Date: 26 June 2023

TRADING CONDUCT REPORT

Market Monitoring Weekly Report

TRADING CONDUCT REPORT

1. Overview for week of 18 – 24 June 2023

1.1. Throughout this week, prices remained close to the historical average with significantly reduced volatility compared to recent weeks. A decrease in demand can be attributed to milder weather conditions experienced nationwide. There was notable price separation between the islands, caused by the high northward flow of HVDC. To meet the increased demand during periods of low wind and high demand, additional thermal generation was employed.

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 identifying 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 any node exceed their historical 90th percentiles. Prices above the historic 90th percentile are highlighted with a black line. Other notable prices, but which did not exceed the 90th percentile, are marked with black dashed lines.

2.2. Between 18 – 24 June:

(a) The average wholesale spot price across all nodes was $89/MWh.

(b) 95 percent of prices fell between $7/MWh and $170/MWh.

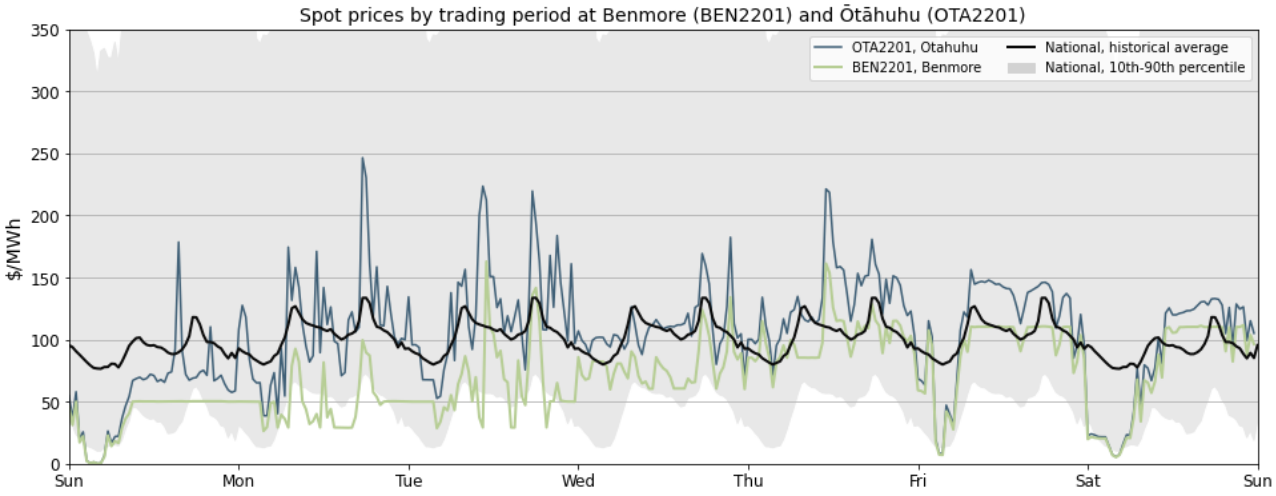
2.3. Figure 1 shows spot prices at Benmore and Ōtāhuhu alongside their historic median and historic 10th - 90th percentiles adjusted for inflation.

2.4. Prices hovered around the historic average and price volatility was not significant compared to the previous months with no prices observed above the 90th percentile.

2.5. The highest spike in prices this week was on Monday at 5.30 pm where the price at Ōtāhuhu was around $246/MWh. At this time there was also a price separation where the Benmore price was around $100/MWh. At this time South Island demand was higher than forecast and the HVDC northward flow ramped back slightly. Wind generation was also below 200 MW and most peakers were running.

2.6. There were a number of incidents of price separations across the week, some occurring consistently throughout the day with Ōtāhuhu prices anywhere between $30/MWh to $150/MWh higher than Benmore prices. During these times Northward flow across the HVDC was high and constrained due to North Island reserve requirements in the event of the loss of one or both poles.

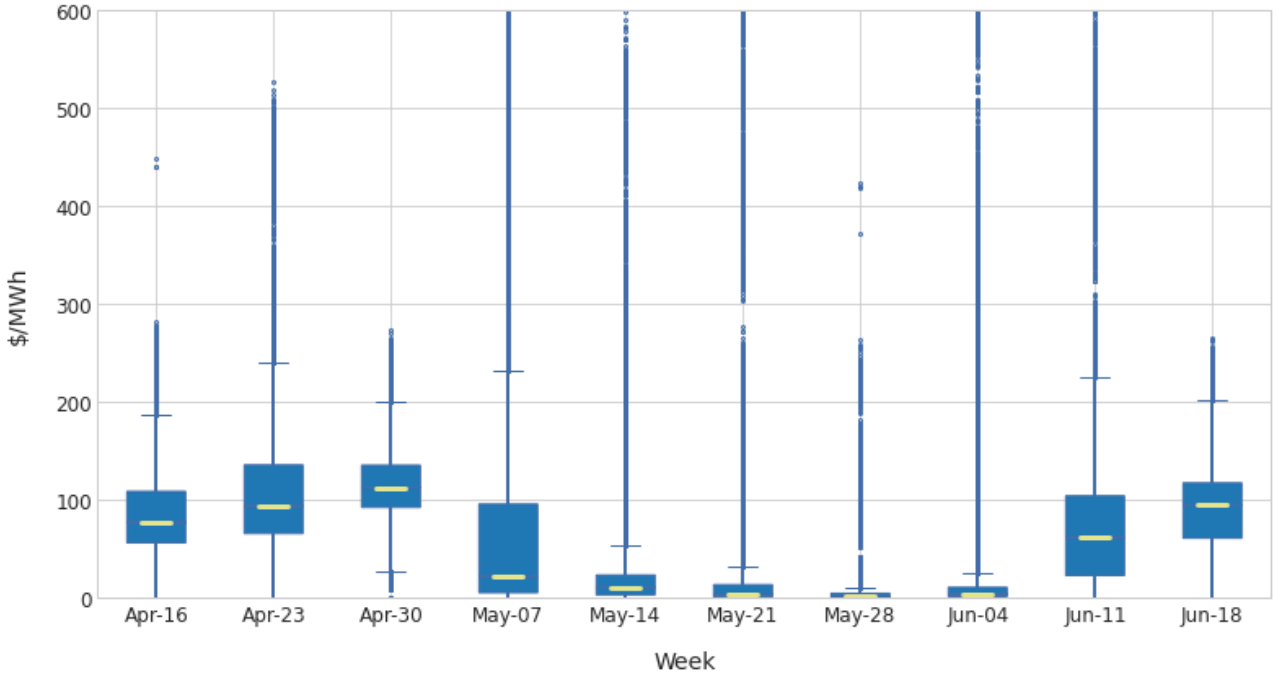
Figure 1: Wholesale Spot Prices between 18 June (Sunday) – 24 June (Saturday) 2023.



2.7. Figure 2 shows a box plot with the distribution of spot prices during this week and the previous nine weeks. The green line shows each week's median price, while the box part shows the lower and upper quartiles (where 50 percent of prices fell). The "whiskers" extend to points that lie within 1.5 times the inter-quartile range (IQR) of the lower and upper quartile, and then observations that fall outside this range are displayed independently.

2.8. This week, the median and upper quartile prices were higher than last week, as hydro storage declined, and prices rose closer to the long-term average. Additionally, there were no exceptionally high prices this week.

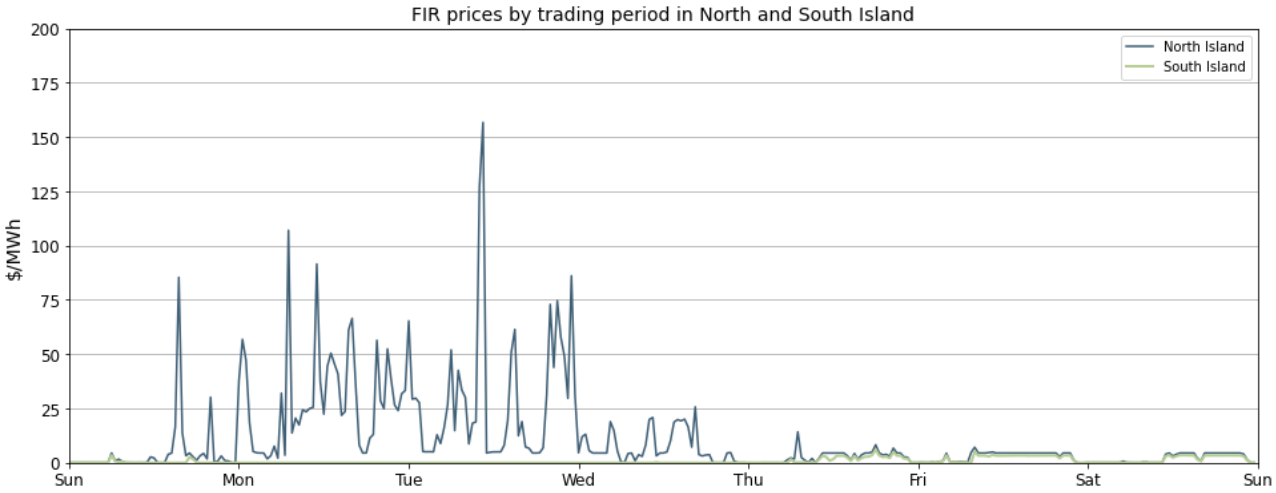
Figure 2: Boxplots showing the distribution of spot prices this week and the previous nine weeks.



3. Reserve Prices

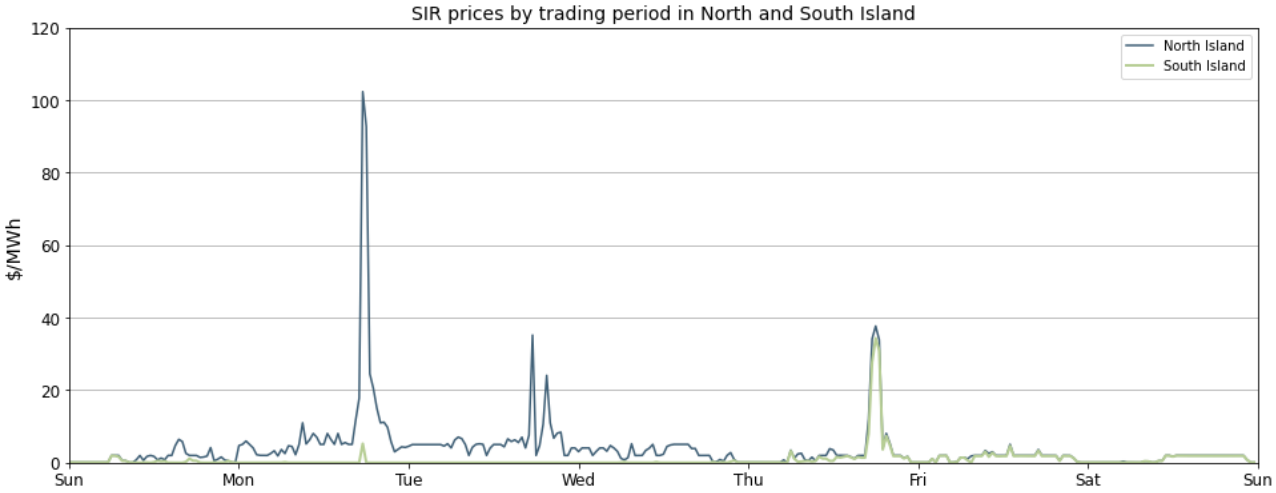
3.1. Fast Instantaneous Reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week the FIR prices were mostly below $5/MWh for the South Island. Meanwhile, the FIR prices for the North Island were volatile and slightly higher, but mostly below $100/MWh. The highest FIR price occurred on Tuesday, 20 June at 10:30 am, with the price reaching $157/MWh in the North Island. The high FIR prices coincided with high HVDC transfer, and additional transfer across the HVDC would have required additional reserve. The high North Island FIR requirement and prices were therefore a factor in price separation observed this week.

Figure 3: Fast instantaneous reserve (FIR) prices by trading period and Island.



3.2. Sustained Instantaneous Reserve (SIR) prices for the North and South Islands are shown in Figure 4. SIR prices were mostly below $10/MWh this week, with occasional price spikes. The highest SIR price occurred on Monday, 19 June between 5:30-6:00 pm, when the price reached $102/MWh in the North Island and $5/MWh in the South Island and coincided with the highest energy prices.

Figure 4: Sustained instantaneous reserve (SIR) prices by trading period and Island.



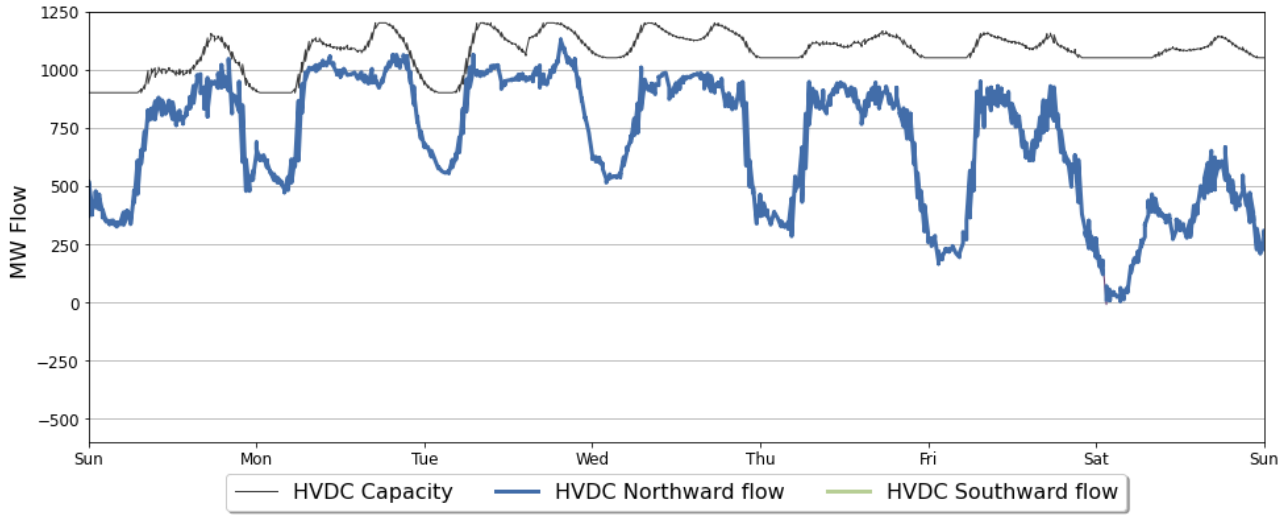
4. HVDC

4.1. Figure 5 shows HVDC flow between 18 – 24 June, which were northwards for the whole week. HVDC flows were relatively high during the day, due to high hydro generation in the

South Island. The high HVDC flows resulted in an increased requirement for reserve in the North Island, in order to cover the risk of the loss of one or both HVDC poles. This constrained flows across the HVDC even when the flows were below the transfer limit.

4.2. The highest prices coincided with a drop in the northward flow across the HVDC. This drop required additional North Island generation (mainly thermal) to be dispatched to meet the North Island load.

Figure 5: HVDC northward flow and capacity.

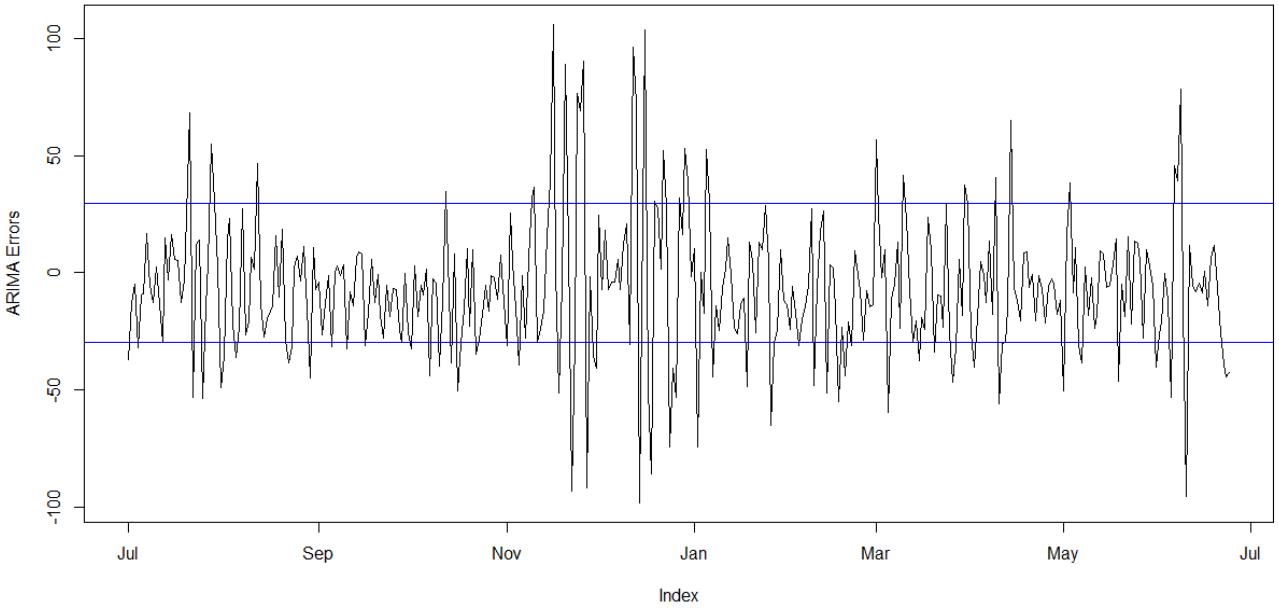


5. Regression Residuals

5.1. 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 on the trading conduct webpage.

5.2. Figure 6 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Residuals were mostly relatively small, suggesting that average daily prices on those dates appear to be largely aligned with market conditions. These small deviations reflect market variations that may not be controlled for in the regression analysis. This week, there was one residual below the one standard deviation indicating that the modelled price was higher than the actual prices on that day.

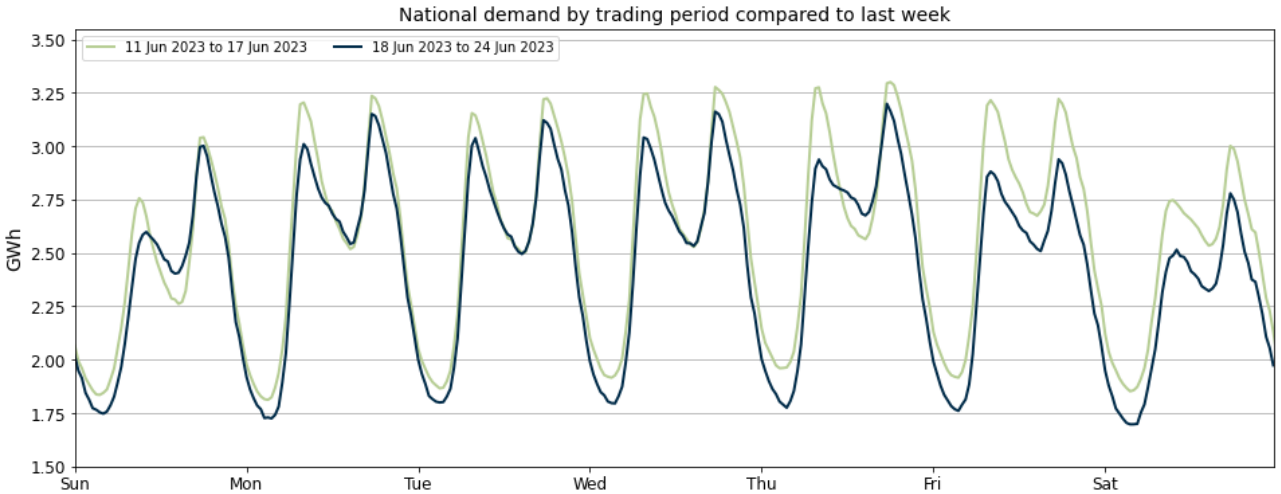
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 24 June 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 18 – 24 June, compared to the previous week. Overall, demand decreased compared to the previous week as temperatures shifted above or around the mean historic temperatures across the country. On Thursday, the morning peak demand was significantly lower compared to the previous week.

Figure 7: National demand by trading period compared to the previous week.

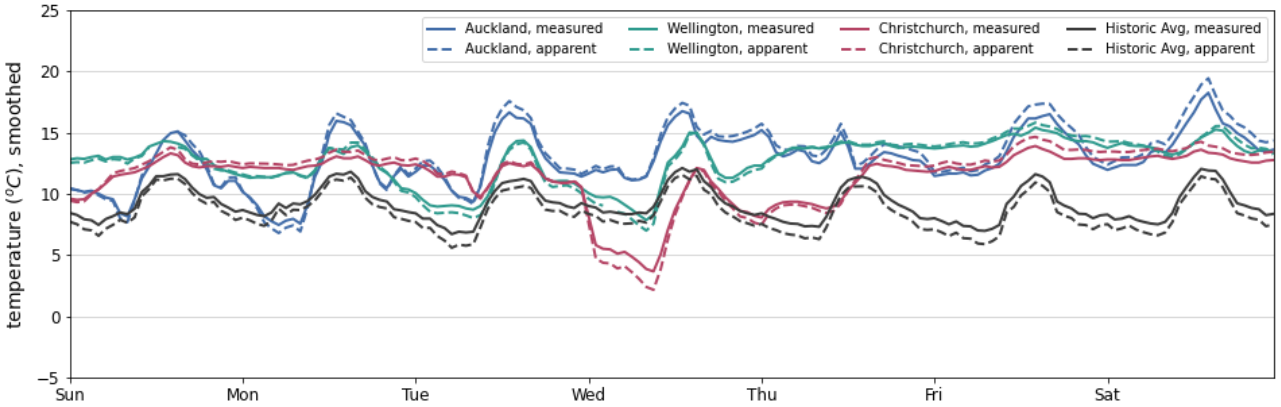


6.1. Figure 8 shows hourly temperatures at the three main population centres between 18 – 24 June. The measured temperature is the recorded temperature, while the apparent temperature adjusts for factors like wind speed and humidity to estimate how cold it feels. Also included for reference is the mean historical temperature of similar weeks, from previous years, averaged across the three main population centres.

6.2. Temperatures in all three main centres were mostly above or around the historic average, ranging between 5 and 20 degrees. Temperatures in Auckland were mostly above average for the week with apparent temperatures around 12 degrees. Temperatures in Wellington were also above average for most of the week ranging between 7-15 degrees. Christchurch

started the week with above average temperatures and saw the dip on Wednesday but were above average for the rest of the week.

Figure 8: Temperatures across main centres.



7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 18 – 24 June ranged between ~500MW and 1100MW.

7.2. Notable outages include:

(a) Huntly 4 was on outage between 19-21 June.

(b) Huntly 2 is on outage from 22 June to 2 July.

(c) Stratford was on outage between 19-20 June.

(d) Whirinaki station was on a short outage on 22 June.

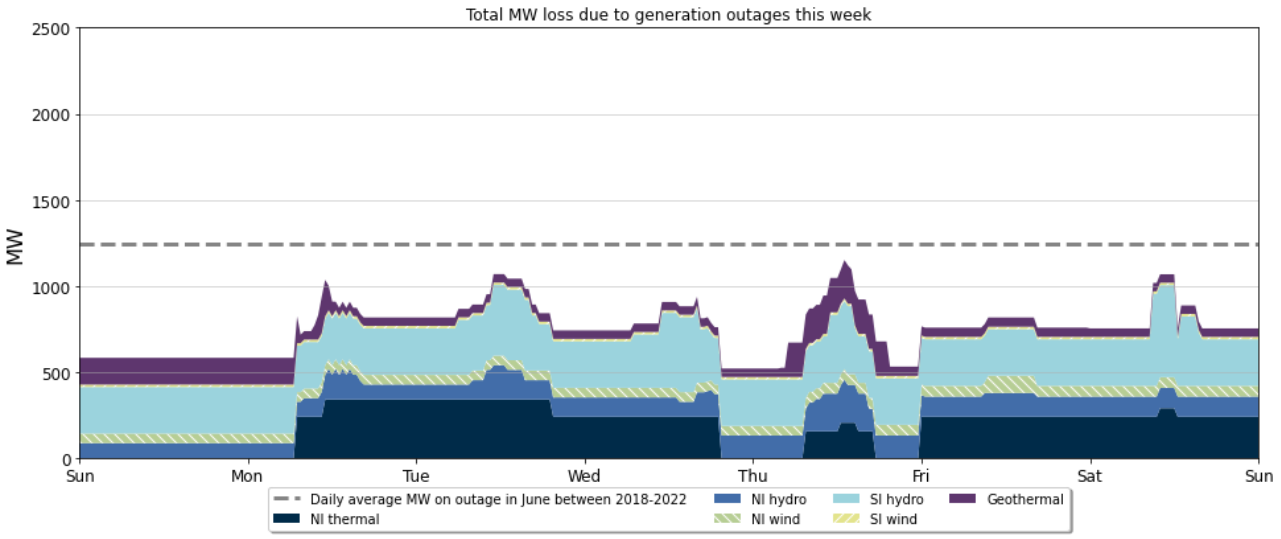
(e) McKee had a short outage on 24 June.

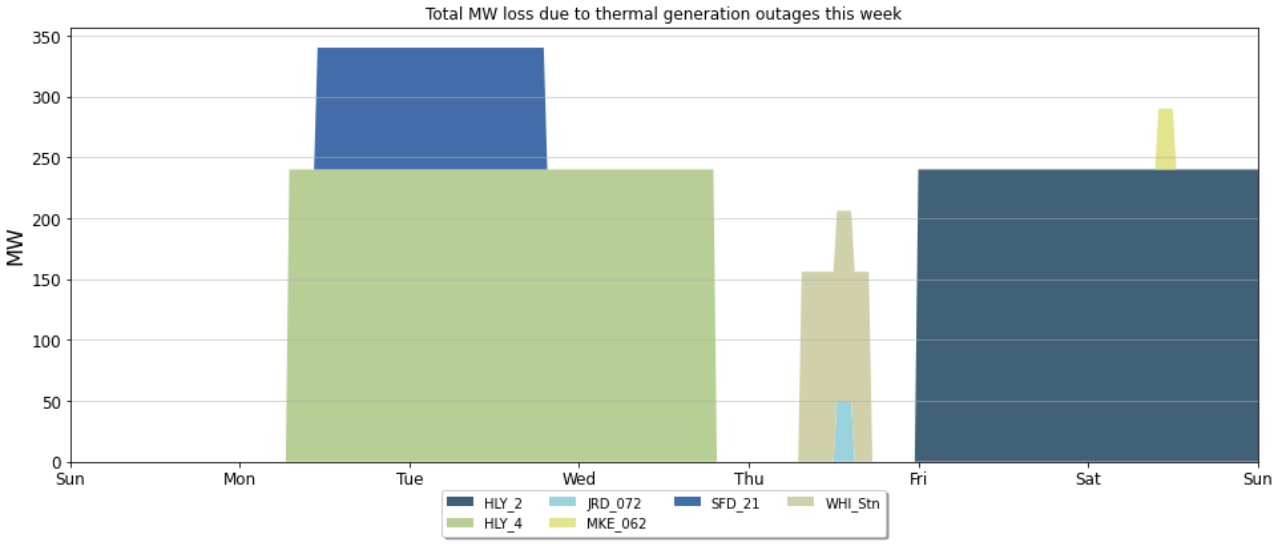
(f) Kawerau geothermal unit came back from outage on 19 June.

(g) Various North and South Island hydro units remain on outage.

(h) West Wind is partly on outage until 24 November.

Figure 9: Total MW loss due to generation outages.

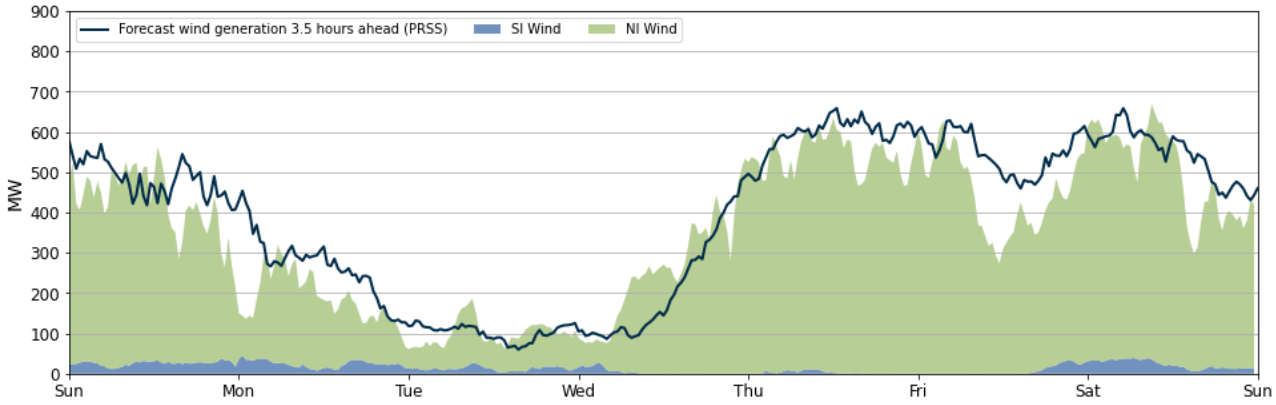




8. Generation

8.1. Figure 10 shows wind generation, from 18 – 24 June, ranged from 20 - 500 MW across the week. Wind generation was around 500 MW at the start of the week and decreased to around 300 MW on Monday and further dropped to below 100 MW on Tuesday. Wind steadily increased from Wednesday and reached up to 600 MW on Thursday. On Saturday, wind dropped from 600 MW to 400 MW.

Figure 10: Wind Generation and forecast.

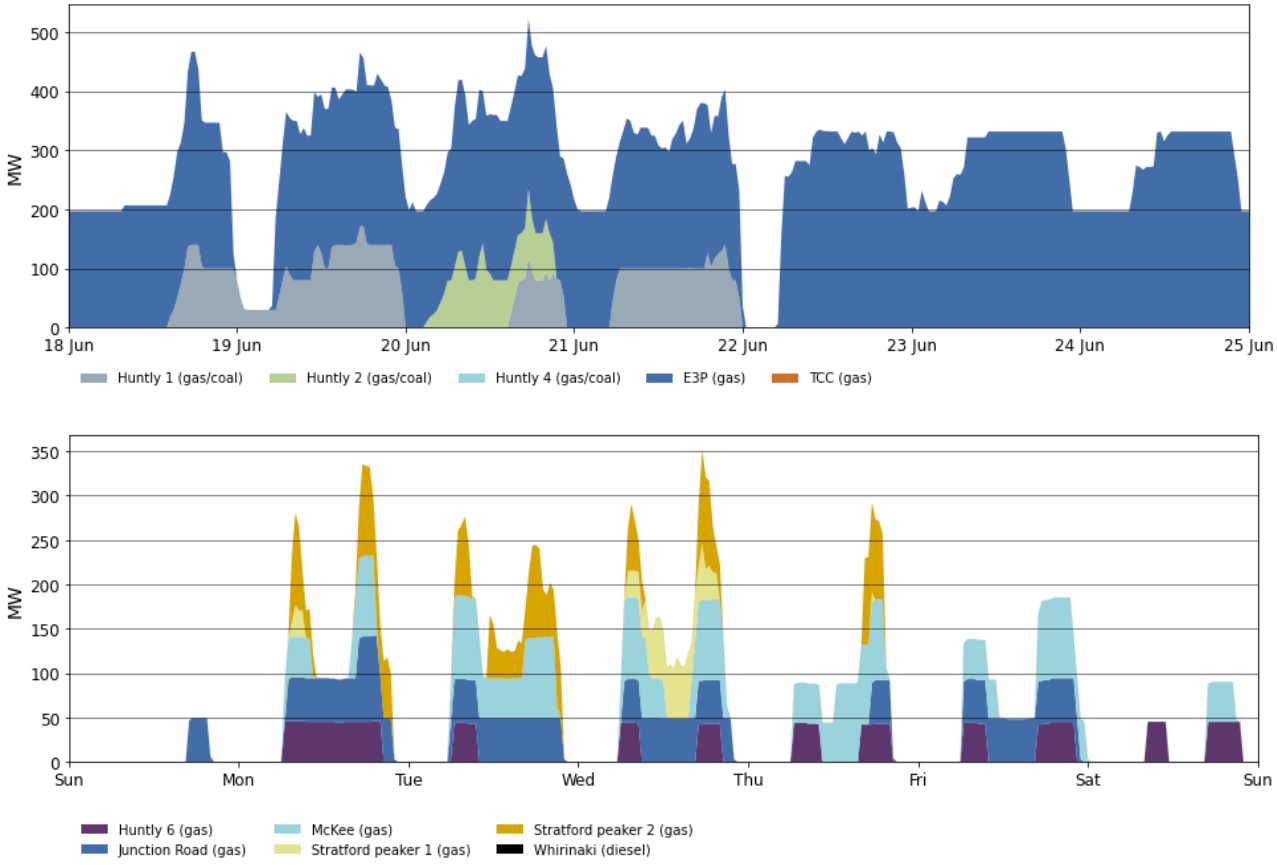


8.2. Figure 11 shows the generation of thermal baseload and thermal peaker plants between 18 – 24 June. E3P (Huntly 5) did not run overnight on Sunday and Wednesday, but did run as a baseload for the remainder of the week. Huntly 1 ran between Sunday and Wednesday to support baseload. Huntly 2 ran on Tuesday from the across the peak and shoulder period.

8.3. Most peakers ran from Monday to Wednesday, with McKee and Junction Road often staying on over the shoulder periods. Stratford 2 ran during Monday to Thursday peaks with Stratford 1 only running on Monday morning and during Wednesday. Huntly 6 ran every day except Sunday. There were fewer peakers running towards the end of the week as national

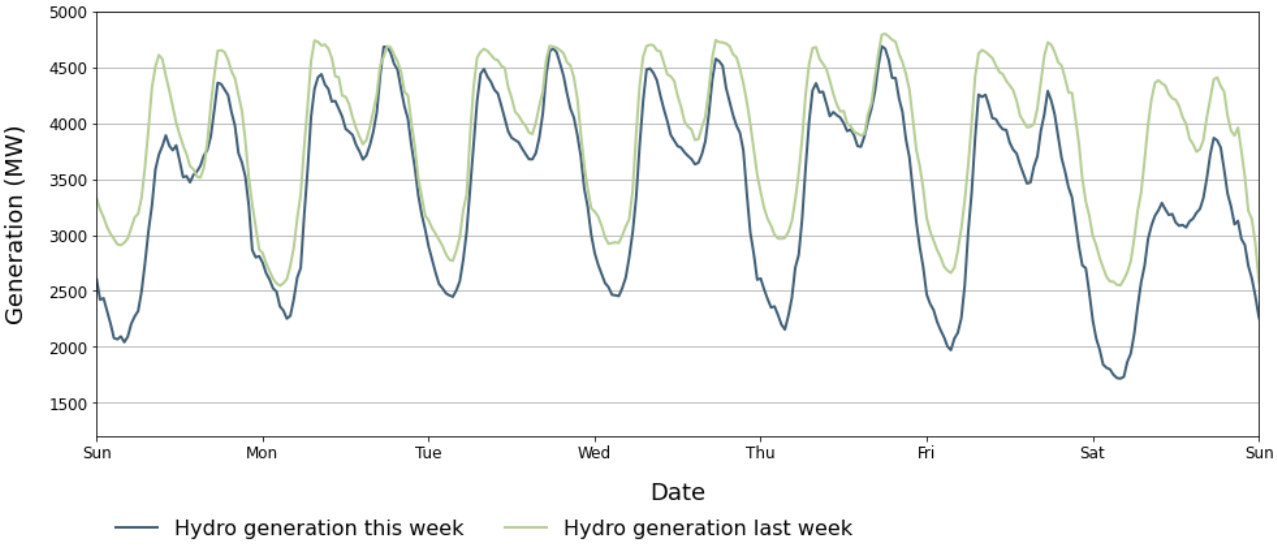
demand decreased due to milder temperatures across the country, as well as an increase in wind generation.

Figure 11: Thermal Generation.



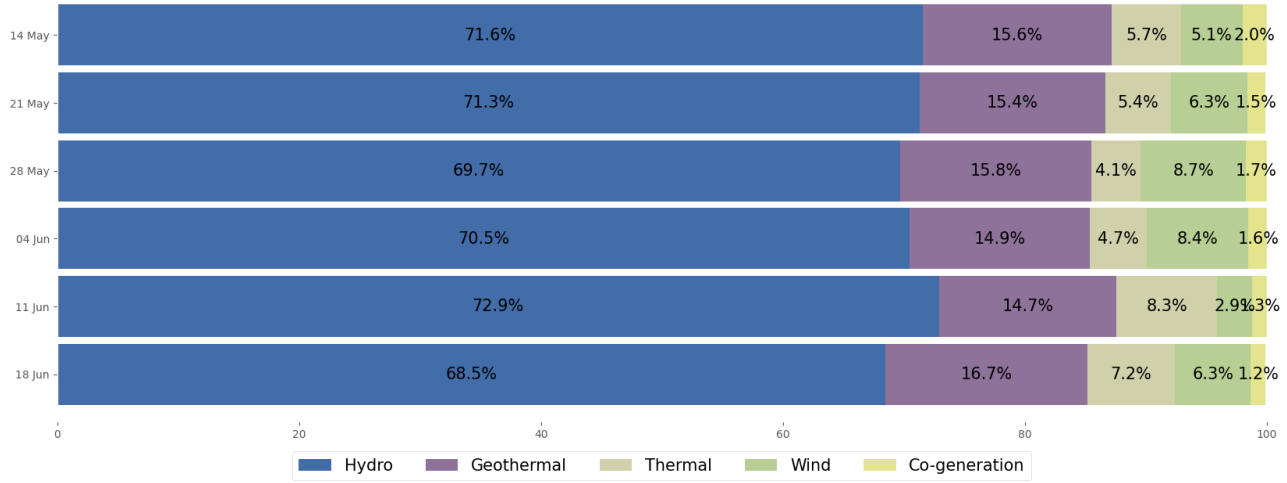
8.4. Figure 12 shows hydro generation between 18 – 24 June. Hydro generation decreased compared to the previous week in line with increased demand and decreased storage.

Figure 12: Hydro generation between 18 – 24 June compared to the previous week.



8.5. As a percentage of total generation, between 18 – 24 June, total weekly hydro generation was 68.5 percent, geothermal 16.7 percent, thermal 7.2 percent, wind increased to 6.3 percent, and co-generation 1.2 percent. Thermal generation was higher than last week, due to low wind and high demand.

Figure 13: Total generation as a percentage each week between 14 May and 24 June 2023.



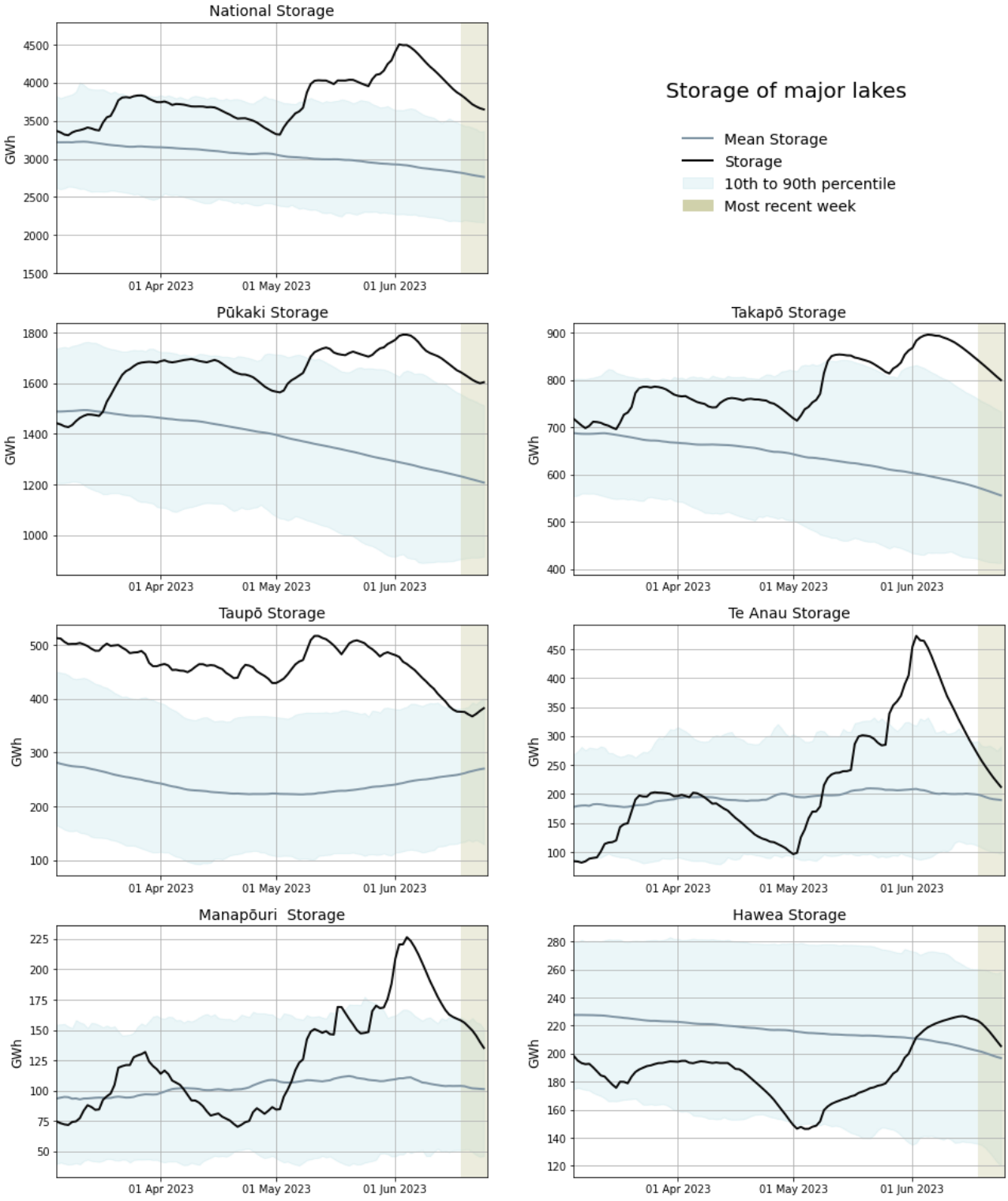
9. Storage/Fuel Supply

9.1. Figure 14 shows total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

9.2. National hydro storage levels have decreased this week to 87.8 percent of nominal full as of 24 June. However national controlled storage is still high at 126 percent of the historic mean for this time of year.

9.3. Most lakes levels decreased this week. Lakes Pūkaki and Takapō have been steadily decreasing but still remain above their 90th percentiles. The steepest drop in lake levels was at Manapōuri and Te Anau, these lakes are below their respective historic 90th percentile. Storage level at Taupō increased slightly and touched its historic 90th percentile. Hawea storage also decreased but remains above its historic mean for this time of year.

Figure 14: Hydro Storage.

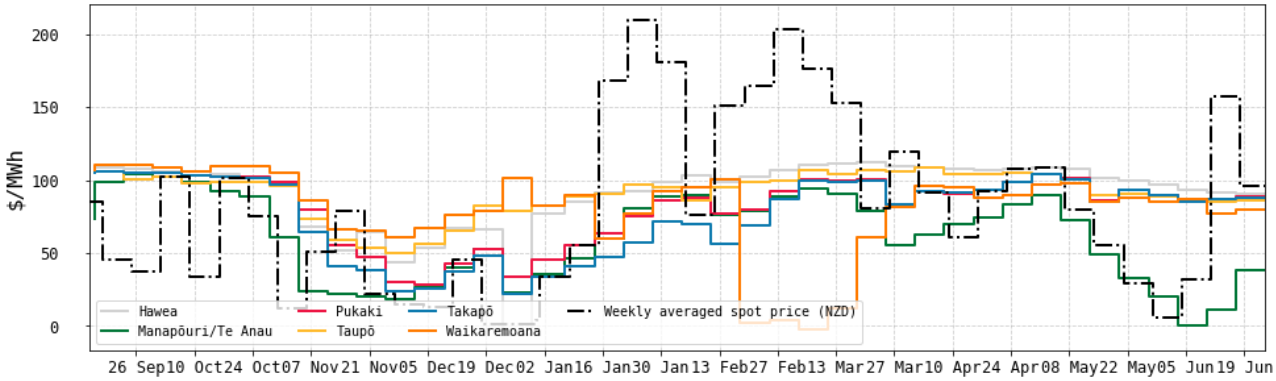


10. JADE Water Values

10.1. The JADE[1] 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 15 shows the national water values between 15 September 2022 and 24 June 2023 using values obtained from JADE. These values are used to estimate the marginal water value at the actual storage level. More details on how water values are calculated can be found in Appendix B.

10.2. Since the beginning of February, the water values at most lakes have been relatively steady, with a small drop in March as lake levels rose. This week water values in all lakes slightly increased due to a decline in hydro storage. Water values at Te Anau and Manapōuri experienced a drastic drop from May but raised over the last two weeks as storage substantially dropped.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 24 June 2023.



11. Prices versus estimated costs

11.1. 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).

11.2. The SRMC (excluding opportunity cost of storage) for thermal fuels is 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.

11.3. Figure 16 shows an estimate of thermal SRMCs as a monthly average up to 1 June 2023. The SRMC of diesel plants has significantly decreased from March, and the SRMC of gas-fuelled and coal plants has also slightly decreased. A reduction in carbon prices has contributed to the decline in SRMCs.

11.4. In early June, Indonesian coal stayed at around ~$466/tonne (NZD) putting the latest SRMC of coal-fuelled Huntly generation at ~$260/MWh.

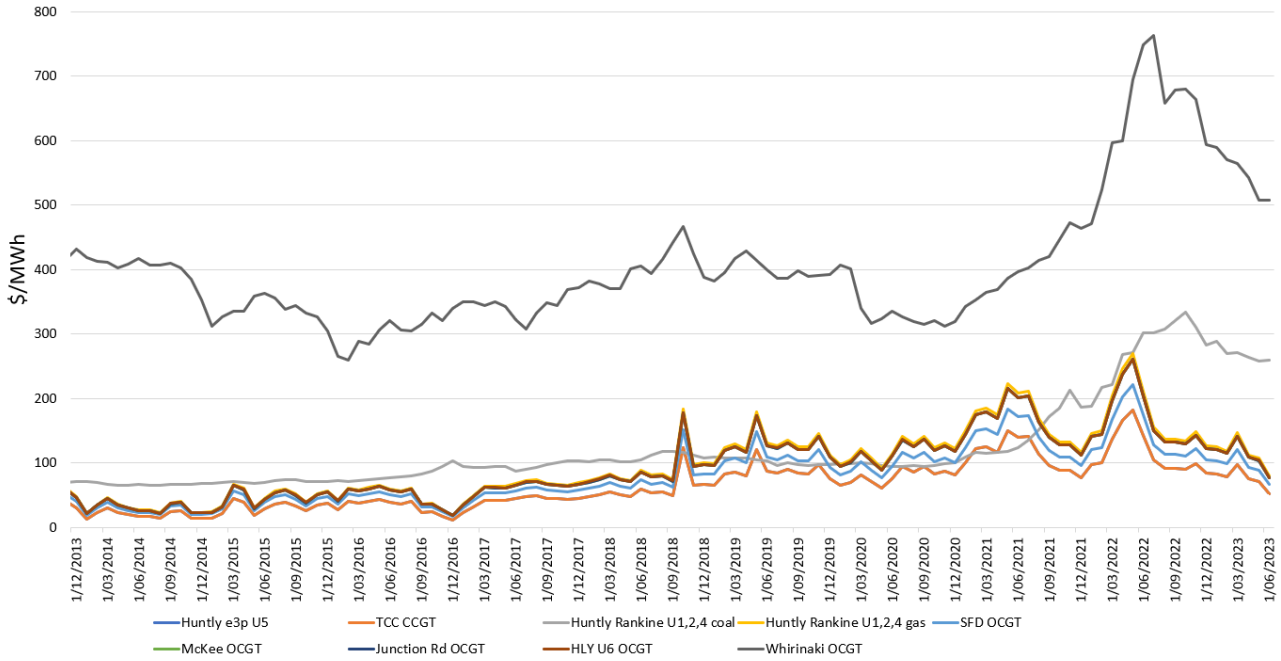
11.5. The SRMC of Whirinaki has decreased to ~$508/MWh.

11.6. The SRMC of gas fuelled thermal plants decreased and is between $53/MWh and $80/MWh, likely due to a decrease in gas demand as well as carbon prices.

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

[1] 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.

Figure 16: Estimated monthly SRMC for thermal fuels.



12. Offer Behaviour

12.1. Figure 17a shows this week's national daily offer stacks. The black line shows cleared energy, indicating the range of the average final price. The offer stack for the South and North Islands is illustrated in Figures 17b and 17c, due to the frequent price separation this week, highlighting their contrasting characteristics.

12.2. On Sunday, there was a substantial amount of generation available at prices ranging from $0 to $50/MWh, primarily attributed to sufficient hydro generation and low demand, and the stack remains thin above the $50/MWh. However, between Monday and Tuesday, there was an increase in offers within the $50-$200/MWh range, which could be attributed to a decrease in wind generation.

12.3. On Wednesday, most of the energy cleared between $50 and $100/MWh. From Thursday, there was a notable surge in the amount of energy offered in the $100-$200/MWh range. This increase in generation offered at higher price bands is likely due to a decline in hydro storage with the change most noticeable in the South Island.

Figure 17a: Daily offer stacks.

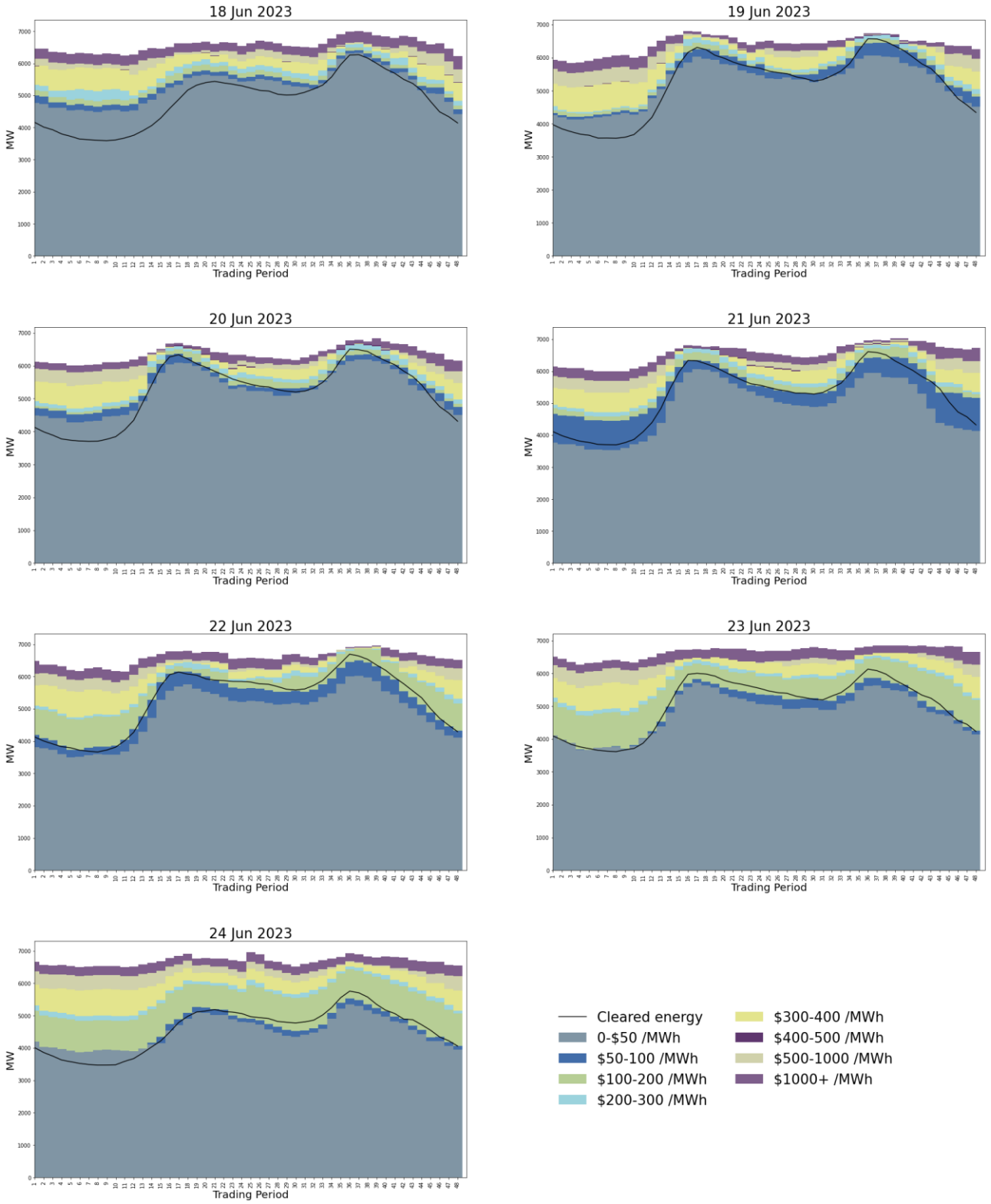


Figure 17b: Daily offer stacks for the North Island.

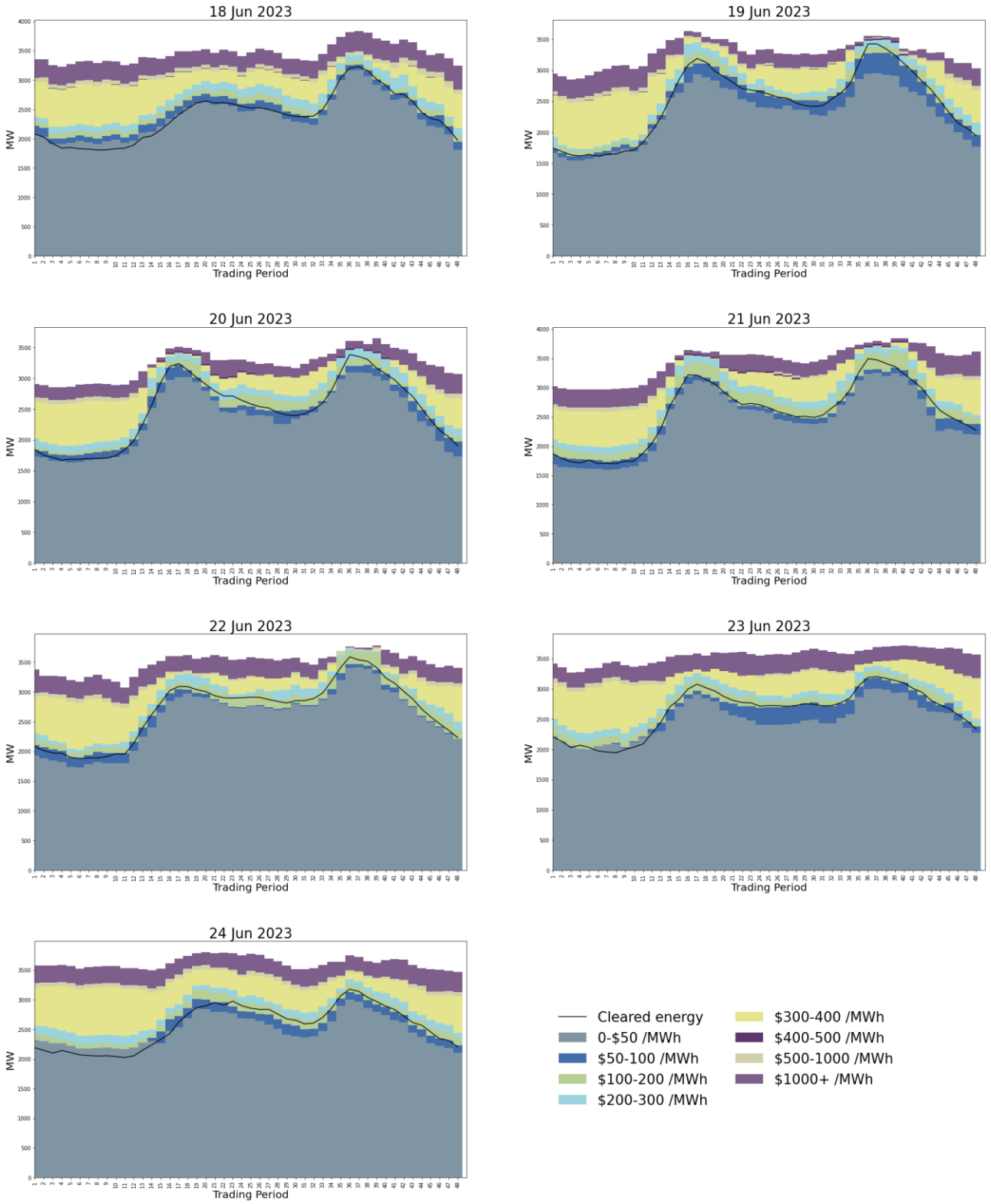
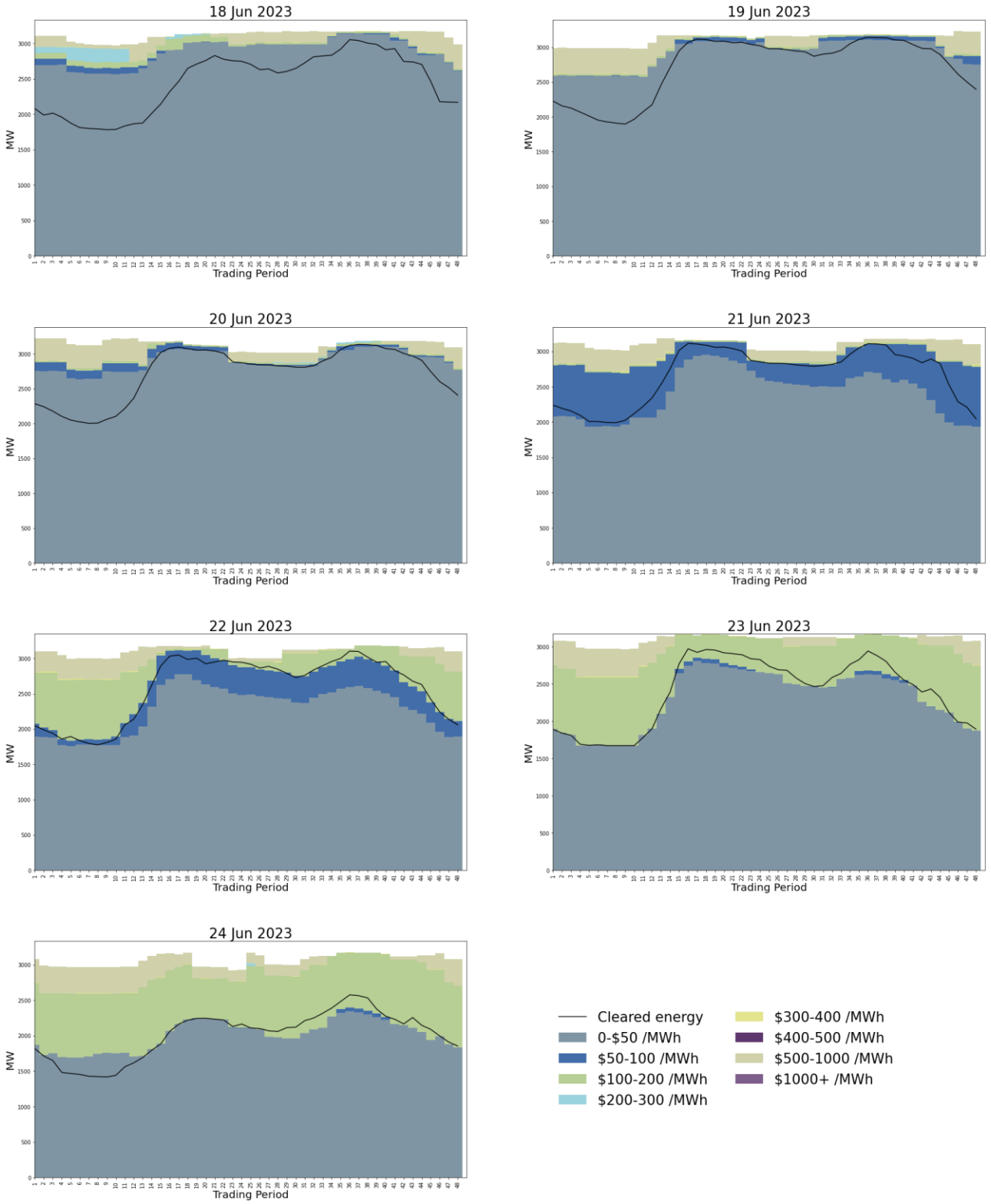


Figure 17c: Daily offer stacks for the South Island.



13. Ongoing Work in Trading Conduct

13.1. This week, prices generally appeared to be consistent with supply and demand conditions.

13.2. 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	Participant	Location	Enquiry Topic
07/10/2022	15-16	Further analysis	Genesis	Huntly 5	Prices change for final energy tranche.
15/1/2023 4/2/2023	Several	Further analysis	N.A.	Multiple	High energy prices associated with high hydro offers.
17/4/2023	48	Further analysis	Contact	Clyde and Roxburgh.	Offer changes.
19/4/2023	27	Further analysis	Contact	Clyde and Roxburgh.	Offer changes.
11/5/2023	37-40	Further analysis	Genesis	Huntly 4	Offer changes.
15/5/2023	36-37	Further Analysis	Genesis	Huntly 2,4,5	Offer changes.
18/05/2023	Several	Further Analysis	N.A.	Multiple	Market conditions which led to higher off-peak prices.
13/06/2023	14-16	Further Analysis	Genesis	Takapō	Offer changes.
14/06/2023	15-17	Further Analysis	Genesis	Multiple	High energy prices associated with high energy offers.
15/06/2023	15-19	Further Analysis	Genesis and Contact	Multiple	High energy prices associated with high energy offers.