14 September 2022

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 4 to 10 September

1.1. Wholesale spot prices between 4 and 10 September appear to be consistent with market conditions.

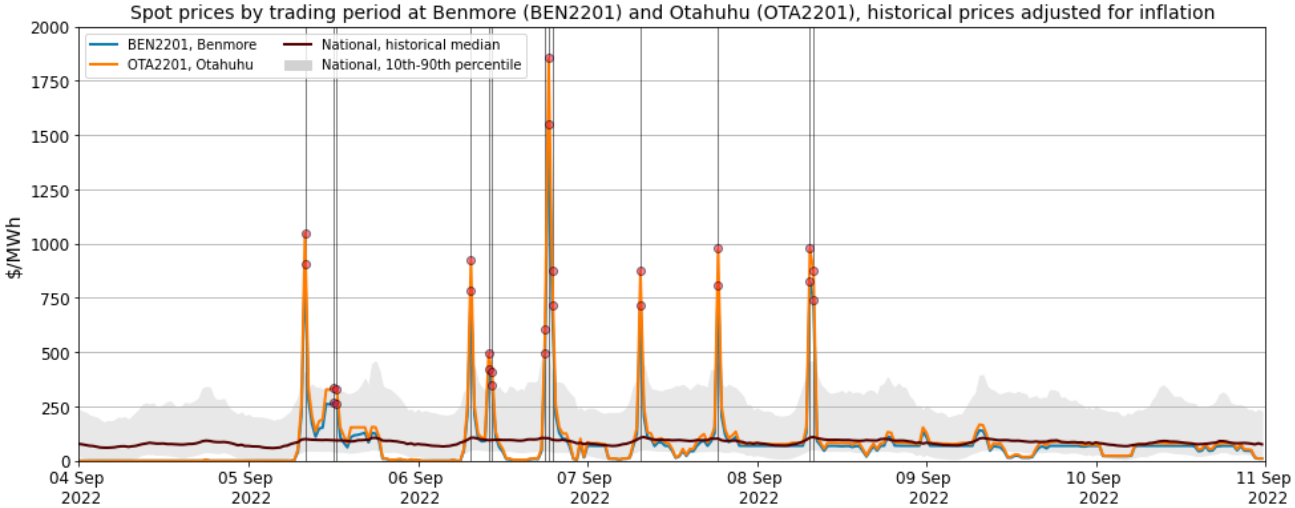
2. Spot Prices

2.1. This report monitors underlying wholesale price drivers to assess whether there are trading periods that require further analysis for the purpose of considering potential non-compliance with the trading conduct rule. In addition to general monitoring, we also single out unusually high-priced individual trading periods for further analysis by identifying when wholesale electricity spot prices at Benmore and/or Otahuhu nodes exceed their historical 90th percentiles. These historically high-priced trading periods are marked out by vertical lines in the majority of figures in this report.

2.2. Between 4 and 10 September wholesale spot prices across all nodes averaged $84.34/MWh with 95 per cent of prices falling between $0.02/MWh and $562.87/MWh.

2.3. Figure 1 shows spot prices at Benmore and Otahuhu alongside their historic median and historic 10th-90th percentiles adjusted for inflation. This week there were several price spikes reaching as high as around ~$1,800/MWh. These price spikes occurred between 5 and 8 September usually during peak demand trading periods. Outside of these price spikes prices were relatively low, falling mostly between $0.01/MWh and $150/MWh.

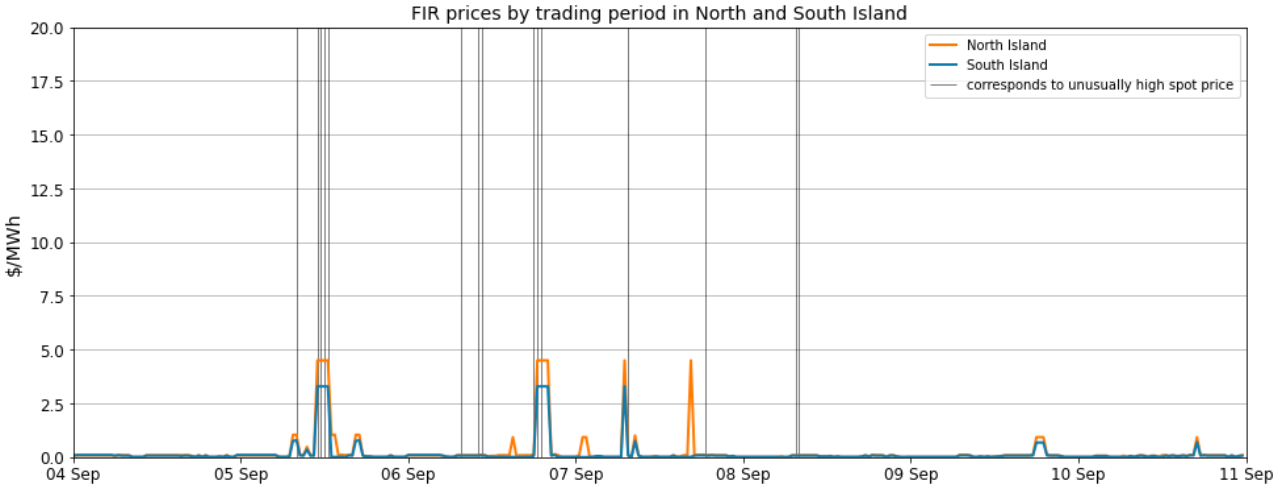
Figure 1: Wholesale Spot Prices



3. Reserve Prices

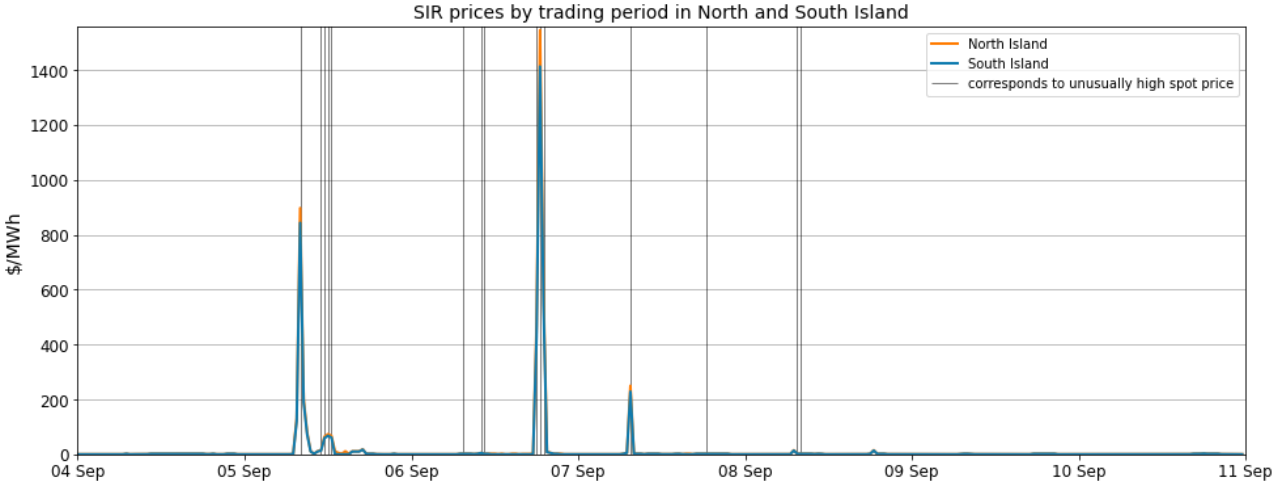
3.1. Fast instantaneous reserves (FIR) prices for the North and South Island are shown below in Figure 2. All FIR prices fell within historical bounds this week with all trading periods below $5/MWh.

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices for the North and South Island are shown below in Figure 3. Aside from a handful of price spikes reaching up to around ~$1,500/MWh most SIR prices this week remained within historical bounds at below $20/MWh. The spikes in SIR prices corresponded with spikes in wholesale spot prices meaning that the increase in SIR prices were likely a result of co-optimisation by the system operator with reserves being dispatched instead of higher priced energy offers.

Figure 3: SIR prices by trading period and Island

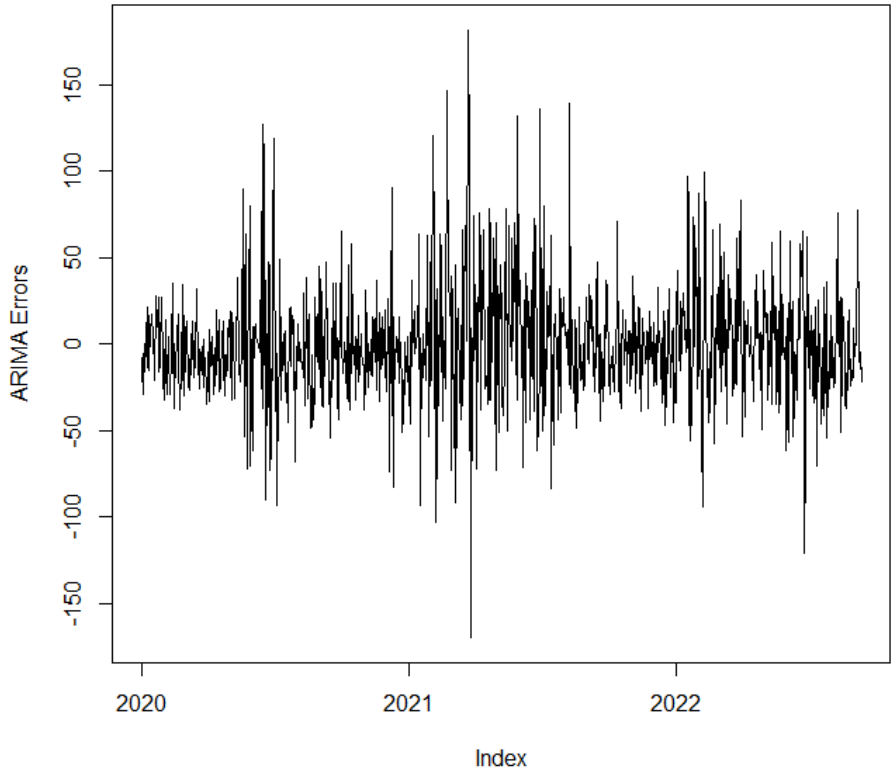


4. Regression Residuals

4.1. The Authority's monitoring team uses a regression model to model spot price. The residuals show how close the predicted prices were to actual prices. Large residuals may indicate that prices do not reflect underlying supply and demand conditions. Details on the regression model and residuals can be found in Appendix A[1] on the trading conduct webpage.

4.2. Figure 4 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Larger residuals occurred on the dates with high price spikes, between 5 and 8 September. Residuals outside of those dates remained relatively small suggesting that prices on those dates appear to be largely aligned with market conditions.

Figure 4: Residual plot of estimated daily average spot prices



5. Demand

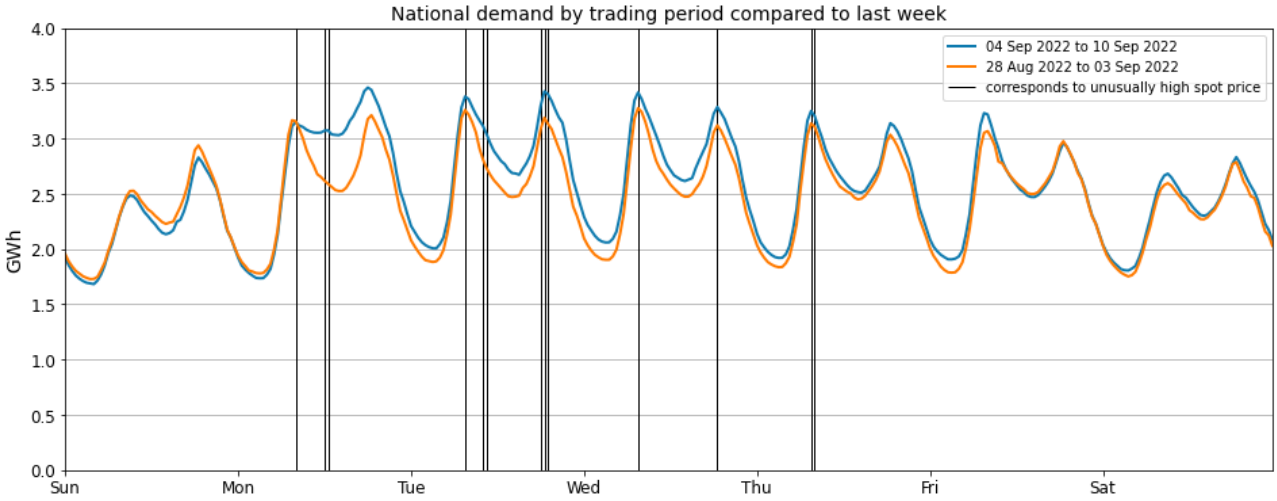
5.1. Figure 5 shows this week's national grid demand against national grid demand from the previous week.

5.2. Demand during the week from 4 to 10 September was noticeably higher between Monday and Thursday than demand during the week from 28 August to 3 September. The increase in demand was likely due to a decrease in temperatures as seen in Figure 6.

5.3. As marked by the vertical lines spikes in spot prices coincided with periods of peak demand with high demand a likely contributor towards the rise in prices. Demand peaked on the evening (6pm) of Monday 5 September at 6,694 MW.

[1] https://www.ea.govt.nz/assets/dms-assets/29/Appendix-A-Regression-Analysis.pdf

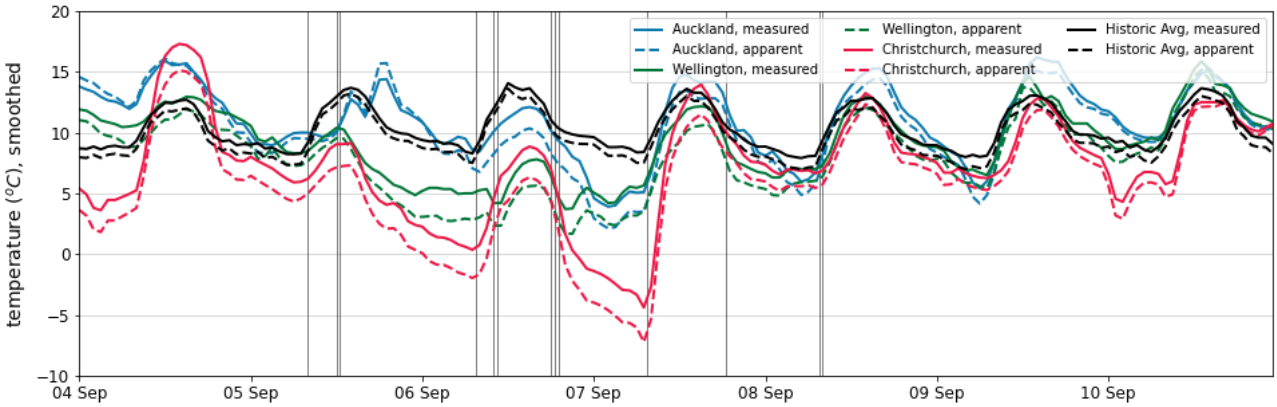
Figure 5: National demand by trading period compared to the previous week



5.4. Figure 6 shows hourly temperature at main population centres. The measured temperature is the recorded temperature, while the apparent temperature adjusts for factors like wind speed and humidity to estimate how cold it feels. Also included for reference is the mean historical temperature of similar weeks from previous years averaged across the three main population centres.

5.5. The majority of temperatures across main population centres this week were close to or below historic average. Auckland and Wellington temperatures were notably lower than usual for this time of year averaging between 5 and 15 degrees Celsius with Christchurch temperatures also falling to -5 degrees Celsius between 6 and 7 September. The decline in temperatures were the likely cause of increased demand.

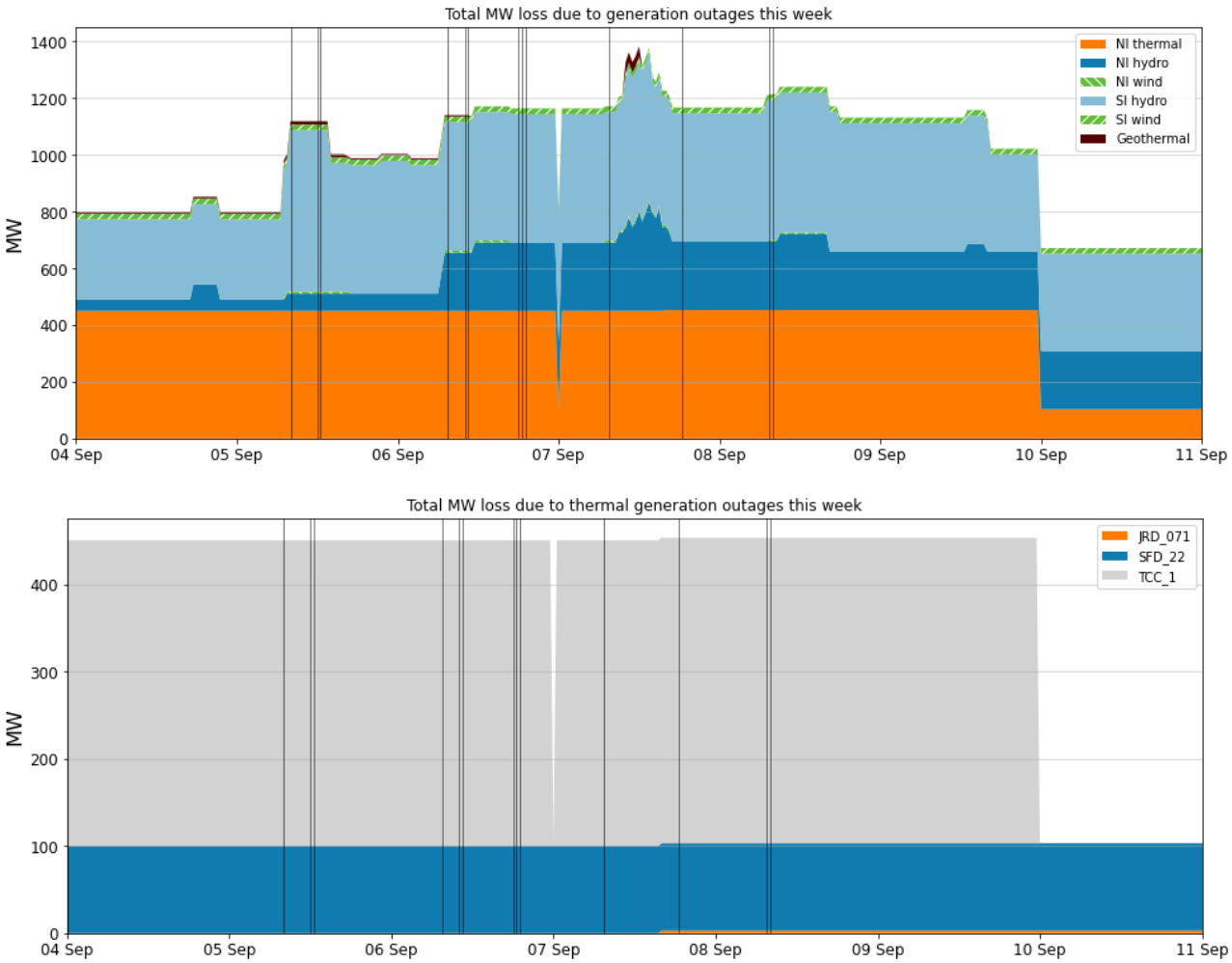
Figure 6: Temperatures across main centres



6. Outages

6.1. Figure 7 shows generation capacity lost due to outages. Total capacity lost between 4 and 10 September increased from 800 MW on Sunday to average around ~1,200 MW from Monday to Friday before falling to around ~600 MW on Saturday. Compared to the previous week hydro outages have increased.

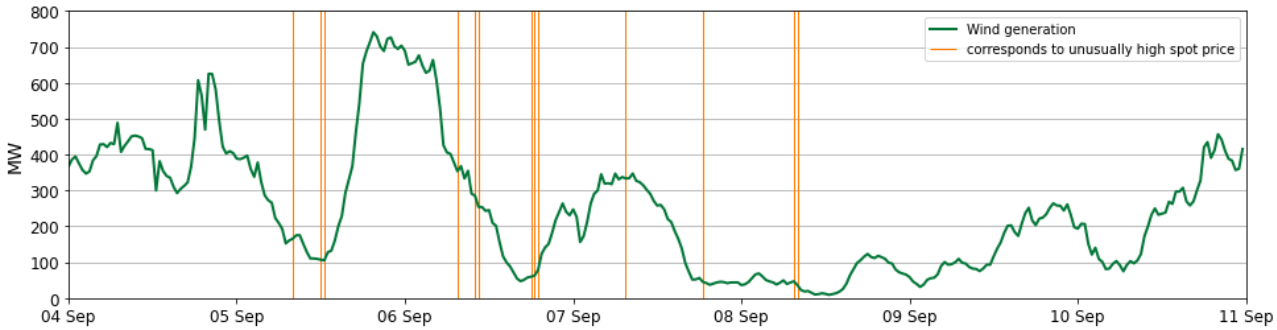
Figure 7: Total MW loss due to generation outages



7. Generation

7.1. Wind generation as seen in Figure 8 varied between close to ~0 MW and ~750 MW over the week with generation remaining mostly below 400 MW for the majority of the week. Most notably wind generation was low (less than 200 MW) for every peak demand period between 5 and 8 September, coinciding with the spikes in spot prices. It is therefore likely that low wind generation contributed to the high prices seen on those dates.

Figure 8: Wind Generation

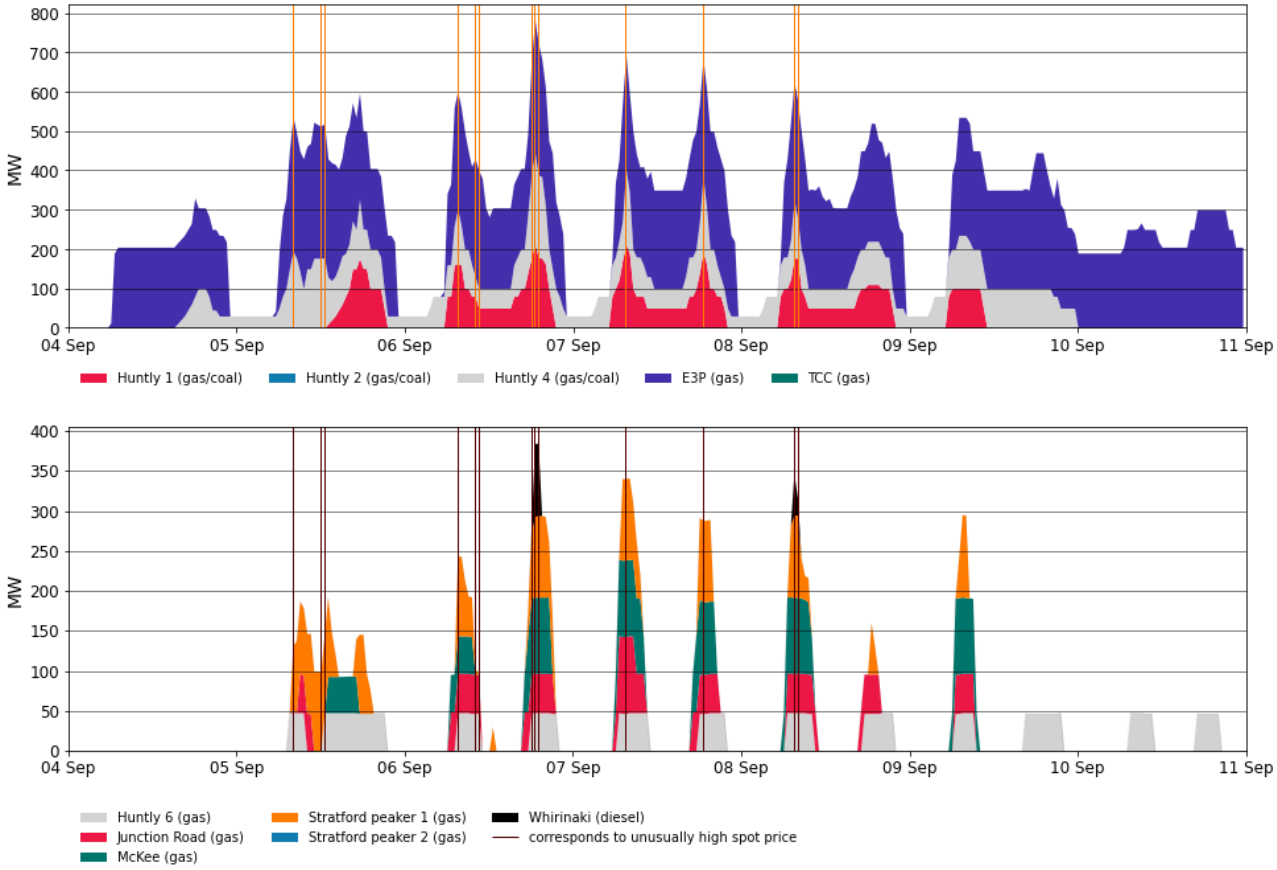


7.2. Figure 9 shows generation at thermal and thermal peaker plants between 4 and 10 September. Following patterns from the previous few weeks E3P continues to only run during the day, with thermal off-peak generation fulfilled by Huntly 4.

7.3. Thermal generation was high when wind generation was low, reaching its highest points during peak demand periods. Thermal generation peaked at its highest point for the week on the evening (6.30pm) of 6 September at almost ~800 MW, the same period as the highest spike in spot prices (~$1,800/MWh). The same applies to thermal peaker generation with peaker generation spiking during peak demand periods, coinciding with spikes in spot prices. It is likely therefore that high thermal and peaker generation contributed to high spot prices.

7.4. Whirinaki ran on both 6 and 8 September. With the last calculated SRMC of Whirinaki at around ~$750/MWh this would justify some of the $1,000/MWh+ prices seen on those dates.

Figure 9: Thermal Generation



7.5. As a percentage of total generation, between 4 and 10 September, hydro generation totalled 70.7 per cent, geothermal 17.9 per cent, thermal 5.8 per cent and wind 4.9 per cent. Despite low wind generation with the current abundance of hydro fuel the above average amount of hydro generation would have contributed to keeping spot prices low outside of peak demand periods this week.

8. Storage/Fuel Supply

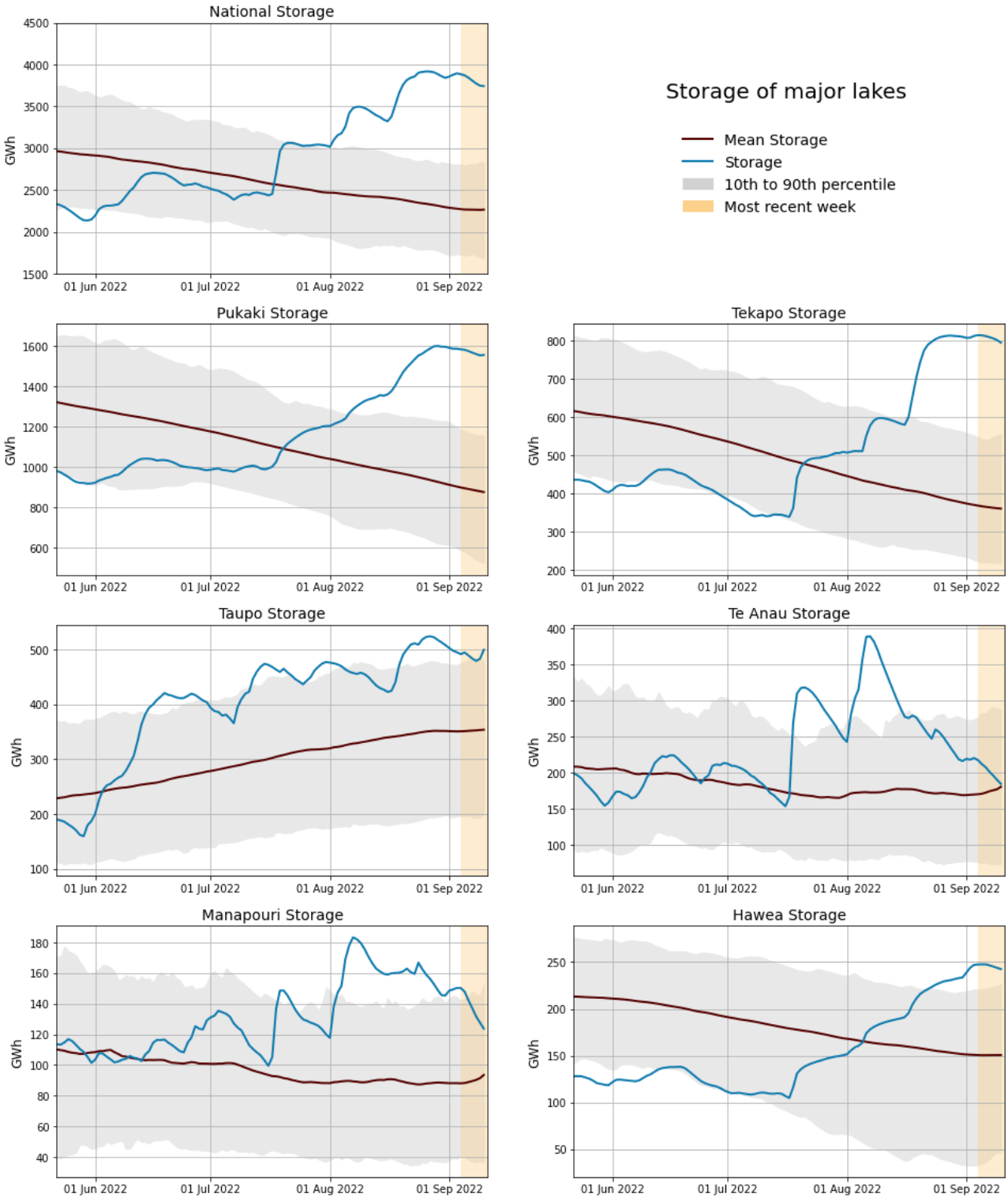
8.1. Figure 10 shows total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

8.2. Hydro storage levels continue to remain well above usual for this time of year at around 89 per cent of nominal full. Most major lakes continue to remain above their historic 90th storage percentiles.

8.3. The high level of hydro fuel has been accompanied by an increase in lower priced hydro generation offers contributing to the low average spot price seen during off peak periods.

8.4. With the abundance of low priced hydro generation in the South Island the flow at the HVDC has been entirely northwards between 4 and 10 September.

Figure 10: Hydro Storage



9. Price versus estimated costs

9.1. In a competitive market, prices should be close to (but not necessarily at) the short run marginal cost (SRMC) of the marginal generator (where SRMC includes opportunity cost).

9.2. The SRMC (excluding opportunity cost of storage) for thermal fuels can be estimated using gas and coal prices, and the average heat rates for each thermal unit. Note that the SRMC calculations include the carbon price, an estimate of operational and maintenance costs, and transport for coal.

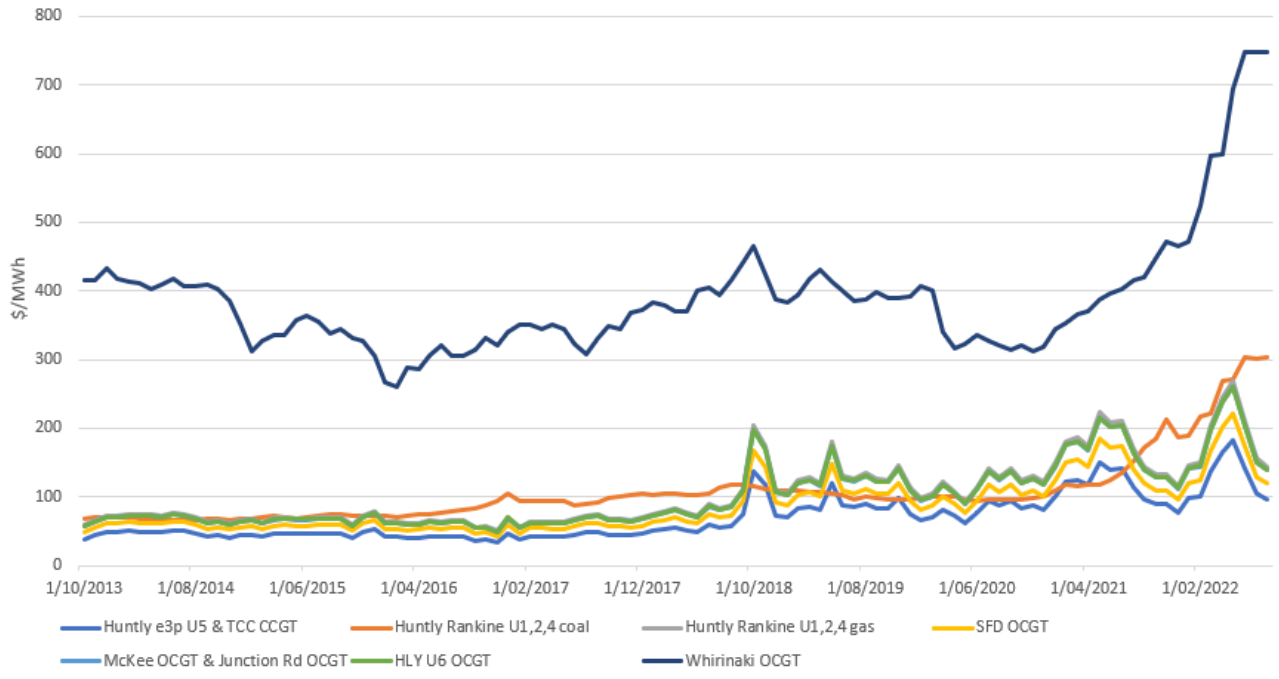
9.3. Figure 11 shows an estimate of thermal SRMCs as a monthly average up to 1 September 2022. The SRMC of gas fuelled plants continues to fall while the SRMC of diesel and coal fuelled plants appears to have plateaued.

9.4. The most recent price for Indonesian coal was around ~$520/tonne putting the latest SRMC of Whirinaki and coal fuelled Huntly generation at around ~$750/MWh and ~$300/MWh respectively.

9.5. SRMCs of gas run thermal plants decreased to between $96/MWh and $144/MWh with the increase in gas fuel availability in the market.

9.6. More information on how the SRMC of thermal plants is calculated can be found in Appendix C[2] on the trading conduct webpage.

Figure 11: Estimated monthly SRMC for thermal fuels



10. JADE Water values

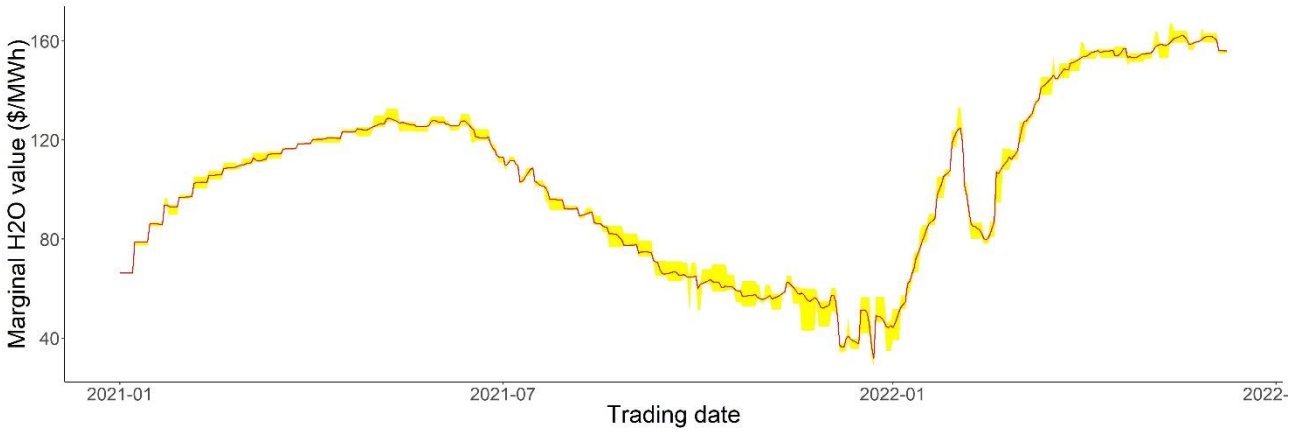
10.1. The JADE[3] model gives a consistent measure of the opportunity cost of water, by seeking to minimise the expected fuel cost of thermal generation and the value of lost load and provides an estimate of water values at a range of storage levels. Figure 12 shows the national water values to 8 June 2022 using values obtained from JADE. The outputs from

[2] https://www.ea.govt.nz/assets/dms-assets/30/Appendix-C-Calculating-thermal-SRMCs.pdf
[3] JADE (Just Another DOASA Environment) is an implementation of the Stochastic Dual Dynamic Programming (SDDP) algorithm of Pereira and Pinto. JADE was developed by researchers at the Electric Power Optimisation Centre (EPOC) for the New Zealand electricity market.

JADE closest to actual storage levels are shown as the yellow water value range. These values are used to estimate marginal water value at the actual storage level. More details on how water values are calculated can be found in Appendix B[4] on the trading conduct webpage.

10.2. In general, marginal water values have increased when total national hydro storage has decreased and decreased when total national hydro storage has increased.

Figure 12: Water Values



11. Offer Behaviour

11.1. **Error! Reference source not found.** shows this week's daily offer stacks, adjusted to take into account wind generation, transmission constraints, reserves and frequency keeping.[5] The black line shows cleared energy, indicating the range of the average final price.

11.2. The majority of cleared energy fell below $100/MWh this week, driven by high hydro generation and low-priced hydro generation offers. Prices going above $100/MWh were likely a product of higher than usual demand and low wind generation.

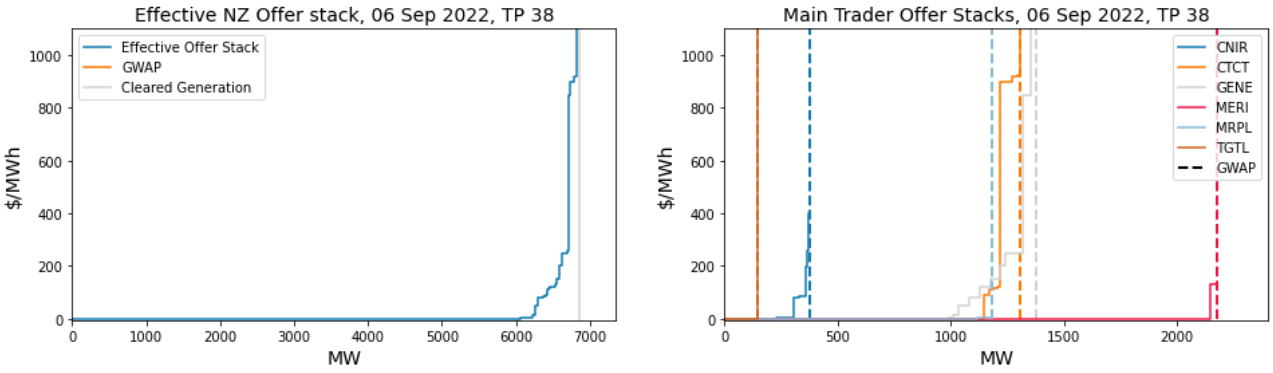
11.3. The unusual abundance of hydro has changed the offer stack with decreased mid-priced generation offers and increased lower priced generation offers. Final tranche thermal generation offers are priced higher than usual, likely to recoup higher operating costs, with runtime costs, etc more likely to be condensed in shorter run time periods resulting in higher prices. The resulting offer curve means that small increases in demand or drops in wind generation can lead to quick advancement up the offer curve leading to jumps from $200/MWh to $600/MWh+ prices quite easily.

11.4. Figure 13 shows the offer curve of the trading period with the highest spot price this week, Trading Period 38 on 6 September. As described above steep growth at the upper end of the offer curve led to the sudden increase in price.

[4] https://www.ea.govt.nz/assets/dms-assets/29/Appendix-B-JADE-water-value-model.pdf

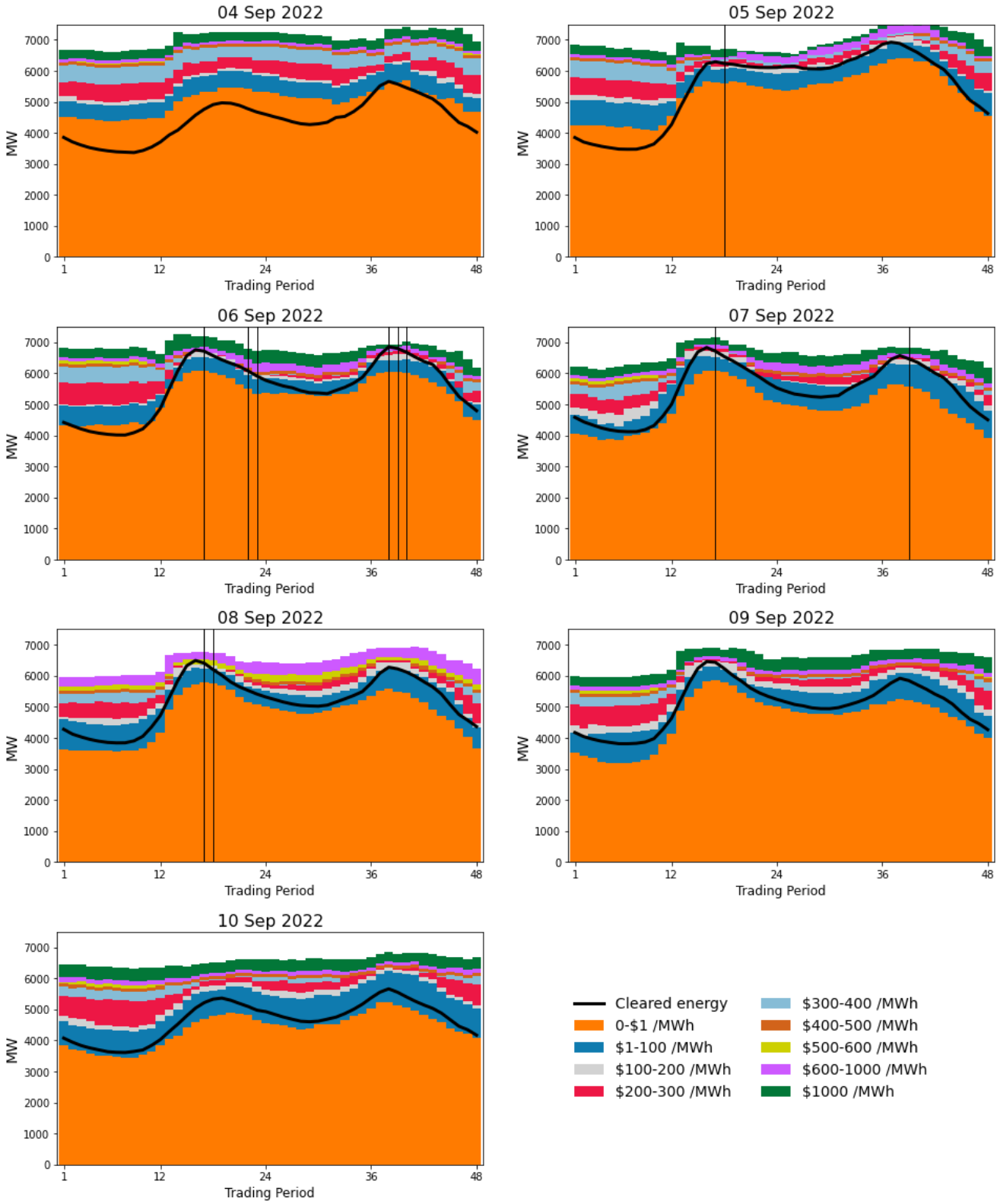
[5] The offer stacks show all offers bid into the market (where wind offers are truncated at their actual generation and excluding generation capacity cleared for reserves) in price bands and plots the cleared quantity against these.

Figure 13: Offer stack at TP 38 6 September



11.5. The pre-dispatch offers in the short term lead up to high prices showed no changes that would suggest generators were trying to take advantage of market conditions.

Figure 14: Daily offer stack



12. Ongoing Work in Trading Conduct

12.1. This week prices appeared to be consistent with supply and demand conditions.

12.2. Further analysis is being done on the trading periods in Table 1 as indicated.

Table 1: Trading periods identified for further analysis

Date	TP	Status	Notes
19/02/22-24/02/22	Several	Compliance enquiries in progress	After reviewing information received from Genesis regarding offers from Tekapo B while Lake Tekapo was spilling, this case has been passed to compliance to assess if the offers were compliant with trading conduct rules.
29/06/2022	26-48	Completed	Explanation from Genesis was given on offers at both Huntly 1 and Huntly 4 which are priced appropriately to cover Genesis's operating costs.