27 September 2022

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 18 to 24 September

1.1. Wholesale spot prices between 18 and 24 September appear to be consistent with market conditions.

2. Spot Prices

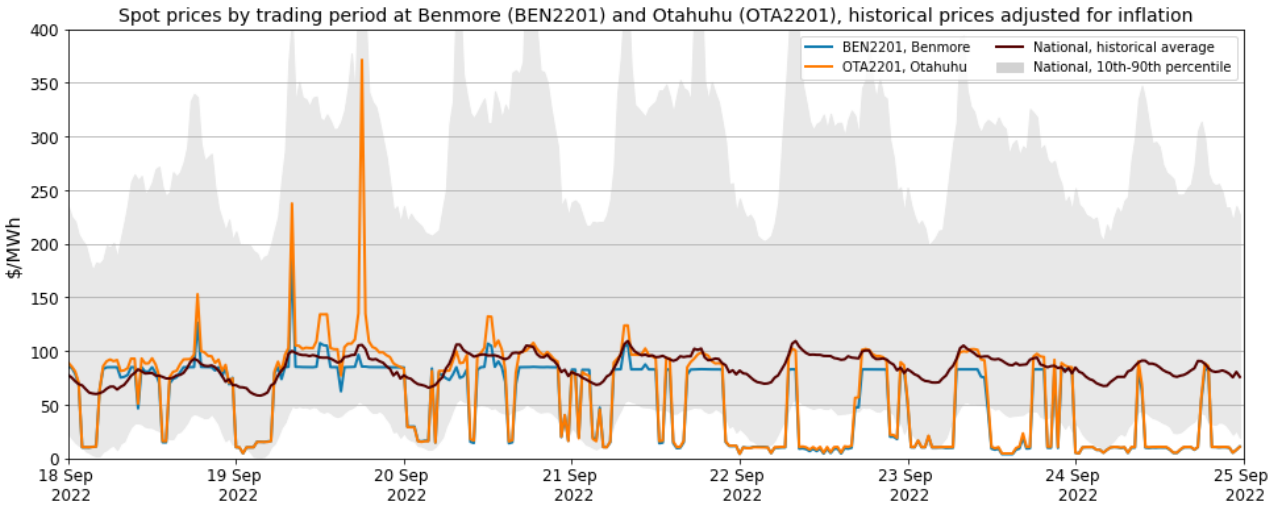
2.1. This report monitors underlying wholesale price drivers to assess whether there are trading periods that require further analysis for the purpose of considering potential non-compliance with the trading conduct rule. In addition to general monitoring, we also single out unusually high-priced individual 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 18 and 24 September wholesale spot prices across all nodes averaged $49/MWh, with 95 per cent of prices falling between $3.9/MWh and $112/MWh.

2.3. Figure 1 shows spot prices at Benmore and Otahuhu alongside their historic median and historic 10^{th}- 90^{th} percentiles adjusted for inflation. A price spike reaching ~$360/MWh at Otahuhu occurred on Monday 19 September at 6:00 pm. This price spike was within historic bounds. Notably, however, the corresponding price at Benmore was close to $100/MWh. Other price spikes also occurred, the largest on Sunday evening and on Monday morning, but these were also within historic price bounds.

2.4. Outside of the spikes, prices hovered around $10/MWh during offpeak (especially overnight), then rose to roughly $100/MWh during the day and peak times.

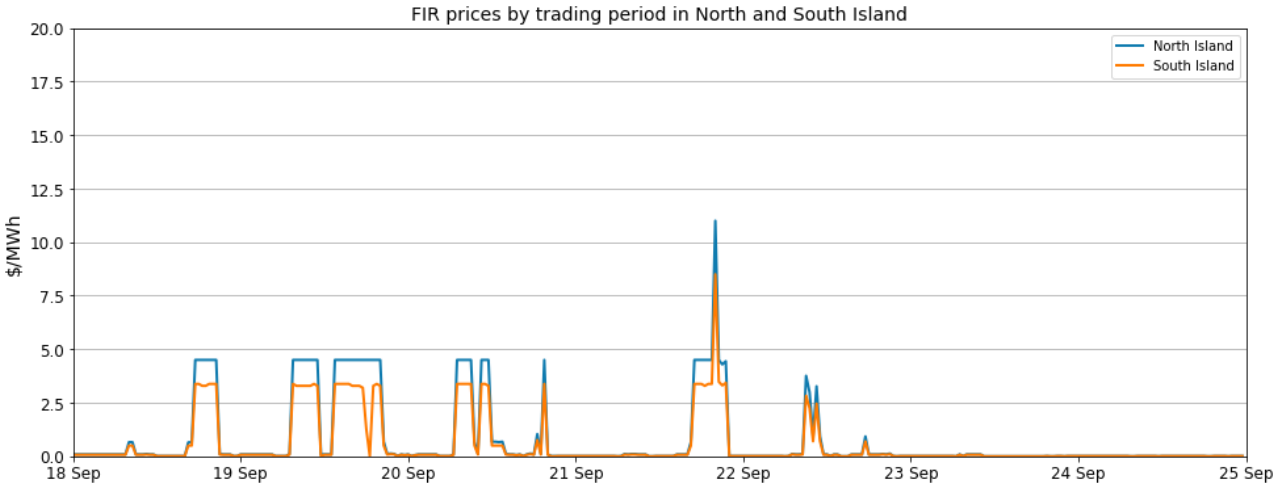
Figure 1: Wholesale Spot Prices



3. Reserve Prices

3.1. Fast instantaneous reserves (FIR) prices for the North and South Island are shown below in Figure 2. Most FIR prices fell within historical bounds this week, with the majority of trading periods below $5/MWh. A spike in FIR prices occurred on Wednesday evening, however, this was only to roughly $12/MWh.

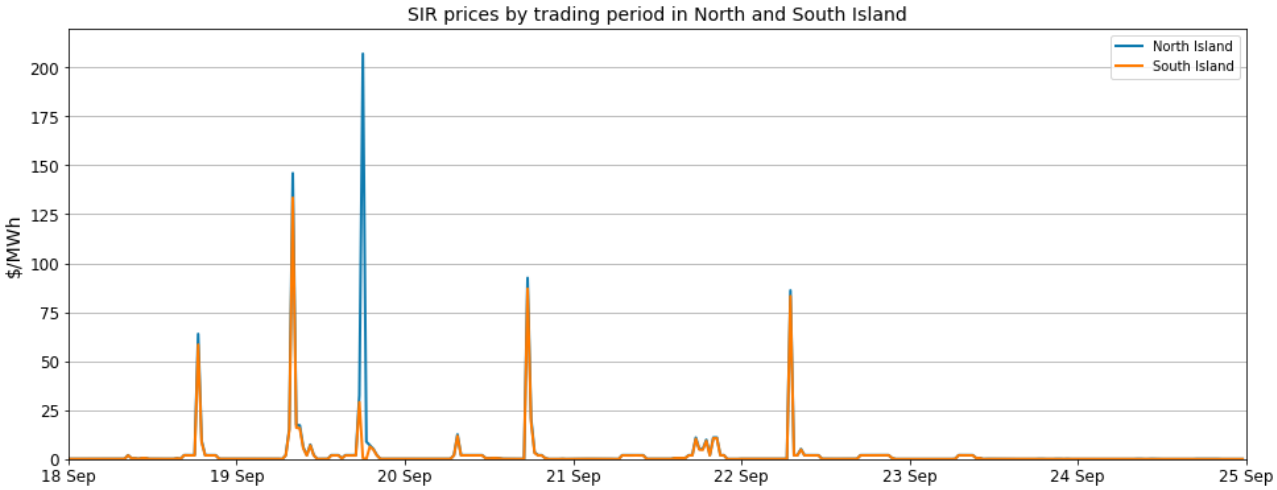
Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices for the North and South Island are shown below in Figure 3. Aside from price spikes on Sunday, Monday, Tuesday and Thursday reaching roughly $60/MWh, $150/MWh. $210/MWh, $90/MWh and $80/MWh, respectively, most SIR prices this week remained within historical bounds at below $20/MWh.

3.3. The largest spike in SIR prices corresponded with spikes in wholesale spot prices. The ~$210/MWh North Island SIR spike on 19 September was likely due to tight supply of energy and reserves in the North Island. The other high SIR prices may have been due to tight supply as well as 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



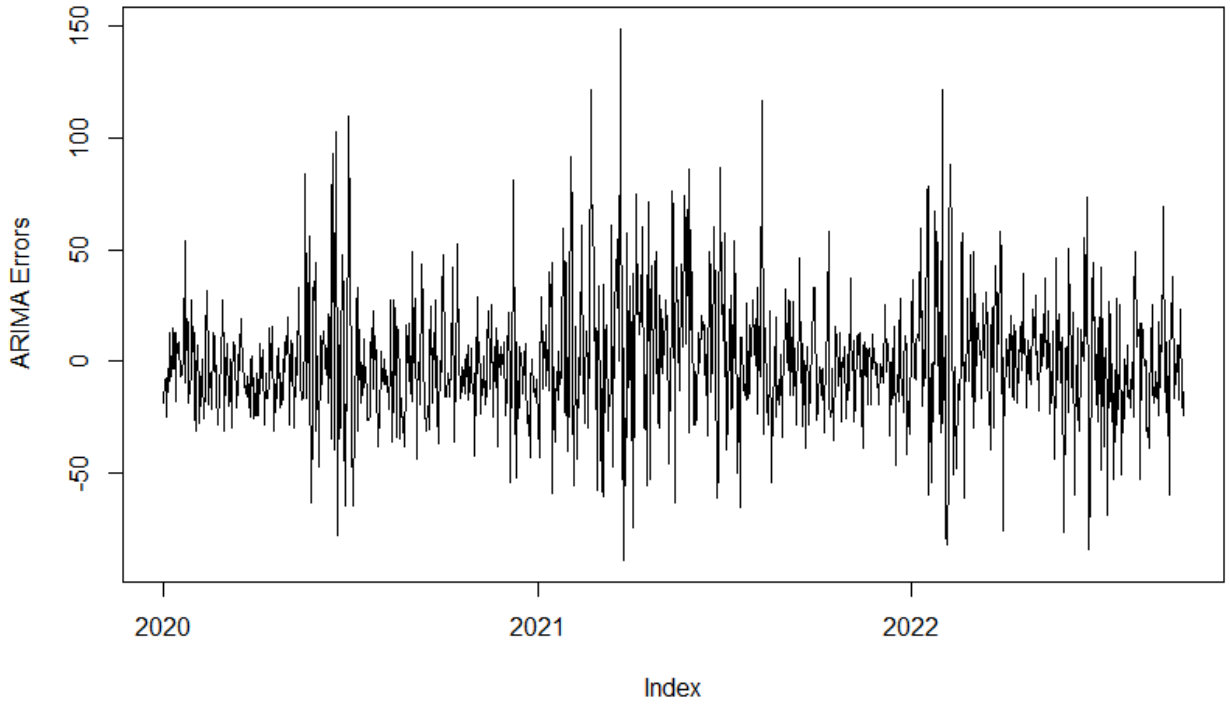
4. Regression Residuals

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. Residuals for 18-24 September were relatively small, suggesting that prices on those dates appear to be largely aligned with market conditions.

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

Figure 4: Residual plot of estimated daily average spot prices

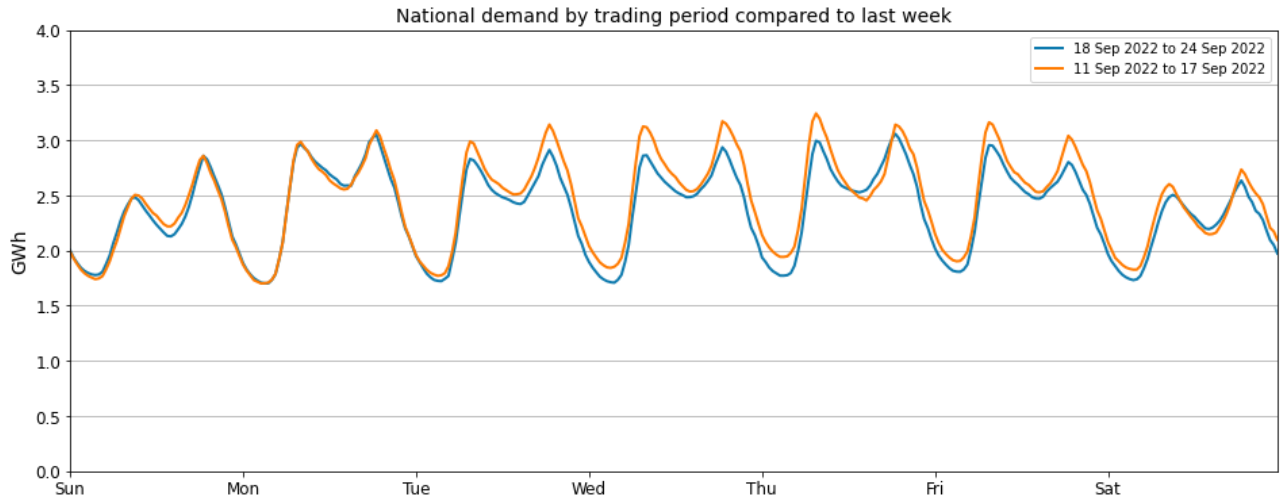


5. Demand

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

5.2. Demand from 18 - 24 September was typically lower, especially between Tuesday and Friday, when compared to the previous week. This decrease in demand was likely due to milder temperatures on those days, as seen in Figure 6. Demand on Monday, however, was roughly similar to the previous week.

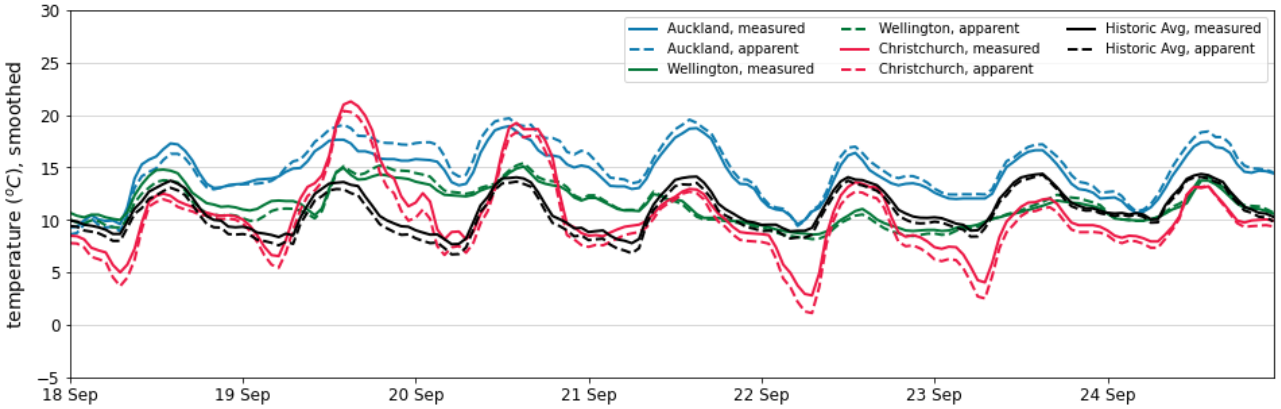
Figure 5: National demand by trading period compared to the previous week



5.3. 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.

5.4. Auckland, Christchurch and Wellington temperatures were either at or above average for most of the week. All main centres experienced a chilly Thursday morning, with all below 10 degrees Celsius, and Christchurch close to 5 degrees Celsius.

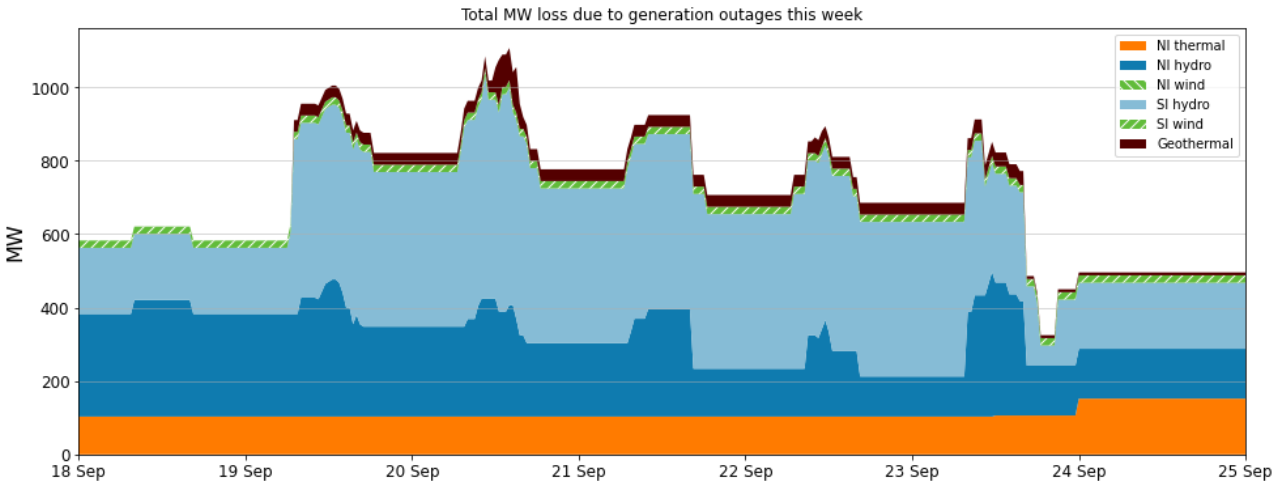
Figure 6: Temperatures across main centres

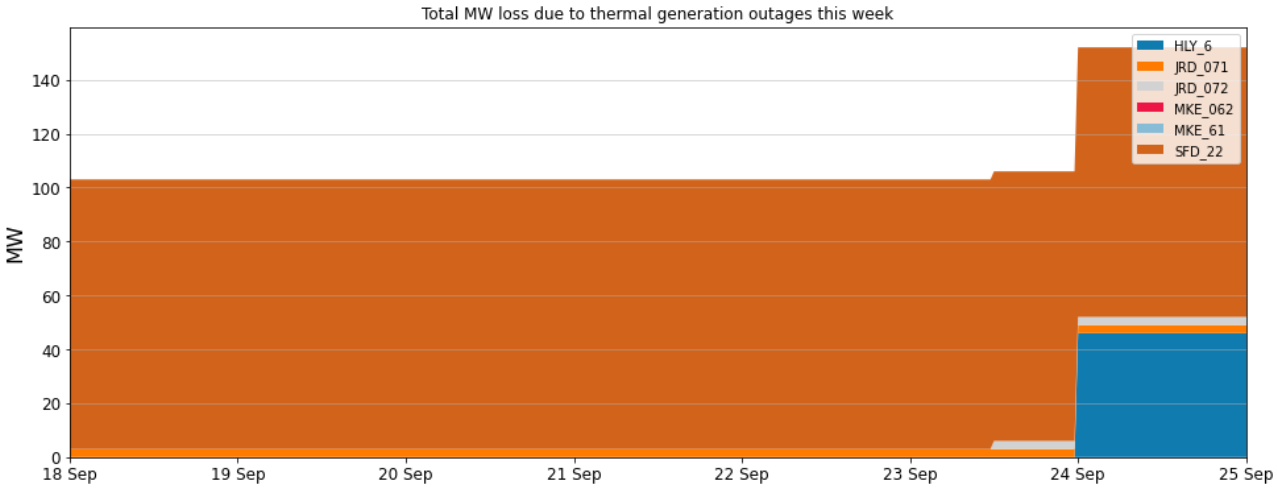


6. Outages

6.1. Figure 7 shows generation capacity lost due to outages. Total capacity lost between 18 and 24 September increased from ~600 MW on Sunday to ~1000MW during times on Monday and Tuesday, due to increased South Island hydro outages. However, as North Island hydro outages decreased, outages from Wednesday onwards spiked at around 900MW. Roughly 30 MW of geothermal was on outage between Monday and Friday.

Figure 7: Total MW loss due to generation outages





7. Generation

7.1. Wind generation, as seen in Figure 8, varied between 50 MW to 700 MW during the week. Wind generation was strong on Monday. However, wind did drop by 100 MW before the evening peak on Monday. This sudden drop likely contributed to the price spike on Monday evening. Wind reached a low on Wednesday, after which it was strong again between Thursday and Friday.

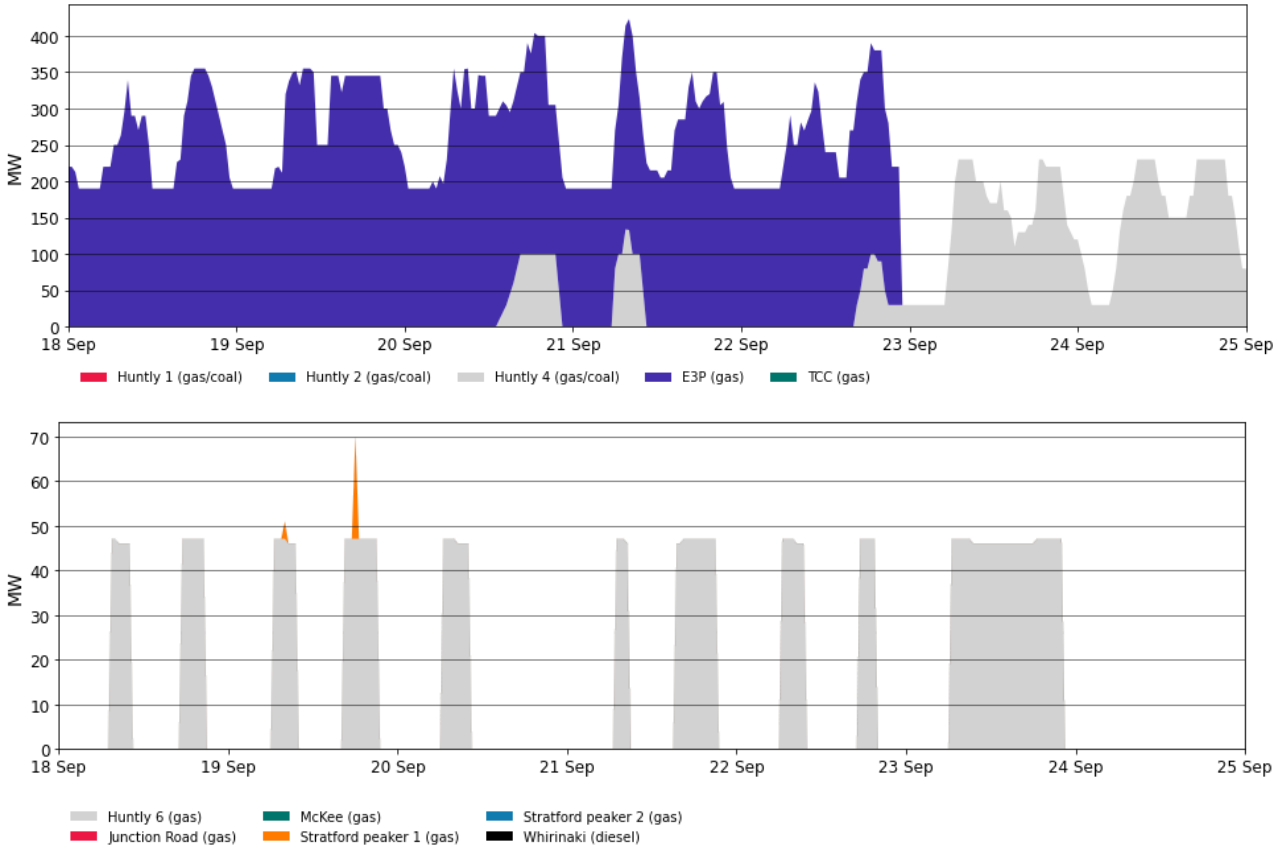
Figure 8: Wind Generation

7.2. Figure 9 shows generation at thermal and thermal peaker plants between 18 – 24 September. Unlike the previous few weeks, E3P ran continuously between Sunday and Thursday, before turning off completely, after which Huntly 4 ramped up and supported baseload.

7.3. Baseload thermal generation was highest when wind generation was low on Tuesday and Wednesday - reaching its highest points during peak demand periods. Thermal generation peaked for the week on the morning of Wednesday 21 September at ~400 MW.

7.4. Different patterns apply to thermal peaker generation. Huntly 4 periodically turned on to support peak demand between Sunday and Thursday, before running continuously on Friday, likely to support baseload after E3P was turned off. Stratford peaker one ran on Monday morning and evening and was constrained on both times. This suggests the high the SIR price was due to tight reserve supply, rather than just a high price from co-optimisation.

Figure 9: Thermal Generation



7.5. As a percentage of total generation, between 19 and 25 September, hydro generation totalled 69.9 per cent, geothermal 17.5 per cent, thermal 4.7 per cent and wind 6.7 per cent. Despite periods of low wind generation, the current abundance of hydro fuel would have kept spot prices low outside of peak demand periods this week.

8. Storage/Fuel Supply

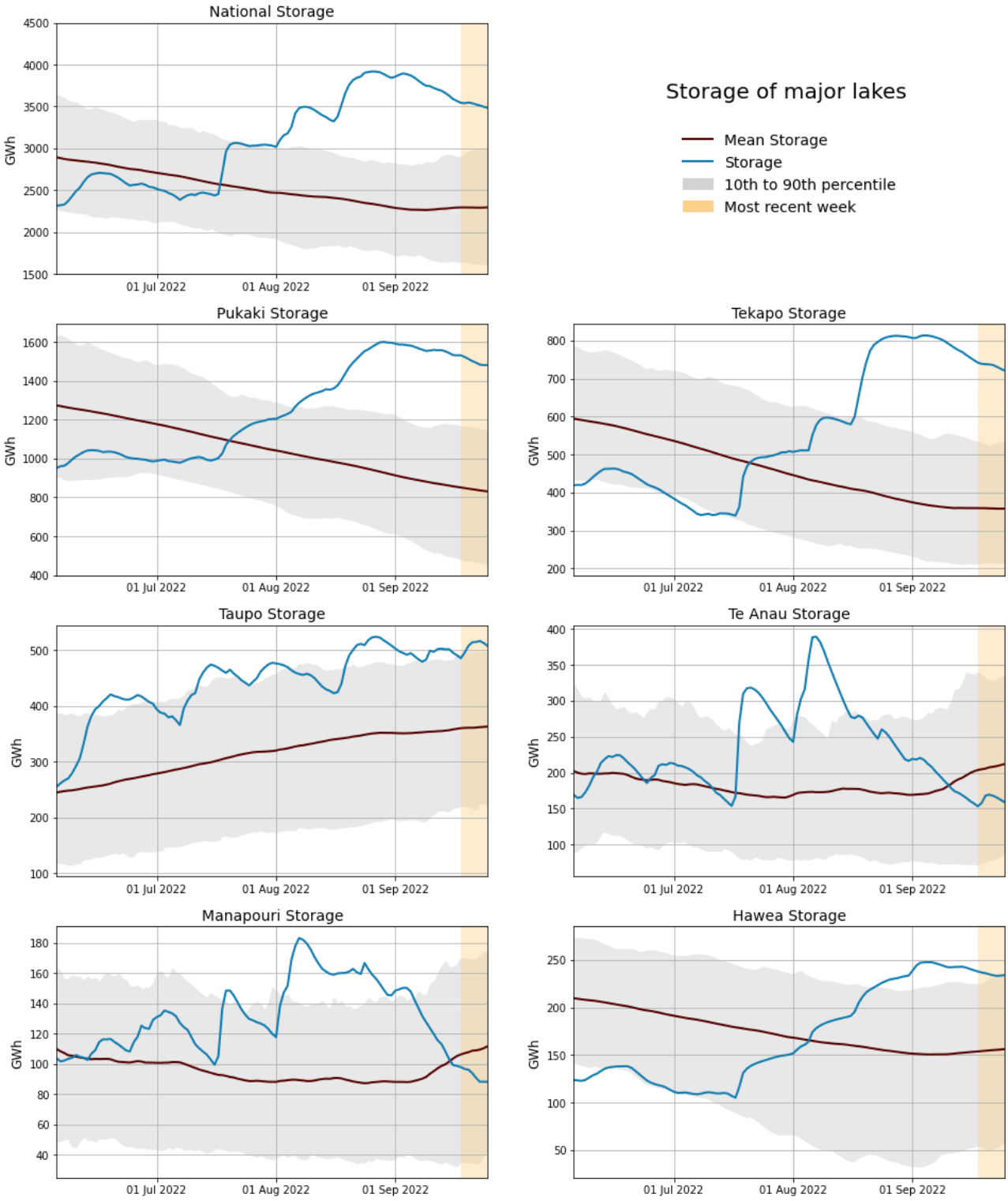
8.1. Figure 10 shows total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

8.2. Hydro storage levels continue to remain well above usual for this time of year at around 84 per cent of nominal full. Most major lakes continue to remain above their historic 90th storage percentile, except Te Anau and Manapōuri, which have fallen below their historic means.

8.3. The high level of hydro storage 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 primarily northwards between 18 - 24 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.

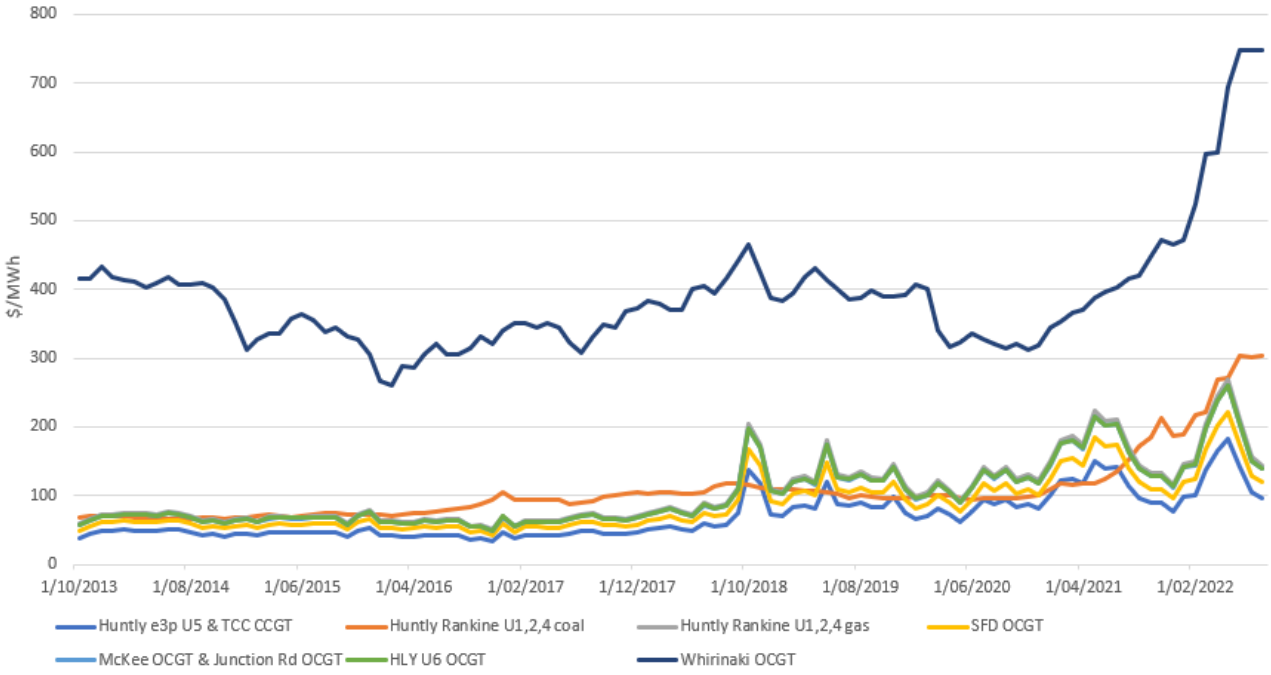
9.3. Figure 11 shows an estimate of thermal SRMCs as a monthly average up to 1 September 2022. The SRMC of gas fuelled plants continues to fall while the SRMC of diesel and coal fuelled plants appears to have plateaued.

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



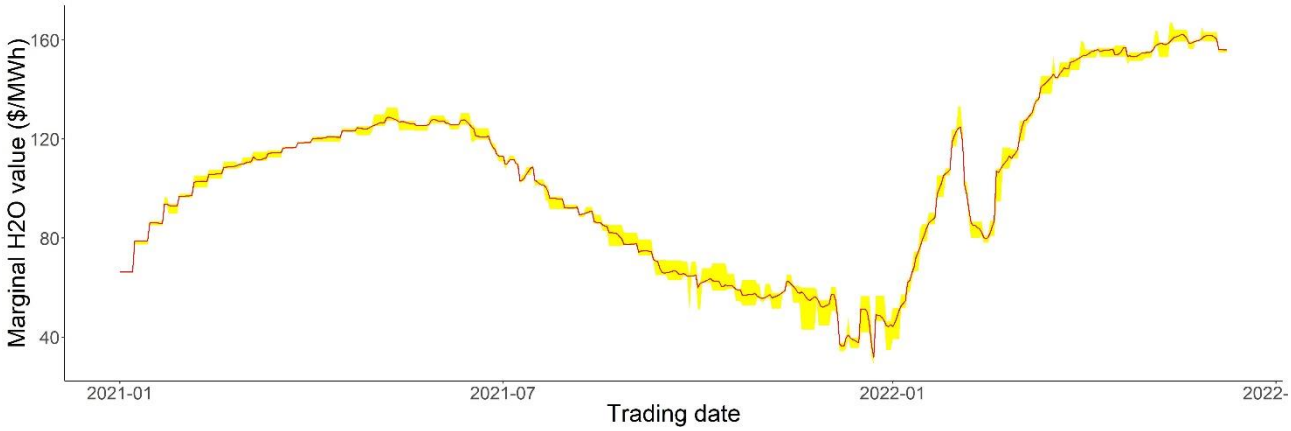
10. JADE Water values

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 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.

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

Figure 12: Water Values



11. Offer Behaviour

11.1. Figure 13 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 in either the $0-50/MWh or $50-100/MWh bands. 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 $100-200/MWh to $600/MWh+ prices quite easily.

11.3. Figure 14 shows the offer curve of the trading period with the highest spot price this week, which was trading period 37 (6:00 pm) on 19 September. As described above, the steep growth at the upper end of the offer curve led to the sudden increase in price in the North Island. Note that there was price separation, so the price in South Island remained around $100/MWh, which is consistent with Meridian's offers.

[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: Daily offer stack

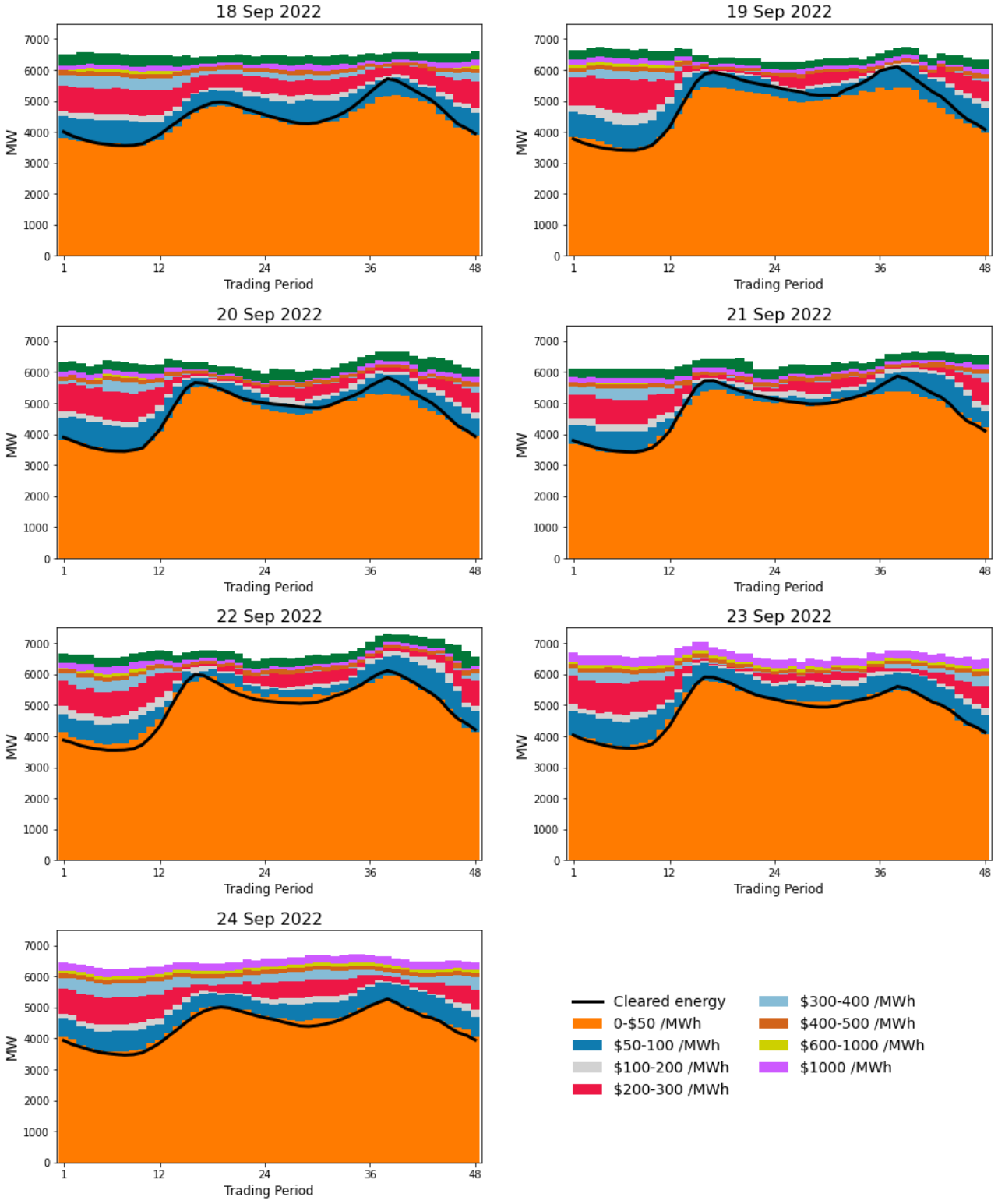
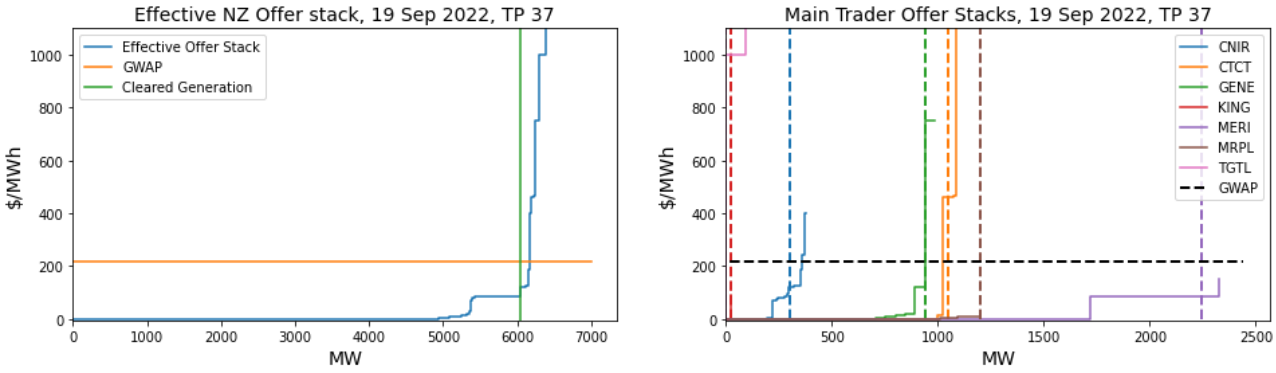


Figure 14: Offer stack at TP 37, 19 September



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.