.012)
HYDRO	0.013	0.009*	0.017****	0.019****	0.013****	0.026****	0.035****	0.032****	0.031**
	(0.021)	(0.005)	(0.004)	(0.002)	(0.002)	(0.002)	(0.004)	(0.006)	(0.012)
GAS	-0.007	0.021	0.039***	0.047****	0.028****	0.066****	0.103****	0.124****	0.141***
	(0.055)	(0.028)	(0.012)	(0.006)	(0.004)	(0.005)	(0.008)	(0.018)	(0.044)
COAL	0.019	0.012	0.013***	0.014****	0.003****	0.024****	0.052****	0.071****	0.073****
	(0.036)	(0.009)	(0.005)	(0.003)	(0.001)	(0.002)	(0.005)	(0.007)	(0.018)
OTH	0.111	-0.020	-0.056**	-0.039****	-0.013****	-0.048****	-0.085****	-0.116**	-0.179***
	(0.127)	(0.051)	(0.024)	(0.006)	(0.001)	(0.004)	(0.022)	(0.051)	(0.057)
FES	-6.799	1.619	2.183	1.205**	-0.045	-1.535***	-1.835	-2.062	11.472
	(7.934)	(2.365)	(1.394)	(0.576)	(0.038)	(0.483)	(1.180)	(2.470)	(7.780)
_cons	-32.697***	-17.306****	-11.418****	-3.503****	0.051	3.966****	11.628****	18.875****	27.307***
	(11.100)	(2.844)	(1.712)	(0.724)	(0.049)	(0.621)	(1.709)	(3.078)	(9.787)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,090	105,090	105,090	105,090	105,090	105,090	105,090	105,090	105,090
MdF	27	27	27	27	27	27	27	27	27
Rank	28	28	28	28	28	28	28	28	28

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.9. Estimates for demand price model for NSW in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	-0.421	0.036	0.044	0.076***	0.042****	0.054**	0.037	-0.070	-0.099
	(0.678)	(0.064)	(0.073)	(0.024)	(0.009)	(0.025)	(0.050)	(0.128)	(0.541)
TDEM	0.184****	0.115****	0.100****	0.065****	0.033****	0.080****	0.142****	0.200****	0.382****
	(0.050)	(0.006)	(0.003)	(0.002)	(0.001)	(0.002)	(0.004)	(0.006)	(0.023)
FES	29.440	9.377***	5.939**	1.786***	-0.012	-1.671***	-5.670**	-10.138**	-30.377***
	(67.693)	(3.330)	(2.621)	(0.634)	(0.053)	(0.630)	(2.256)	(4.601)	(10.984)
_cons	-134.652**	-48.180****	-27.897****	-7.771****	0.113	8.211****	28.717****	50.147****	123.349****
	(67.144)	(3.692)	(2.912)	(1.029)	(0.095)	(0.842)	(2.915)	(6.154)	(13.404)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.10. Estimates for demand price model for NSW in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.267****	0.197****	0.159****	0.104****	0.060****	0.092****	0.136****	0.149****	0.174**
	(0.069)	(0.026)	(0.016)	(0.008)	(0.005)	(0.007)	(0.011)	(0.022)	(0.069)
TDEM	0.122****	0.089****	0.073****	0.047****	0.027****	0.060****	0.112****	0.148****	0.255****
	(0.020)	(0.005)	(0.003)	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)	(0.014)
FES	24.594***	5.120**	3.195**	1.266****	0.018	-0.977***	-3.613***	-6.032***	-15.923***
	(7.734)	(2.048)	(1.550)	(0.326)	(0.056)	(0.307)	(1.198)	(1.991)	(5.468)
_cons	-84.688****	-26.810****	-17.044****	-5.400****	0.033	5.640****	19.124****	30.570****	67.966****
	(10.867)	(3.126)	(2.023)	(0.499)	(0.077)	(0.562)	(1.839)	(2.765)	(7.854)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.11. Estimates for demand price model for QLD in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.174	0.396****	0.278****	0.155****	0.064****	0.140****	0.317****	0.326***	0.183
	(1.256)	(0.037)	(0.054)	(0.031)	(0.011)	(0.026)	(0.040)	(0.108)	(0.507)
TDEM	0.231****	0.148****	0.121****	0.074****	0.038****	0.087****	0.163****	0.227****	0.398****
	(0.024)	(0.008)	(0.004)	(0.002)	(0.002)	(0.002)	(0.004)	(0.006)	(0.021)
FES	54.928****	17.472****	8.663****	2.186****	-0.042	-2.273****	-7.847****	-12.608**	-45.745****
	(13.518)	(4.463)	(2.425)	(0.554)	(0.052)	(0.512)	(2.067)	(5.217)	(10.184)
_cons	-162.051****	-56.426****	-32.162****	-8.501****	0.088	8.427****	30.164****	52.994****	141.024****
	(17.500)	(5.193)	(3.005)	(1.000)	(0.079)	(0.887)	(2.656)	(5.751)	(15.597)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.12. Estimates for demand price model for QLD in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.215**	0.137****	0.093****	0.046****	0.018****	0.041****	0.071****	0.095****	0.023
	(0.089)	(0.017)	(0.009)	(0.004)	(0.002)	(0.004)	(0.010)	(0.019)	(0.060)
TDEM	0.124****	0.085****	0.073****	0.043****	0.018****	0.054****	0.107****	0.145****	0.227****
	(0.014)	(0.005)	(0.003)	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)	(0.018)
FES	10.469*	3.288	1.587	0.370	-0.041	-0.657**	-2.219	-2.564	-11.407**
	(5.439)	(2.620)	(1.856)	(0.303)	(0.032)	(0.262)	(1.431)	(2.092)	(5.408)
_cons	-53.480****	-22.153****	-12.612****	-3.626****	0.027	4.407****	14.317****	22.452****	51.130****
	(13.957)	(3.394)	(1.985)	(0.410)	(0.040)	(0.447)	(1.587)	(2.750)	(7.114)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.13. Estimates for demand price model for SA in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.466	0.396****	0.409****	0.251****	0.094****	0.208****	0.341****	0.413****	0.267
	(0.390)	(0.113)	(0.082)	(0.028)	(0.011)	(0.024)	(0.041)	(0.104)	(0.594)
TDEM	0.684****	0.321****	0.248****	0.129****	0.045****	0.156****	0.328****	0.446****	0.814****
	(0.063)	(0.026)	(0.012)	(0.005)	(0.002)	(0.006)	(0.012)	(0.021)	(0.108)
FES	-10.182	1.316	3.577	1.055**	0.018	-1.080*	-2.800	1.257	61.614
	(14.941)	(10.770)	(7.262)	(0.527)	(0.065)	(0.579)	(3.921)	(14.520)	(43.880)
_cons	-68.628****	-28.928**	-19.965***	-5.339****	0.003	5.725****	20.129****	28.274*	11.595
	(19.728)	(11.412)	(7.522)	(0.664)	(0.081)	(0.702)	(4.251)	(14.930)	(44.473)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom. Standard errors in parentheses

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.14. Estimates for demand price model for SA in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.574****	0.279****	0.225****	0.119****	0.053****	0.099****	0.159****	0.189****	0.070
	(0.075)	(0.030)	(0.022)	(0.009)	(0.005)	(0.009)	(0.018)	(0.030)	(0.131)
TDEM	0.569****	0.313****	0.226****	0.110****	0.045****	0.134****	0.277****	0.372****	0.560****
	(0.033)	(0.014)	(0.011)	(0.005)	(0.003)	(0.006)	(0.013)	(0.019)	(0.044)
FES	-8.796	-8.819	-1.141	1.080**	0.019	-1.654****	-0.673	10.859*	31.763***
	(10.445)	(7.682)	(2.281)	(0.516)	(0.054)	(0.449)	(3.660)	(5.961)	(11.786)
_cons	-79.288****	-24.104***	-16.241****	-5.163****	-0.014	5.992****	18.346****	22.267***	55.127****
	(16.150)	(8.267)	(2.865)	(0.689)	(0.075)	(0.638)	(4.302)	(6.864)	(16.001)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom. Standard errors in parentheses

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.15. Estimates for demand price model for VIC in 2024.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.521	0.361****	0.259****	0.138****	0.084****	0.137****	0.219****	0.237****	-0.177
	(0.318)	(0.048)	(0.028)	(0.010)	(0.007)	(0.009)	(0.023)	(0.040)	(0.282)
TDEM	0.146****	0.114****	0.105****	0.064****	0.032****	0.072****	0.134****	0.174****	0.289****
	(0.020)	(0.006)	(0.003)	(0.002)	(0.001)	(0.002)	(0.004)	(0.006)	(0.018)
FES	-39.522	5.900*	4.424*	1.170**	-0.034	-1.592****	-3.750	-4.847	27.553
	(25.035)	(3.216)	(2.601)	(0.588)	(0.048)	(0.464)	(3.488)	(3.559)	(74.614)
_cons	-39.522	5.900*	4.424*	1.170**	-0.034	-1.592****	-3.750	-4.847	27.553
	(25.035)	(3.216)	(2.601)	(0.588)	(0.048)	(0.464)	(3.488)	(3.559)	(74.614)
N	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
SumW	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406	105,406
RdF	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384	105,384
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom; DE: Density Estimate. Standard errors in parentheses

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.16. Estimates for supply price model for VIC in 2025.

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	0.208****	0.151****	0.123****	0.063****	0.031****	0.052****	0.078****	0.090****	0.123**
	(0.057)	(0.018)	(0.015)	(0.005)	(0.003)	(0.005)	(0.012)	(0.017)	(0.050)
TDEM	0.120****	0.092****	0.080****	0.050****	0.024****	0.059****	0.109****	0.140****	0.206****
	(0.013)	(0.005)	(0.003)	(0.002)	(0.001)	(0.002)	(0.003)	(0.005)	(0.013)
FES	-9.310	0.673	2.254	0.753	-0.061	-1.107***	-1.247	-1.171	13.927***
	(8.266)	(2.361)	(1.389)	(0.647)	(0.068)	(0.415)	(1.556)	(1.965)	(5.226)
_cons	-30.333**	-17.323****	-11.760****	-3.595****	0.093	4.085****	11.535****	17.862****	21.827****
	(12.522)	(2.711)	(1.759)	(0.713)	(0.080)	(0.542)	(1.928)	(2.659)	(6.401)
N	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
SumW	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118	105,118
RdF	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096	105,096
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.17. Estimates for supply volatility model for NSW (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	19.199**	14.258***	5.388	0.296	-0.012	-0.114	0.138	-0.471	-0.363
	(8.579)	(5.381)	(11.810)	(0.377)	(0.155)	(0.230)	(1.437)	(2.581)	(0.371)
DPUMP	30.012**	5.326	3.477	0.944	0.225	0.925	-2.557	-0.256	-28.434****
	(13.813)	(15.714)	(9.592)	(0.762)	(0.330)	(0.707)	(5.164)	(18.912)	(1.366)
RSOL	0.159	0.094	0.020	0.003	0.007	0.001	-0.043	-0.189	-0.036
	(0.262)	(0.244)	(0.114)	(0.013)	(0.006)	(0.012)	(0.075)	(0.279)	(0.027)
SOL	-0.669*	-0.461*	-0.129	0.001	0.007	-0.001	-0.050	-0.301	-0.233****
	(0.369)	(0.236)	(0.447)	(0.010)	(0.006)	(0.009)	(0.061)	(0.284)	(0.024)
WIND	0.122	0.275	0.083	-0.001	-0.006	-0.001	0.124	0.426**	0.239****
	(0.276)	(0.197)	(0.155)	(0.007)	(0.005)	(0.008)	(0.089)	(0.215)	(0.027)
HYDRO	1.587****	1.858****	0.709	0.075***	0.055***	0.094***	0.682*	1.629***	2.686****
	(0.345)	(0.395)	(1.336)	(0.029)	(0.018)	(0.030)	(0.383)	(0.505)	(0.039)
BIO	-8.267	2.494	-0.881	0.122	0.094	0.041	1.956	10.091*	8.800****
	(7.112)	(9.559)	(1.900)	(0.339)	(0.162)	(0.273)	(1.355)	(5.347)	(0.509)
GAS	0.009	0.091	0.044	0.066**	0.067****	0.060	0.455*	1.028	2.441****
	(0.662)	(1.059)	(0.392)	(0.026)	(0.015)	(0.039)	(0.270)	(0.840)	(0.046)
COAL	-0.328*	-0.256	-0.080	-0.011*	-0.009**	-0.014**	-0.071	-0.174	-0.358****
	(0.178)	(0.160)	(0.277)	(0.006)	(0.004)	(0.007)	(0.053)	(0.113)	(0.017)
DIESEL	1,113.358****	778.309**	1,039.383	847.198****	853.441****	837.096****	737.848****	678.900**	801.723****
	(224.706)	(354.904)	(1480.941)	(90.064)	(43.433)	(109.492)	(140.298)	(263.349)	(12.404)
OTH	-5.706*	-3.507	-0.909	-0.007	-0.008	-0.043	-1.125	-5.133	-9.017****
	(3.275)	(2.900)	(2.553)	(0.067)	(0.055)	(0.079)	(0.864)	(3.160)	(0.220)
FES	583.465***	157.472	69.875	7.188	-0.619	0.466	-39.013	54.503	32.495**
	(205.903)	(191.675)	(115.299)	(7.225)	(3.872)	(6.087)	(48.836)	(179.541)	(14.827)
_cons	-1,404.647****	-802.992****	-328.257	-28.176***	-4.241	9.304	217.533*	848.075***	1,719.975****
	(376.563)	(149.370)	(827.939)	(8.993)	(3.215)	(6.975)	(122.916)	(325.338)	(26.570)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	703	703	703	703	703	703	703	703	703
MdF	25	25	25	25	25	25	25	25	25
Rank	26	26	26	26	26	26	26	26	26

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.18. Estimates for supply volatility model for QLD (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-8.975	-2.620	-0.336	-0.217	-0.051	-0.308	-1.486	-5.240	-36.411****
	(25.296)	(4.533)	(0.375)	(0.260)	(0.169)	(0.273)	(1.209)	(7.149)	(0.908)
RSOL	0.977**	0.388	0.079****	0.048****	0.044****	0.044****	0.100	0.355	0.813****
	(0.445)	(0.344)	(0.020)	(0.008)	(0.006)	(0.009)	(0.062)	(0.242)	(0.019)
SOL	1.342*	-0.065	-0.007	-0.003	0.005	0.011	0.030	0.137	0.805****
	(0.761)	(0.156)	(0.019)	(0.008)	(0.008)	(0.009)	(0.036)	(0.177)	(0.026)
WIND	0.603	0.010	-0.010	-0.011	-0.016**	-0.018**	0.018	0.025	0.217****
	(0.760)	(0.140)	(0.019)	(0.008)	(0.007)	(0.007)	(0.038)	(0.147)	(0.026)
HYDRO	-7.110	0.810	-0.095	0.026	0.013	0.067	-0.176	-4.742*	-5.719****
	(11.154)	(2.599)	(0.198)	(0.133)	(0.098)	(0.116)	(0.540)	(2.843)	(0.457)
BIO	6.058	-10.412	-1.148*	-0.222	-0.135	-0.186	0.333	3.428	-9.746****
	(18.340)	(11.613)	(0.683)	(0.201)	(0.204)	(0.321)	(0.801)	(5.507)	(0.782)
GAS	1.449	0.431	0.103****	0.069****	0.052****	0.073****	0.192*	0.924**	2.756****
	(0.905)	(0.463)	(0.022)	(0.012)	(0.010)	(0.011)	(0.110)	(0.461)	(0.037)
COAL	1.093**	0.055	-0.010	-0.012	-0.006	-0.009	0.010	0.256	0.313****
	(0.478)	(0.116)	(0.014)	(0.008)	(0.007)	(0.007)	(0.024)	(0.173)	(0.022)
OTH	-7.548	2.860	0.388	0.008	-0.101	-0.066	-0.546	-3.468	-9.757****
	(8.416)	(3.900)	(0.258)	(0.101)	(0.095)	(0.116)	(0.541)	(3.543)	(0.557)
FES	801.748***	-21.541	10.414	3.979	2.036	3.674	15.316	-4.796	-71.595****
	(259.342)	(145.090)	(6.339)	(3.139)	(2.848)	(2.632)	(12.642)	(55.340)	(8.217)
_cons	-2,017.348**	-222.197	-27.541****	-9.840****	0.537	10.338***	65.886	507.731***	1,088.139****
	(943.038)	(231.233)	(7.090)	(2.973)	(2.353)	(3.892)	(51.383)	(184.744)	(16.085)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	706	706	706	706	706	706	706	706	706
MdF	22	22	22	22	22	22	22	22	22
Rank	23	23	23	23	23	23	23	23	23

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table B.19. Estimates for supply volatility model for SA (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	-4.399	1.740	1.558	0.455	0.235	-0.186	-0.426	-3.261**	-12.464****
	(3.925)	(1.694)	(1.326)	(0.310)	(0.278)	(0.272)	(0.600)	(1.649)	(0.315)
RSOL	0.393*	0.052	0.101	0.036**	0.032*	0.062*	0.094	0.179	0.425****
	(0.219)	(0.158)	(0.079)	(0.017)	(0.018)	(0.036)	(0.061)	(0.120)	(0.014)
SOL	0.411	-0.278	-0.190	-0.066	-0.030	-0.043	-0.100	-0.109	0.799****
	(0.370)	(0.279)	(0.279)	(0.051)	(0.032)	(0.042)	(0.088)	(0.178)	(0.030)
WIND	-0.096	-0.051	-0.022	-0.020**	-0.018*	-0.021*	-0.018	-0.013	-0.102****
	(0.106)	(0.068)	(0.035)	(0.009)	(0.011)	(0.011)	(0.029)	(0.055)	(0.008)
GAS	-0.054	0.145	0.107	-0.007	-0.015	-0.012	0.037	0.240	0.335****
	(0.265)	(0.200)	(0.211)	(0.021)	(0.013)	(0.018)	(0.081)	(0.151)	(0.019)
DIESEL	141.955****	91.479****	64.872*	33.197	28.992	31.179	55.143	90.346****	176.356****
	(35.695)	(18.639)	(37.539)	(21.562)	(27.460)	(40.220)	(44.343)	(16.710)	(2.075)
FES	172.395*	60.929*	35.949*	12.188**	8.779**	3.657	10.611	-39.732*	-12.042**
	(92.218)	(35.161)	(20.796)	(5.902)	(3.708)	(5.121)	(24.166)	(20.879)	(4.687)
_cons	-1,235.283****	-174.535***	-67.366***	-22.903****	-1.629	17.291****	57.780**	167.546****	854.296****
	(280.573)	(65.385)	(23.751)	(5.441)	(6.823)	(4.831)	(24.659)	(45.480)	(15.480)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	709	709	709	709	709	709	709	709	709
MdF	19	19	19	19	19	19	19	19	19
Rank	20	20	20	20	20	20	20	20	20

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table B.20. Estimates for supply volatility model for VIC (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
DBESS	0.402***	0.401	0.052	-0.009	0.068	0.027	-0.044	0.313	-0.096
	(0.145)	(0.317)	(0.177)	(0.106)	(0.076)	(0.090)	(0.181)	(0.299)	(0.098)
RSOL	0.017	0.019	0.029****	0.028****	0.022****	0.023****	0.021	0.003	0.025****
	(0.011)	(0.020)	(0.007)	(0.008)	(0.005)	(0.005)	(0.013)	(0.013)	(0.005)
SOL	-0.045	-0.081*	-0.028	-0.034*	-0.012	-0.017	0.010	0.025	-0.272****
	(0.036)	(0.048)	(0.032)	(0.019)	(0.014)	(0.014)	(0.021)	(0.039)	(0.013)
WIND	-0.006	-0.001	0.003	-0.003	-0.000	-0.007*	-0.010*	-0.002	-0.060****
	(0.006)	(0.013)	(0.005)	(0.005)	(0.005)	(0.004)	(0.006)	(0.010)	(0.003)
HYDRO	0.043*	0.022	0.037**	0.044**	0.031***	0.021*	0.020	-0.031	-0.582****
	(0.023)	(0.028)	(0.016)	(0.020)	(0.012)	(0.011)	(0.027)	(0.051)	(0.009)
GAS	0.032	0.040	0.039	0.009	0.028**	0.029**	0.073*	0.140****	0.825****
	(0.024)	(0.053)	(0.024)	(0.026)	(0.012)	(0.014)	(0.037)	(0.040)	(0.010)
COAL	-0.025****	-0.012	-0.000	-0.003	-0.006*	-0.005*	-0.002	-0.026***	-0.147****
	(0.007)	(0.012)	(0.005)	(0.006)	(0.003)	(0.003)	(0.007)	(0.009)	(0.004)
OTH	0.014	-0.039	-0.016	0.018	0.005	0.051	0.109**	-0.021	-0.422****
	(0.063)	(0.103)	(0.053)	(0.039)	(0.036)	(0.037)	(0.045)	(0.106)	(0.022)
FES	24.266****	18.621***	11.083****	5.395*	2.672	-0.246	11.404**	4.580	-15.674****
	(4.263)	(6.938)	(2.743)	(3.135)	(2.301)	(2.388)	(4.481)	(7.802)	(2.279)
_cons	-46.366****	-39.666****	-28.738****	-12.986**	0.024	11.449****	23.645****	51.934****	298.229****
	(8.438)	(9.648)	(7.995)	(5.048)	(2.924)	(2.843)	(5.992)	(8.896)	(12.658)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	707	707	707	707	707	707	707	707	707
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table B.21. Estimates for demand volatility model for NSW (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	33.745****	12.318**	2.875	0.370	0.087	0.165	0.099	3.270*	2.108**
	(7.743)	(5.024)	(2.487)	(0.302)	(0.102)	(0.152)	(0.375)	(1.924)	(1.017)
TDEM	0.553***	0.299**	0.081	0.003	-0.000	0.009**	0.060	0.210*	0.712****
	(0.177)	(0.147)	(0.073)	(0.004)	(0.003)	(0.004)	(0.066)	(0.110)	(0.024)
FES	453.827	150.702	22.439	7.960	5.900	5.508	24.870	116.665	519.604****
	(465.302)	(164.408)	(49.192)	(20.338)	(9.872)	(11.032)	(53.950)	(148.255)	(38.915)
_cons	-1,747.639***	-1,152.331***	-231.351	-29.417	-14.528	4.857	53.389	191.562	1,932.220****
	(544.193)	(400.052)	(203.938)	(25.408)	(11.807)	(12.185)	(51.985)	(190.974)	(92.371)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	707	707	707	707	707	707	707	707	707
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table B.22. Estimates for demand volatility model for QLD (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	-2.488	-0.185	0.160	0.326	-0.002	-0.285	-0.525	-0.027	-28.884****
	(5.919)	(2.512)	(0.836)	(0.480)	(0.215)	(0.190)	(0.396)	(1.464)	(0.567)
TDEM	-0.063	-0.062	-0.029**	-0.012**	-0.011**	-0.006	0.006	0.060	0.496****
	(0.109)	(0.084)	(0.014)	(0.006)	(0.004)	(0.006)	(0.009)	(0.049)	(0.011)
FES	18.020	49.906	13.016	3.516	-5.867	-7.649	-15.151	-197.732	-215.013****
	(629.084)	(75.175)	(11.161)	(7.357)	(5.503)	(12.462)	(18.447)	(448.176)	(11.817)
_cons	-1,358.175	-318.376	-87.335***	-23.466*	-2.384	9.067	26.514	420.514	499.818****
	(1167.194)	(1528.921)	(32.084)	(12.970)	(7.759)	(12.496)	(19.374)	(600.211)	(12.822)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	707	707	707	707	707	707	707	707	707
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

Table B.23. Estimates for demand volatility model for SA (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	-4.565	4.220	2.275***	0.512	-0.046	0.114	0.514	5.816	2.218***
	(6.958)	(4.076)	(0.808)	(0.529)	(0.394)	(0.400)	(0.985)	(3.548)	(0.686)
TDEM	0.072	0.010	-0.011	-0.001	-0.018*	-0.014	0.016	0.070	-0.055****
	(0.150)	(0.094)	(0.030)	(0.014)	(0.010)	(0.011)	(0.038)	(0.054)	(0.016)
FES	70.020	65.456	19.335	14.020*	3.620	6.471	1.886	-5.025	-11.725
	(240.531)	(57.217)	(18.329)	(8.497)	(9.775)	(12.658)	(12.239)	(19.101)	(9.857)
_cons	-1,177.047**	-499.000	-50.301**	-33.907**	-2.502	14.005	50.973**	375.442	1,131.348****
	(522.398)	(636.644)	(25.478)	(13.201)	(13.376)	(12.698)	(24.771)	(236.490)	(54.096)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	707	707	707	707	707	707	707	707	707
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

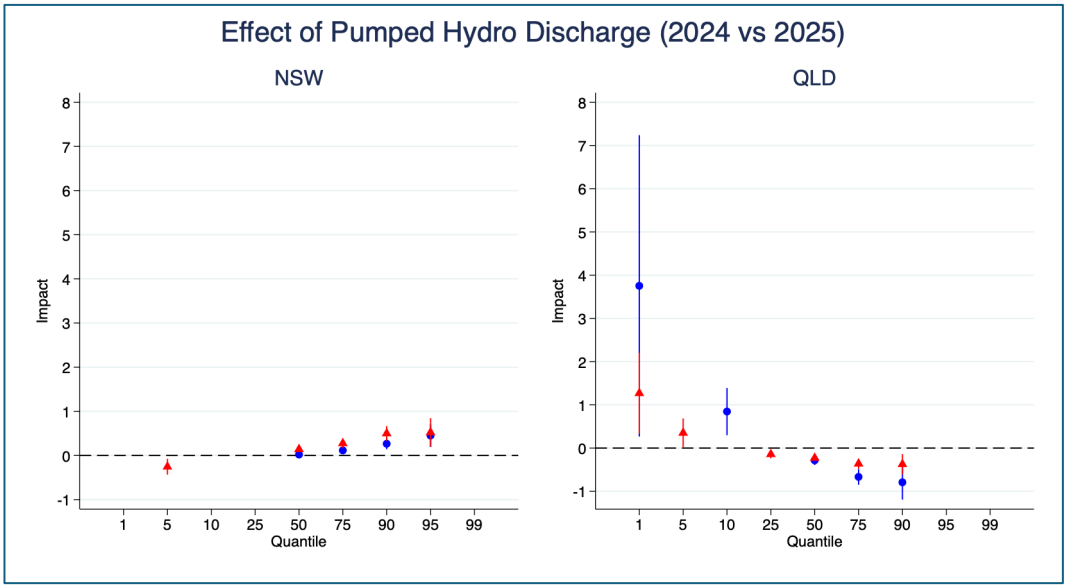
Table B.24. Estimates for demand volatility model for VIC (2024-2025).

	(1) Q1	(2) Q5	(3) Q10	(4) Q25	(5) Q50	(6) Q75	(7) Q90	(8) Q95	(9) Q99
CBESS	2.045****	1.112	0.662***	0.514****	0.097	0.016	0.021	-0.180	-0.843****
	(0.589)	(0.799)	(0.217)	(0.154)	(0.194)	(0.213)	(0.355)	(0.304)	(0.040)
TDEM	0.030****	0.010	0.009**	0.003	-0.004	-0.000	-0.004	-0.002	-0.003****
	(0.007)	(0.008)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)	(0.008)	(0.001)
FES	-21.001	7.399	-11.128	0.667	4.209	7.906	26.681***	79.088****	65.337****
	(37.392)	(11.473)	(11.894)	(7.004)	(9.197)	(11.243)	(9.870)	(11.707)	(1.955)
_cons	-21.001	7.399	-11.128	0.667	4.209	7.906	26.681***	79.088****	65.337****
	(37.392)	(11.473)	(11.894)	(7.004)	(9.197)	(11.243)	(9.870)	(11.707)	(1.955)
N	729	729	729	729	729	729	729	729	729
SumW	729	729	729	729	729	729	729	729	729
RdF	707	707	707	707	707	707	707	707	707
MdF	21	21	21	21	21	21	21	21	21
Rank	22	22	22	22	22	22	22	22	22

Note: SumW: Sum of Weights: RdF: Residual Degree of Freedom; MdF: Model Degree of Freedom.
Standard errors in parentheses
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$, $^{****}\ p < 0.001$

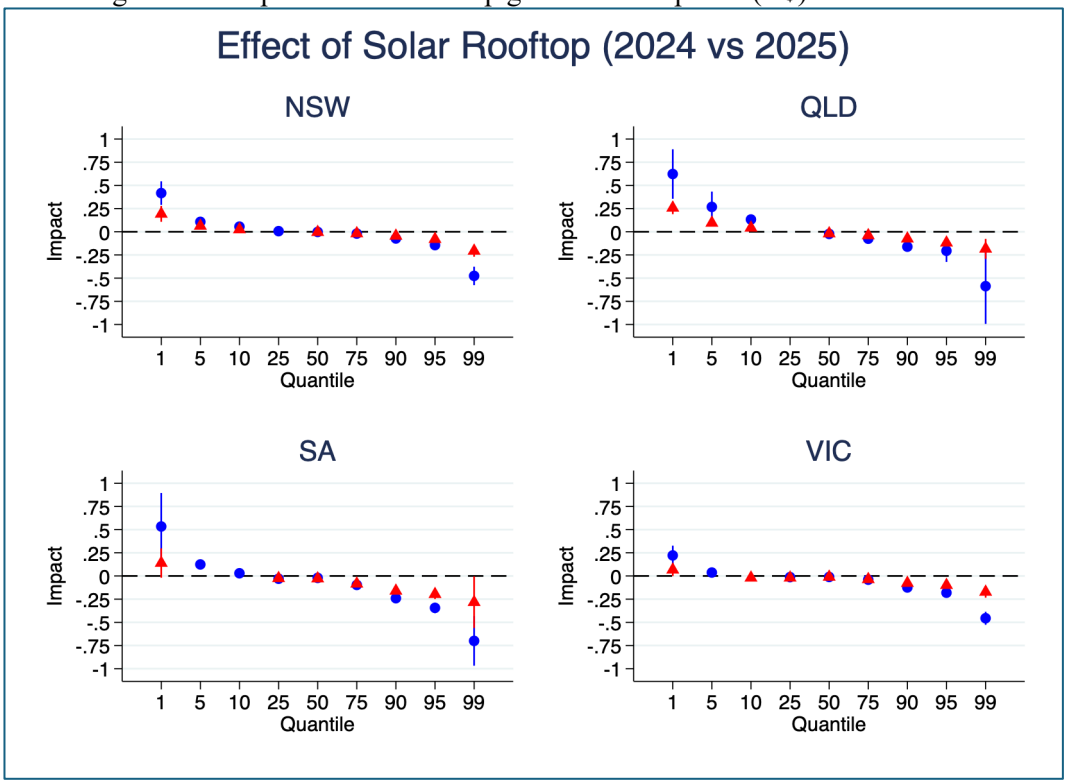
Appendix C – Additional Figures

Figure C.1. Impact of discharging 1MWh from pumping hydropower generation on prices (A$) for each state.



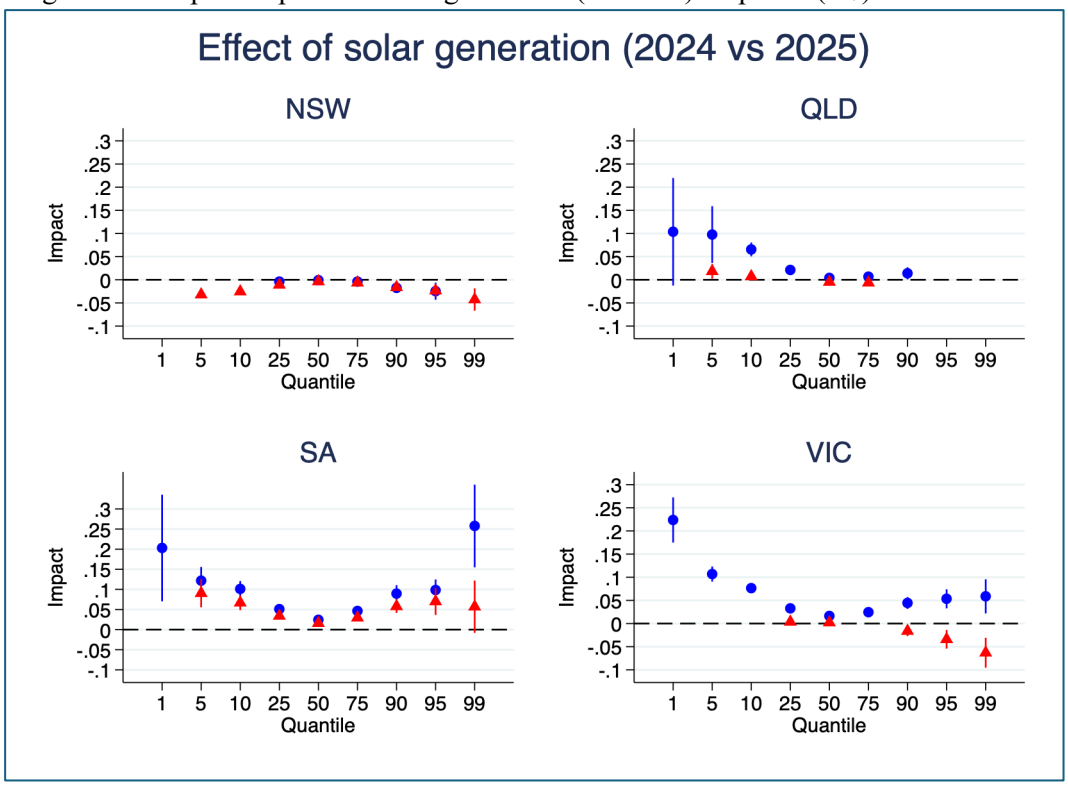
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.2. Impact of solar rooftop generation on prices (A$) for each state.



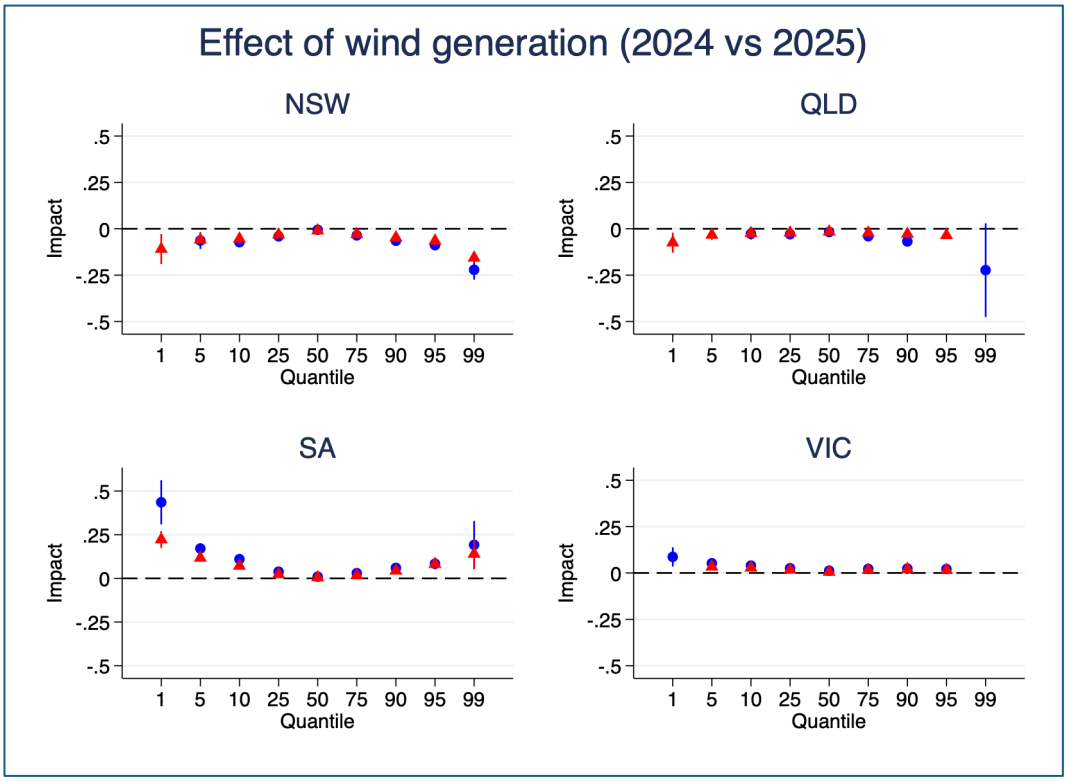
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.3. Impact of photovoltaics generation (+1MWh) on prices (A$) for each state.



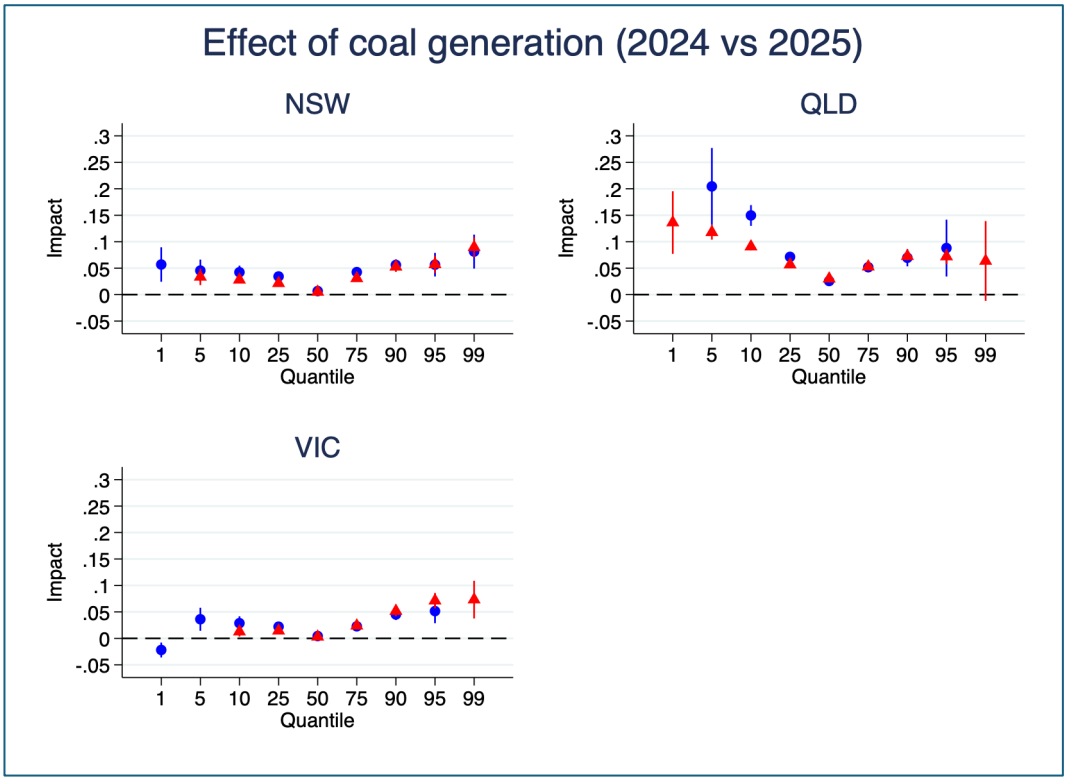
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.4. Impact of wind generation (+1MWh) on prices (A$) for each state.



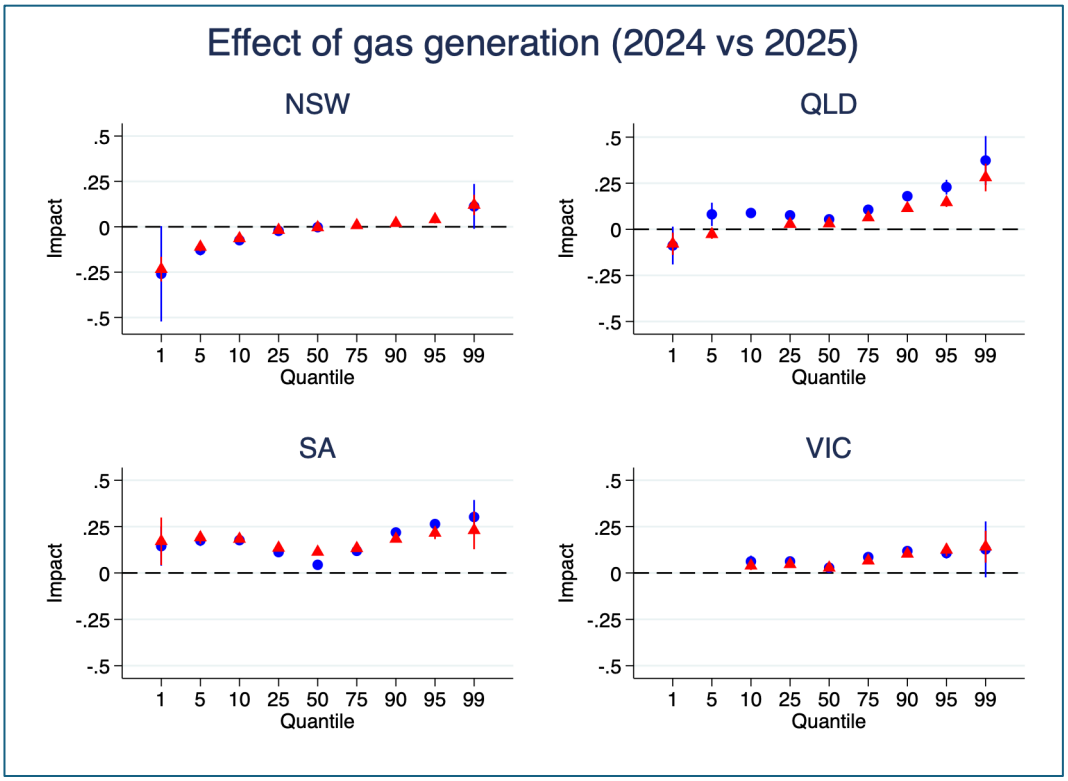
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.5. Impact of coal generation (+1MWh) on prices (A$) for each state.



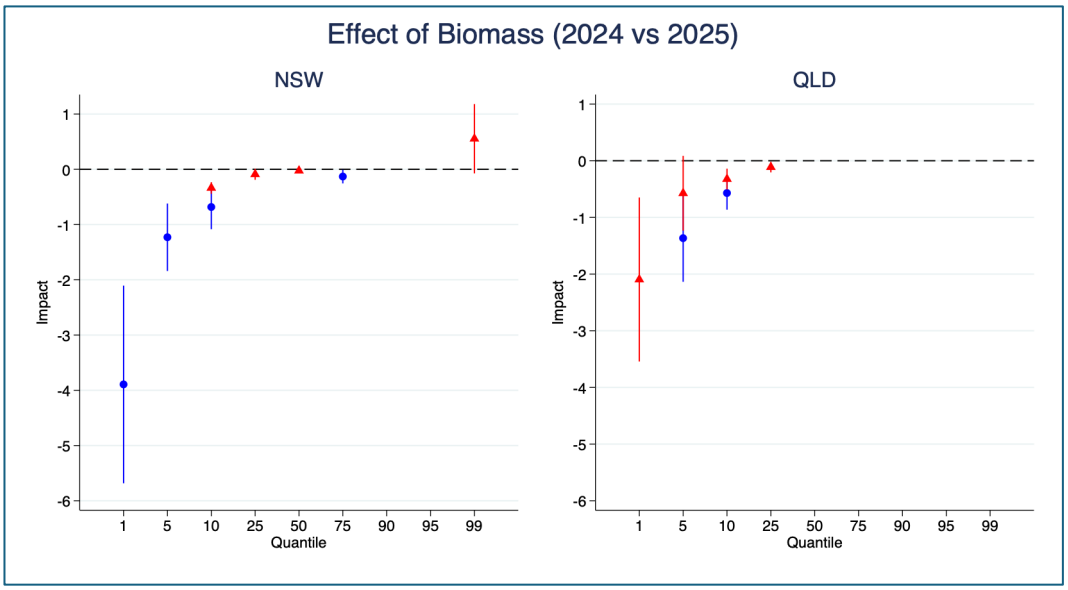
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.6. Impact of gas generation (+1MWh) on prices (A$) for each state.



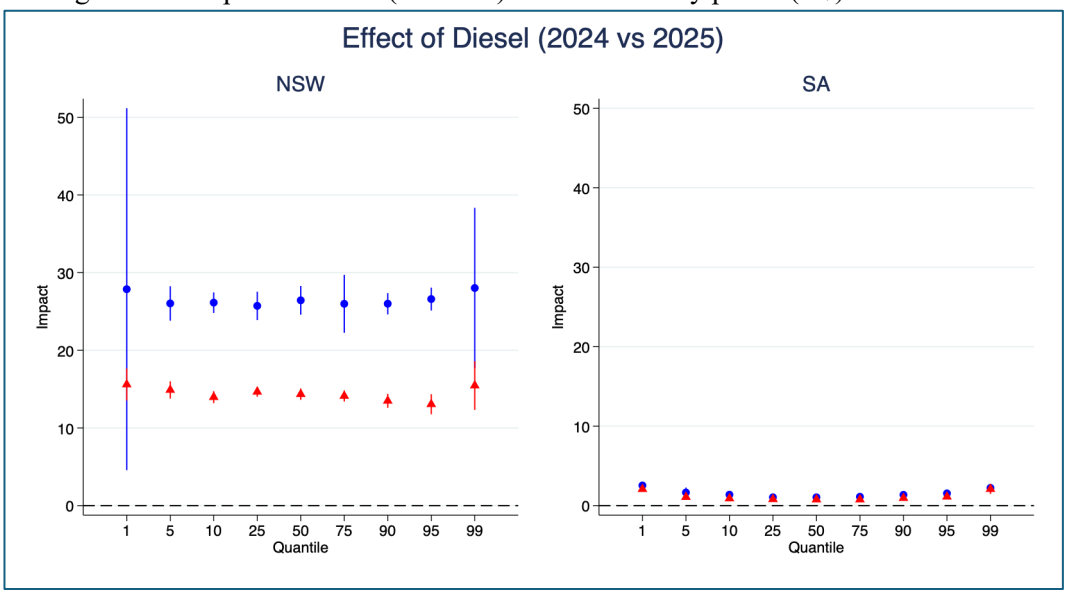
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.1 to B.8.

Figure C.7. Impact of biomass (+1MWh) on prices (A$) for each state.



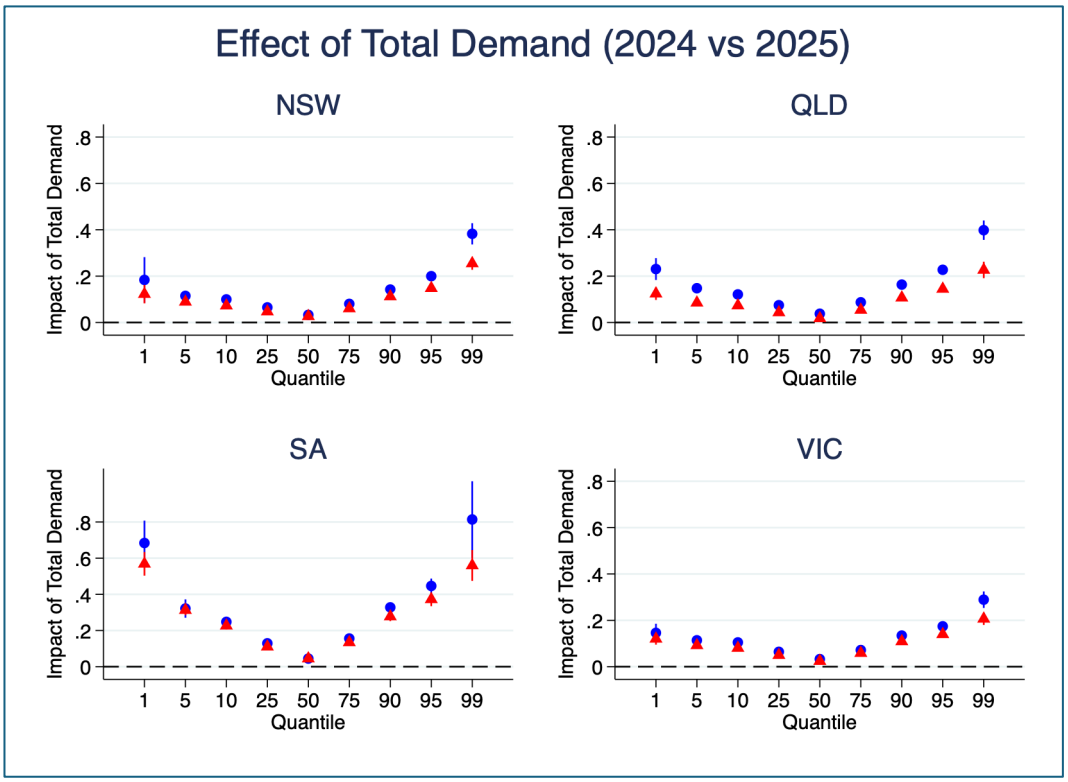
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.9 to B.16.

Figure C.8. Impact of diesel (+1MWh) in the electricity prices (A$) for each state.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.9 to B.16.

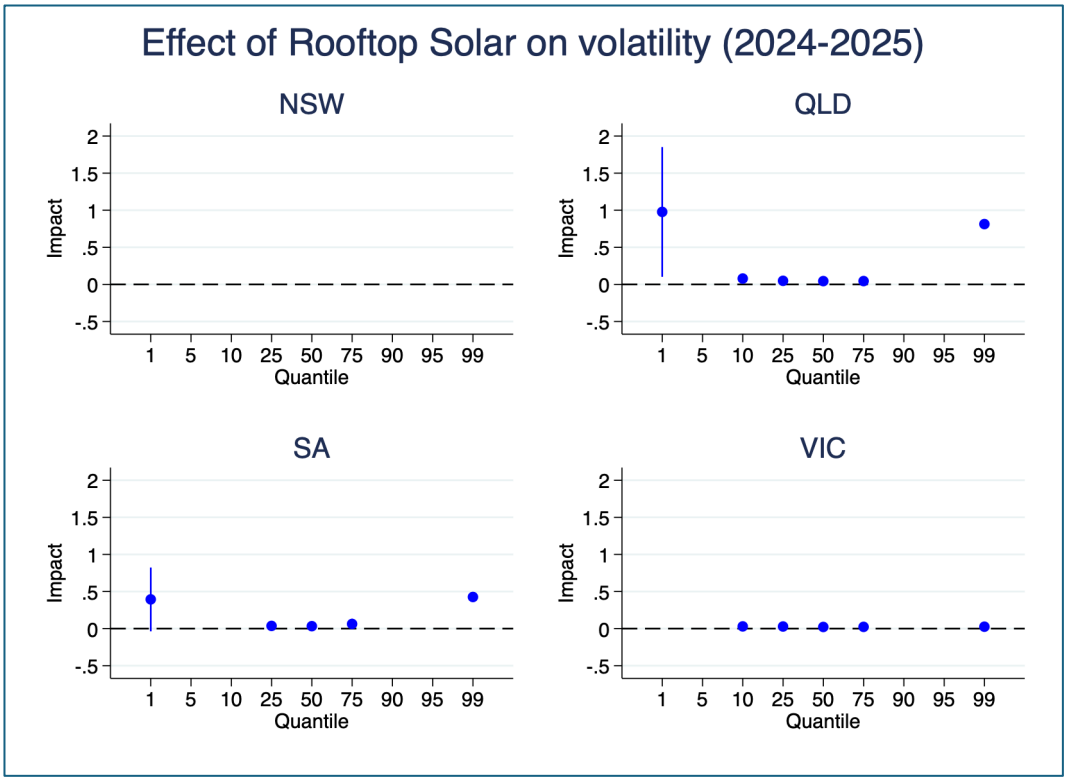
Figure C.9. Impact of total demand (+1MWh) on prices (A$) for each state.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.9 to B.16.

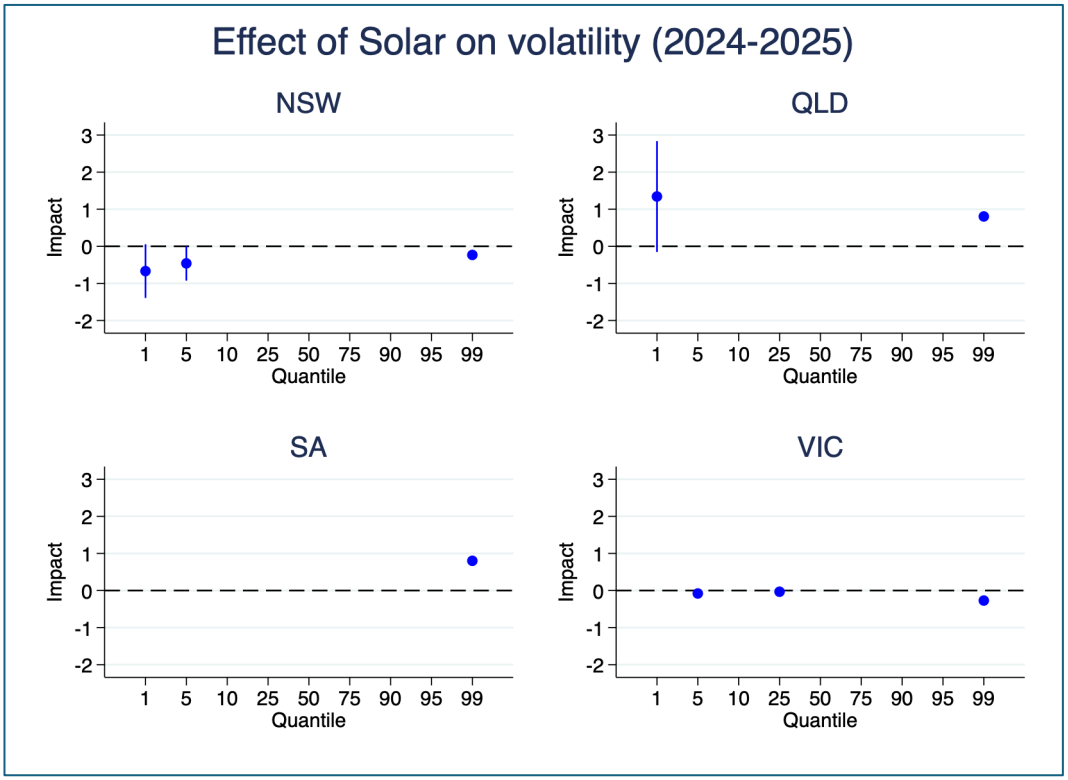
Appendix D – Additional Figures

Figure D.1. Impact of rooftop solar (+1MWh) in the volatility of prices (A$) for each state.



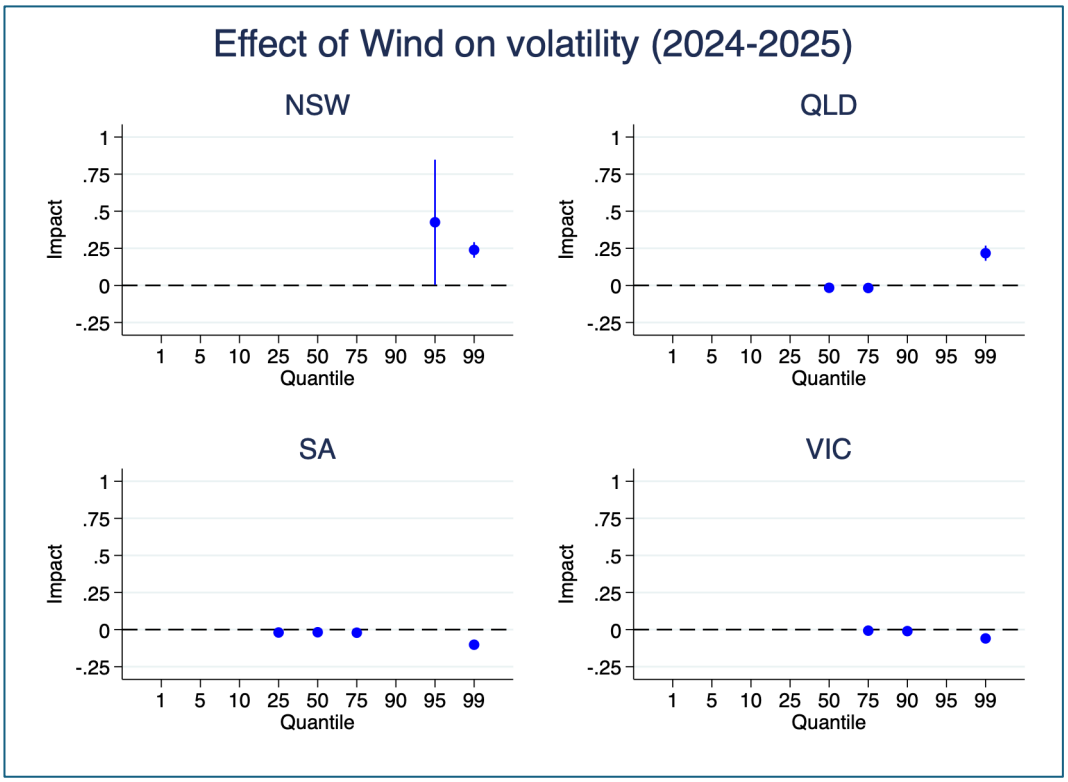
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.2. Impact of solar (+1MWh) in the volatility of prices (A$) for each state.



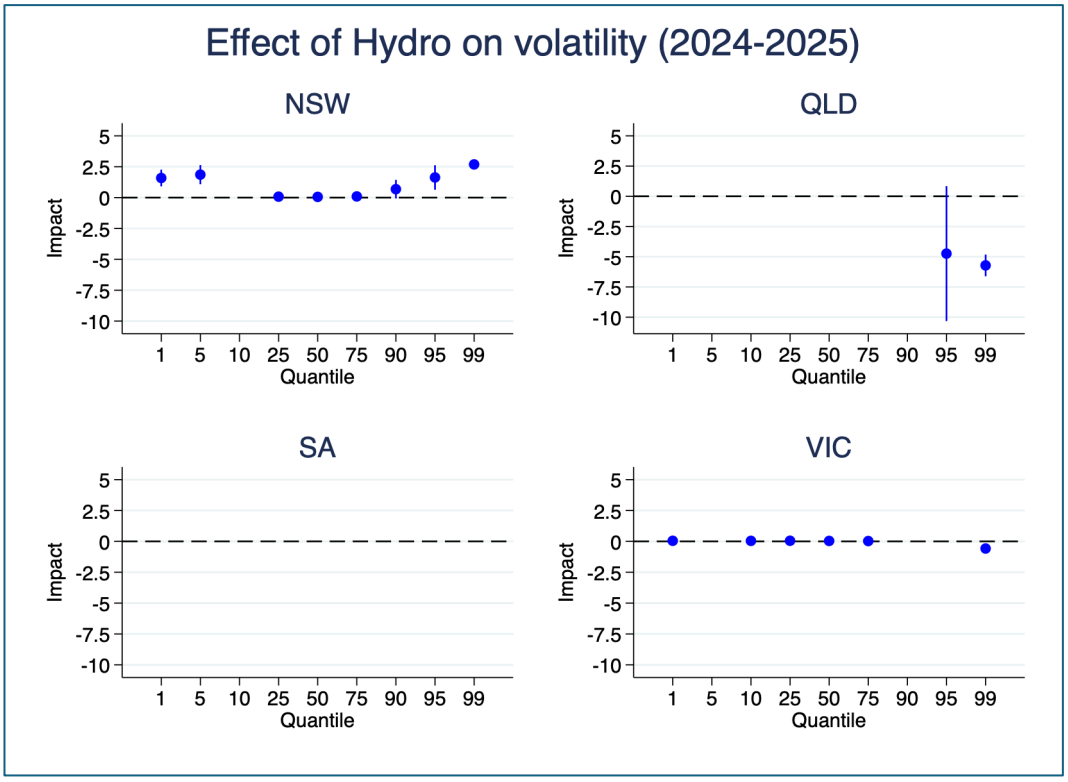
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.3. Impact of wind (+1MWh) in the volatility of prices (A$) for each state.



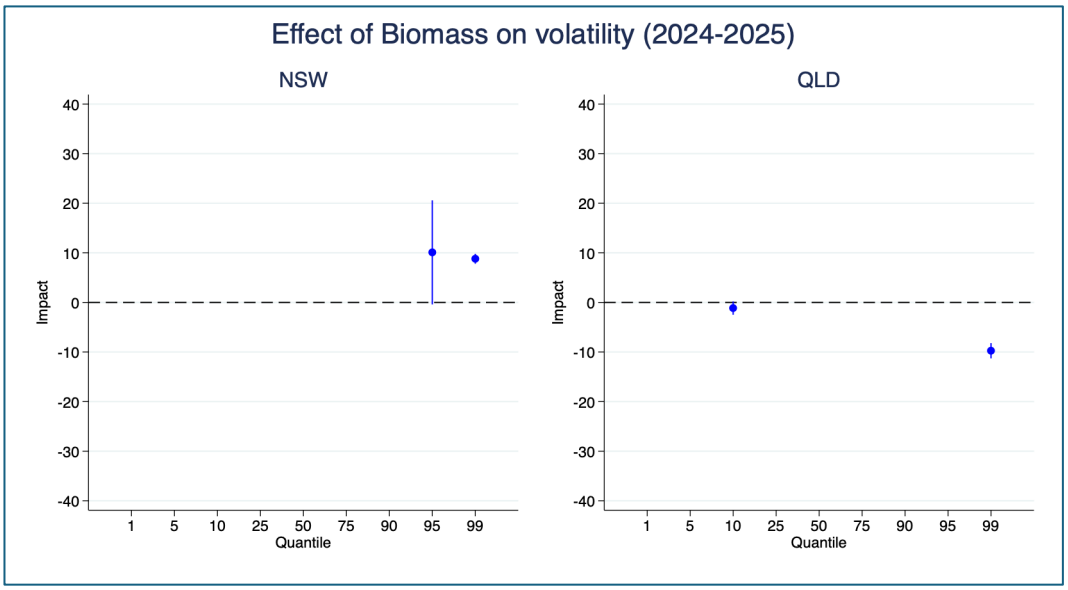
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.4. Impact of hydro (+1MWh) in the volatility of prices (A$) for each state.



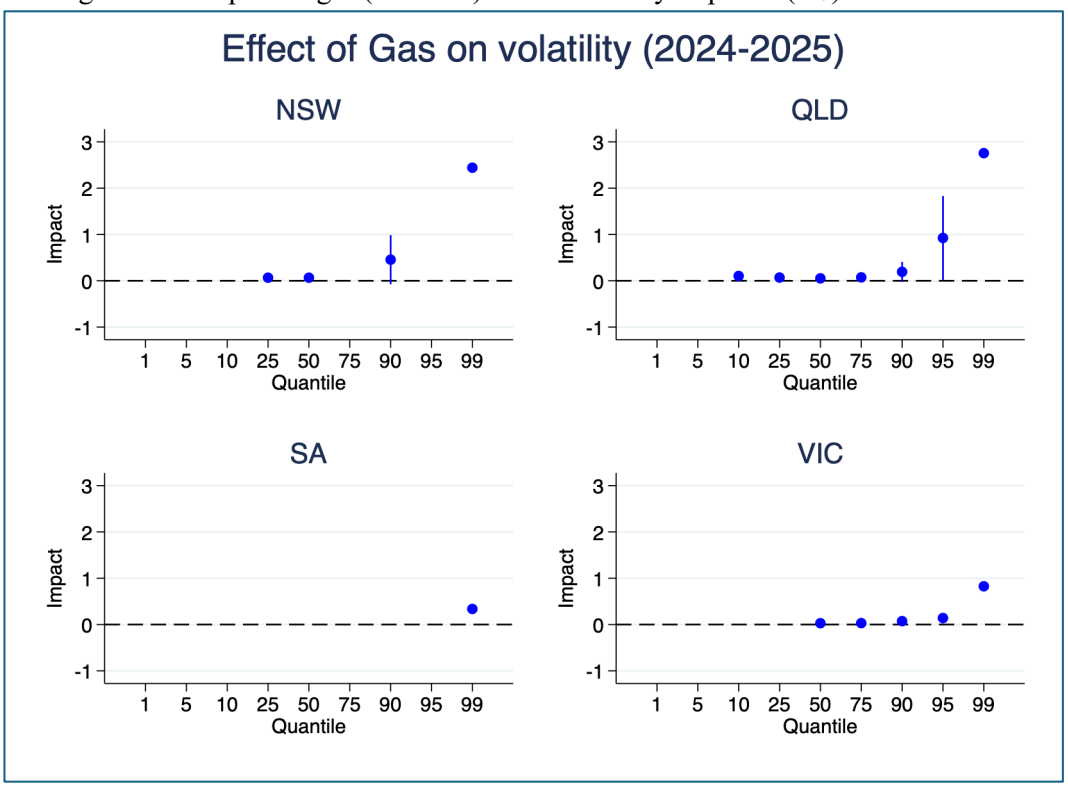
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20

Figure D.5. Impact of biomass (+1MWh) in the volatility of prices (A$) for each state.



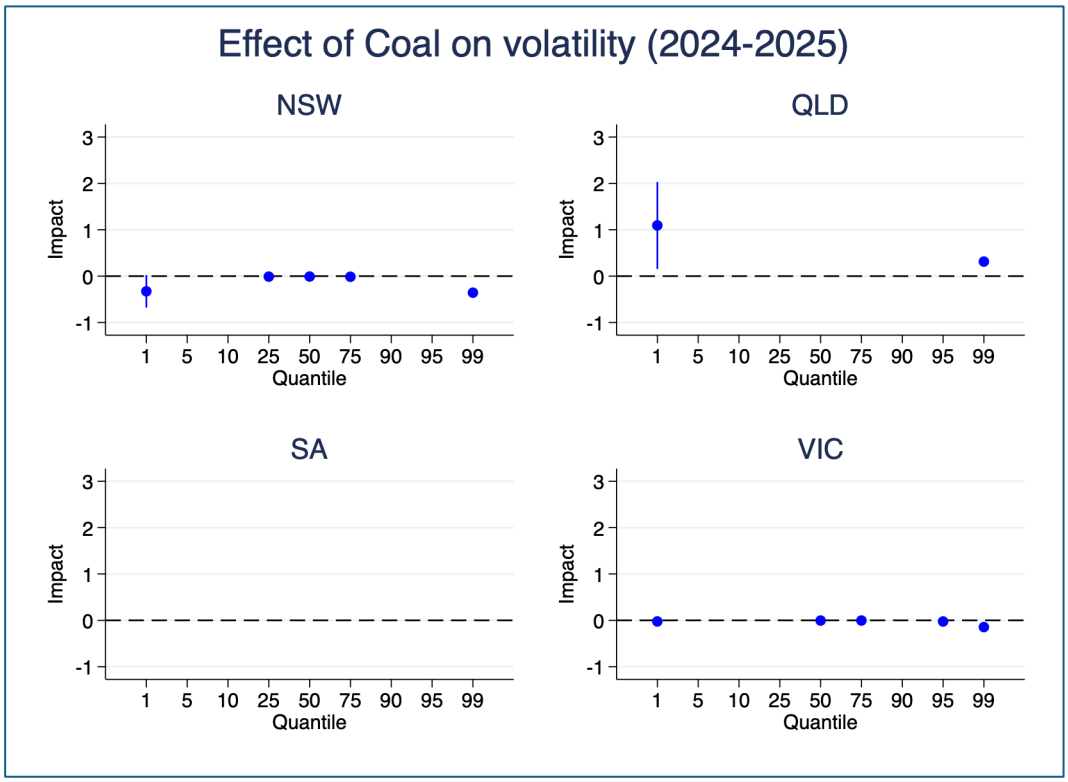
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.6. Impact of gas (+1MWh) in the volatility of prices (A$) for each state.



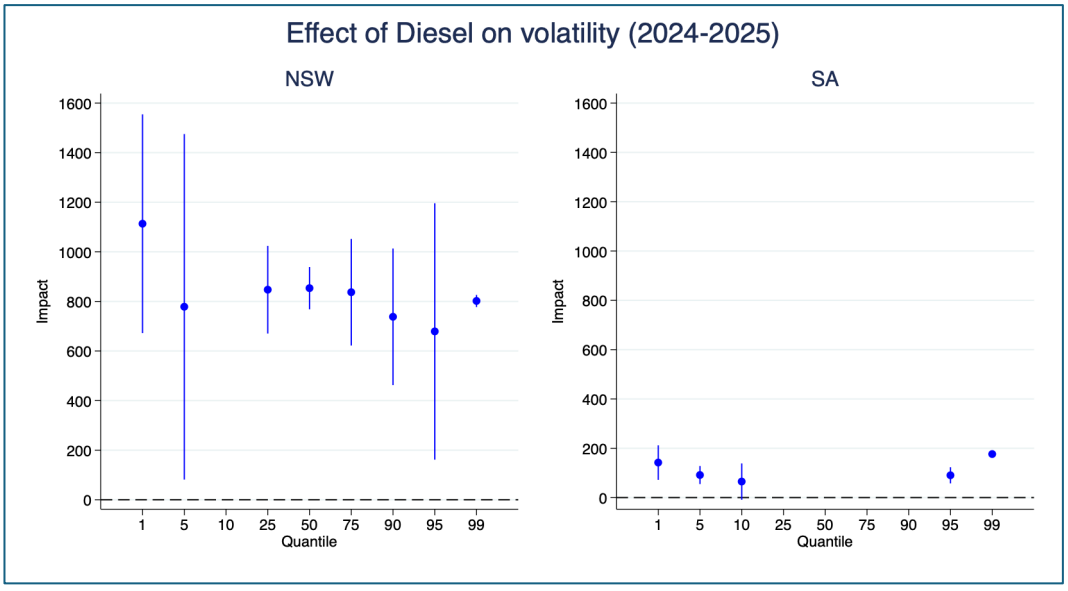
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.7. Impact of coal (+1MWh) in the volatility of prices (A$) for each state.



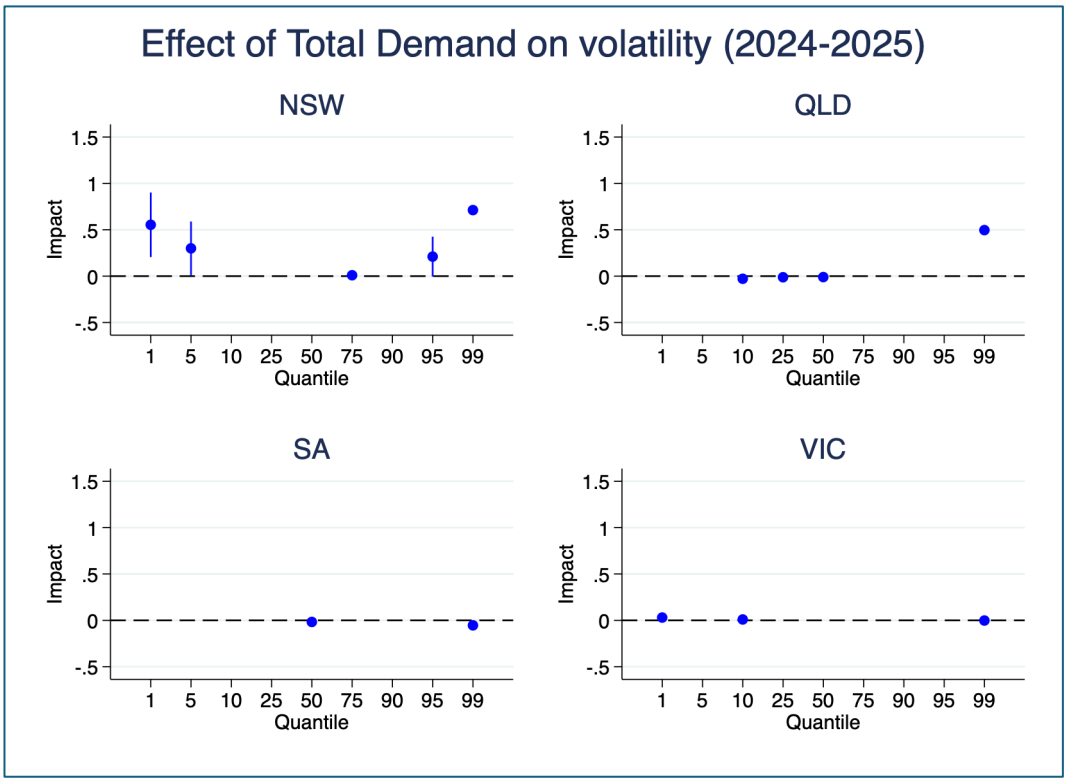
Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.8. Impact of diesel (+1MWh) in the volatility of prices (A$) for each state.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.17 to B.20.

Figure D.9 Impact of electricity demand (+1MWh) in the volatility of prices (A$) for each state.



Note: Dots correspond to significant coefficients (p<0.1) in Tables B.21 to B.24.