Date: 22 May 2023

TRADING CONDUCT REPORT

Market Monitoring Weekly Report

TRADING CONDUCT REPORT

1. Overview for week of 14 – 20 May 2023

1.1. Price volatility remained high this week, with low off-peak prices due to increased hydro storage and generation, but significant price spikes occurred during peak times when additional thermal generation was necessary to meet demand. On Monday and Tuesday, prices exceeded the 90th percentile, primarily driven by high peak demand and a reserve deficit. Prices were also higher on Thursday, likely due to low wind generation.

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 its historical 90th percentiles. Prices above the historic 90th percentile are highlighted with a black line. Other notable prices, but which did not breach the 90th percentile, are marked in black dashed lines (if any).

2.2. Between 14 – 20 May 2023:

(a) The average wholesale spot price across all nodes was $56/MWh.

(b) 95 percent of prices fell between $0/MWh and $308/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. Price volatility was significant throughout the week similar to the previous week, with prices both below the 10th percentile and above the 90th percentile. Most prices fell below the historic average (around $100/MWh), however, there were significant price spikes.

2.5. On Monday, 15 May 2023 three price spikes above the historic 90th percentile were observed. First, during the morning peak time at 8:00 am, with prices reaching $870/MWh at Ōtāhuhu and $686/MWh at Benmore. Two price spikes were observed during the evening peak demand time at 5:30 pm and 6:00 pm due to a shortfall which resulted in a reserve deficit. This gave us maximum prices of $1,769/MWh at Ōtāhuhu and $1,418/MWh at Benmore with SIR prices of $1,452/MWh for the North Island and $1,327/MWh for the South Island.

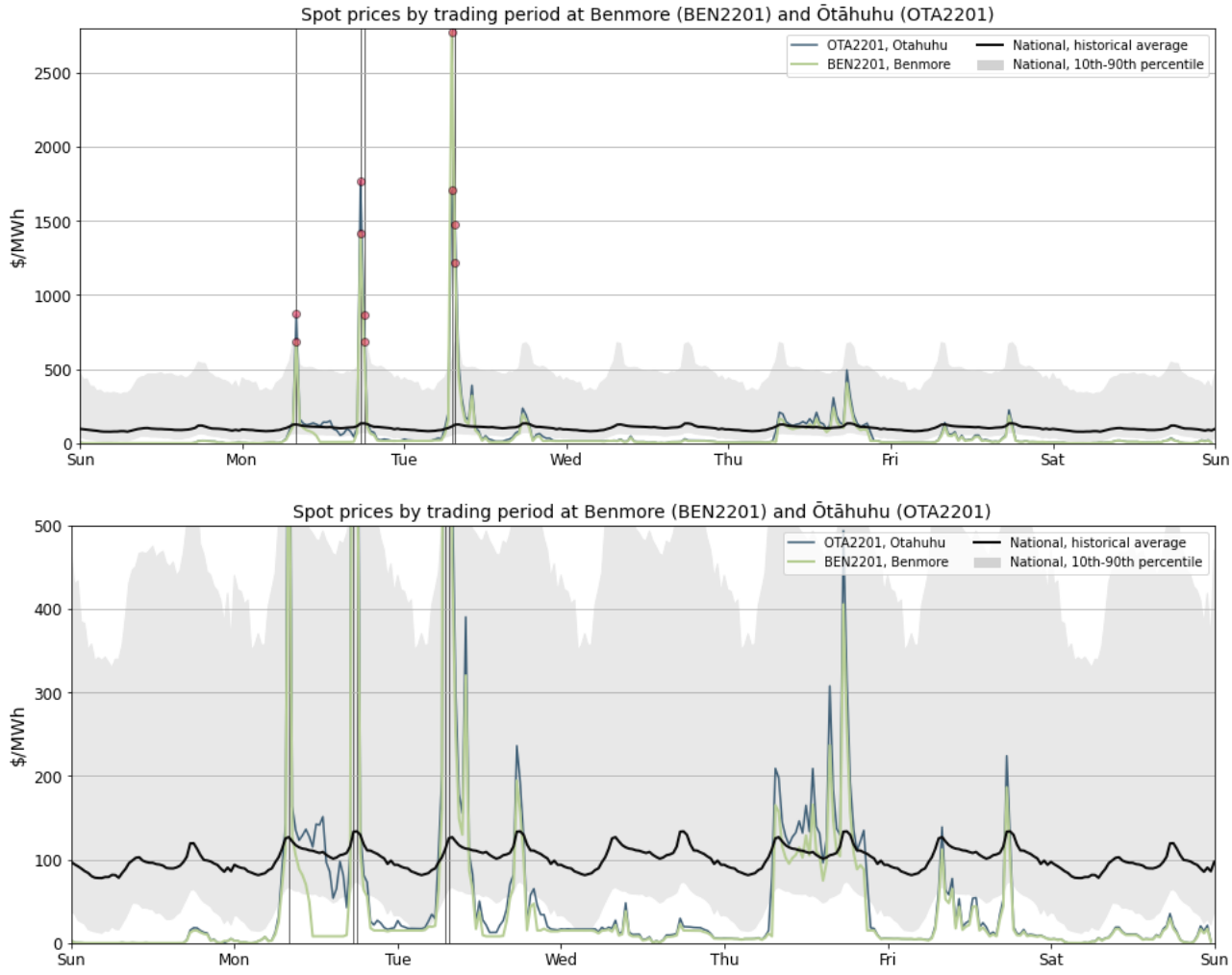
2.6. Other price spikes breached the 90th percentile on Tuesday, 16 May 2023 during the morning peak time at 7:00 am and 7:30 am with prices of $1,704/MWh at Ōtāhuhu and $2,771 at Benmore with SIR prices of $963/MWh for the North Island and $906/MWh for the South Island. On Tuesday morning the demand was high due to low temperatures (Christchurch was below zero degrees). Wind generation was low around 50 MW and HVDC was constrained on. Due to outages of Takapō units, some offers were removed from the South Island which results in a drop in HVDC northward transfer.

2.7. Transpower issued a Customer Advice Notice (CAN) for low residuals for Tuesday evening, from 5:30-6:30 pm, but no significant price spikes were observed during the evening peak time.

2.8. From Wednesday onwards there were low prices due to high hydro storage, with spilling at Pūkaki. During Sunday, Wednesday and Saturday, prices were mostly below the 10th percentile for most of the day. However, on Thursday prices were relatively high due to low wind generation but were not above the 90th percentile.

2.9. During 18 May there were some higher prices compared to most other days, with the highest price just under $500/MWh and below the historic 90th percentile. The prices this day were likely due to lower wind generation with more peakers running to cover the evening peak demand.

Figure 1: Wholesale Spot Prices between 14 May (Sunday) – 20 May (Saturday) 2023.



2.10. Figure 2a 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)[1] of the lower and upper quartile, and then observations that fall outside this range are displayed independently. Figure 2b shows this week's volatility.

2.11. This week, the median was lower when compared to the week before with more outliers due to price spikes. The price decrease was driven by relatively high hydro generation. Prices were lower than prices in late February and early March, due to increased hydro generation as lake levels have recovered.

[1] Quartile - Wikipedia

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

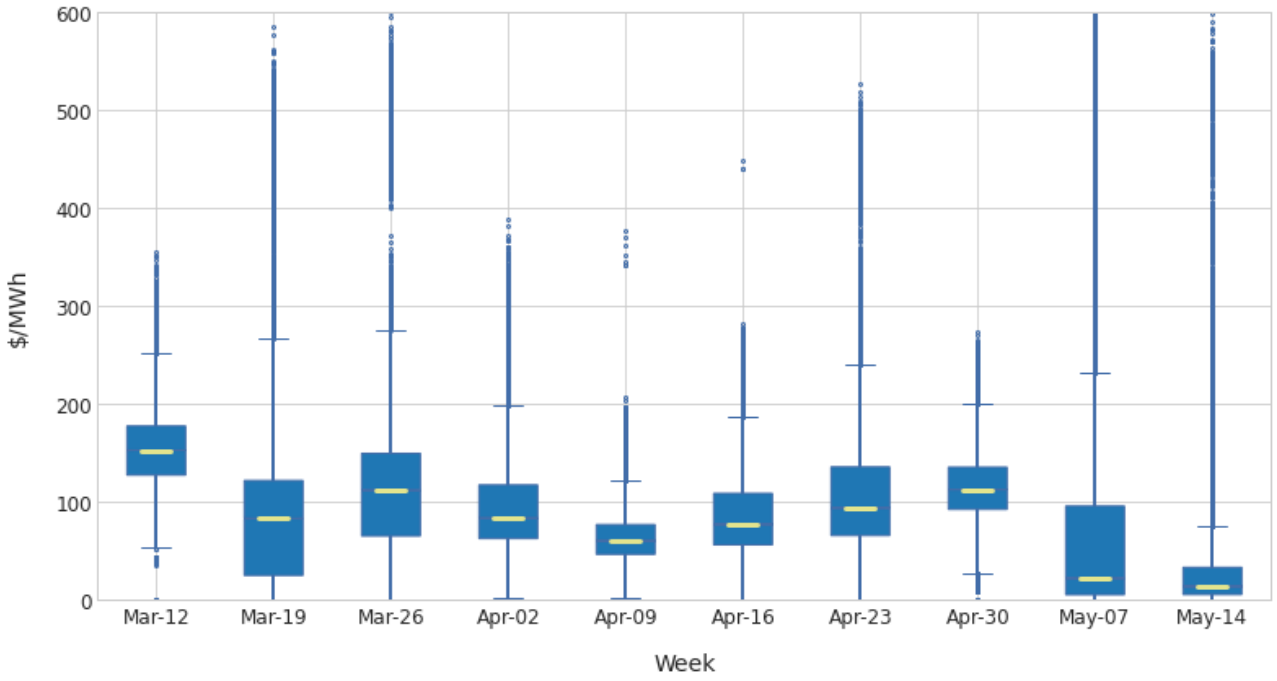
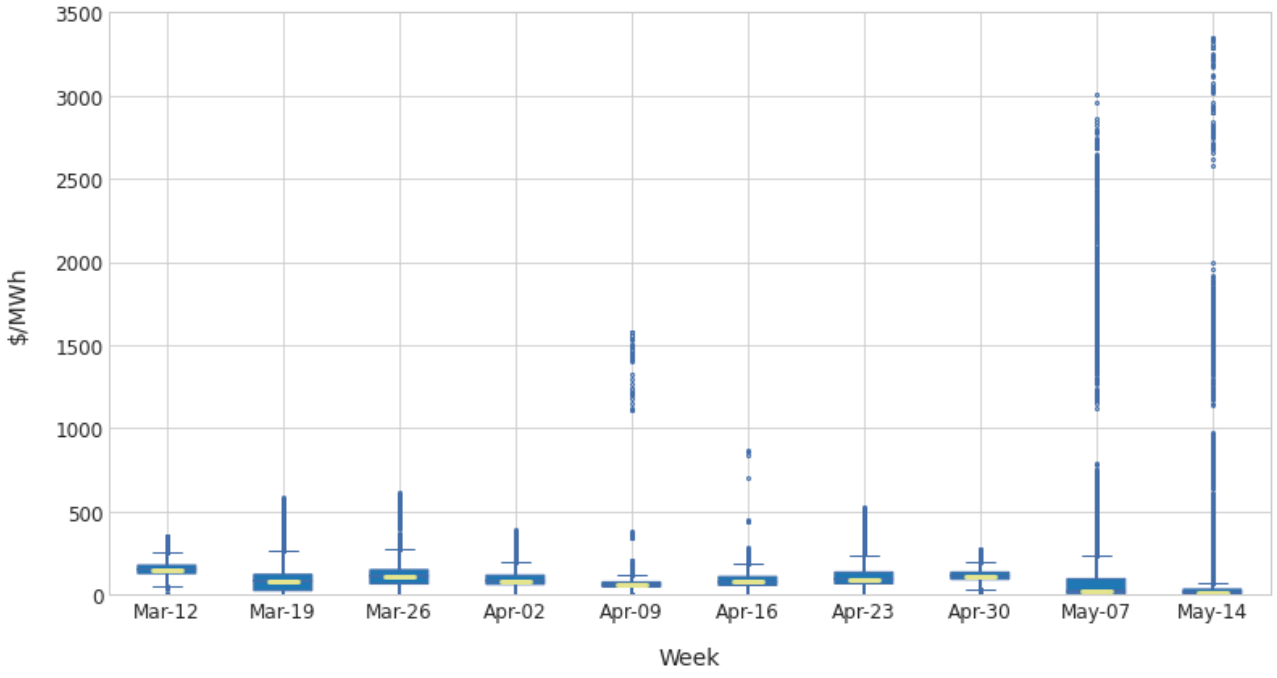


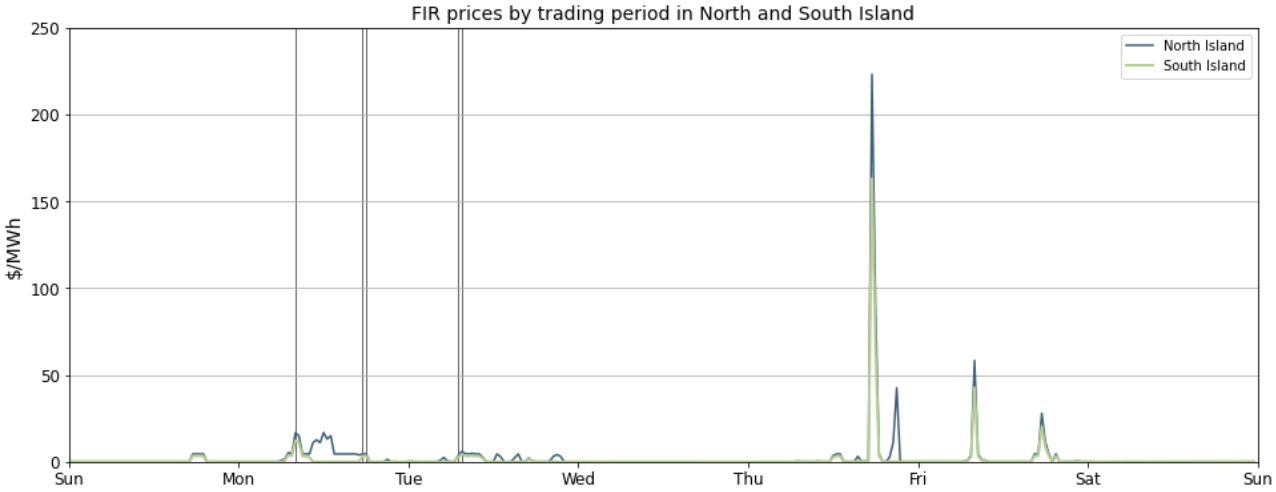
Figure 2b: Boxplots showing the volatility in spot prices this week compared to the previous nine weeks.



3. Reserve Prices

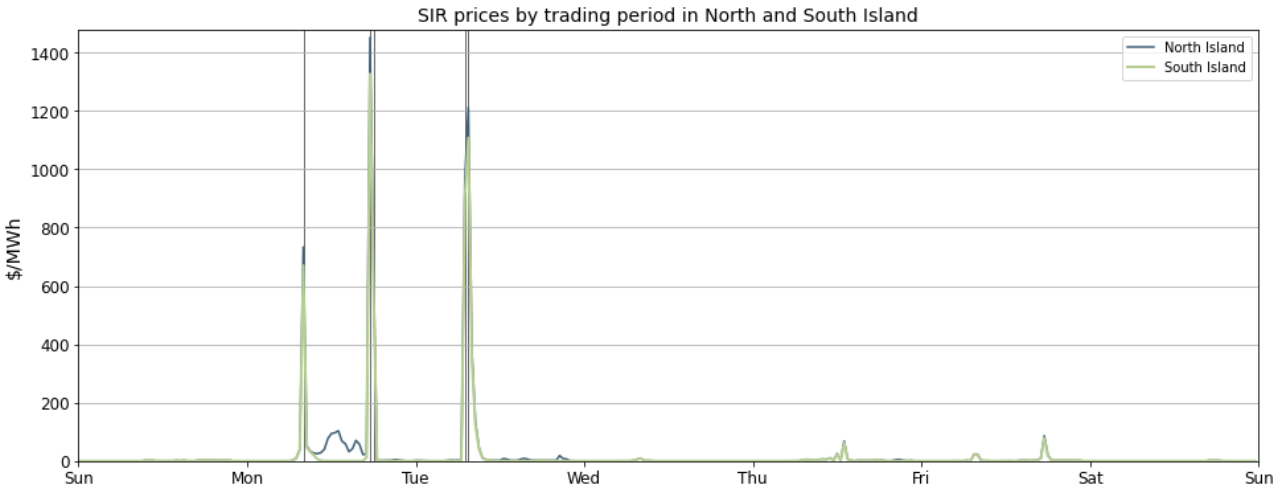
3.1. Fast instantaneous reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week the FIR prices were mostly below $20/MWh for both Islands with a significant price spike on Thursday, 18 May at 5:30 pm during the evening peak due to relatively low wind generation when North Island prices reached $223/MWh and South Island to $163/MWh.

Figure 3: 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, however, there were several significant price spikes on Monday and Tuesday. All price spikes coincided with high energy prices, indicating reserve shortfall. The highest reserve pricing occurred on Monday, 15 May at 5:30 pm with North Island SIR prices of $1,452/MWh and South Island SIR prices of $1,327/MWh.

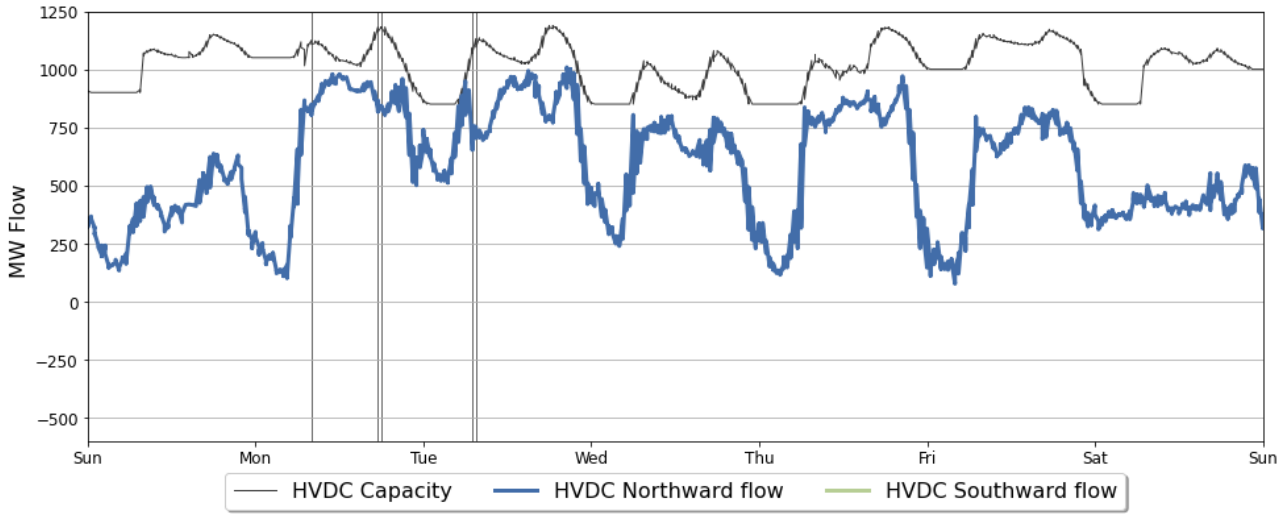
Figure 4: SIR prices by trading period and Island.



4. HVDC

4.1. Figure 5 shows HVDC flow between 14 – 20 May. HVDC flows were northward during both daytime and night-time, reaching up to 1000 MW during the daytime. Northward flows were particularly high on Monday and Tuesday when demand was high and wind generation was low. This week, no southward HVDC flow was observed.

Figure 5: HVDC northward flow and capacity.



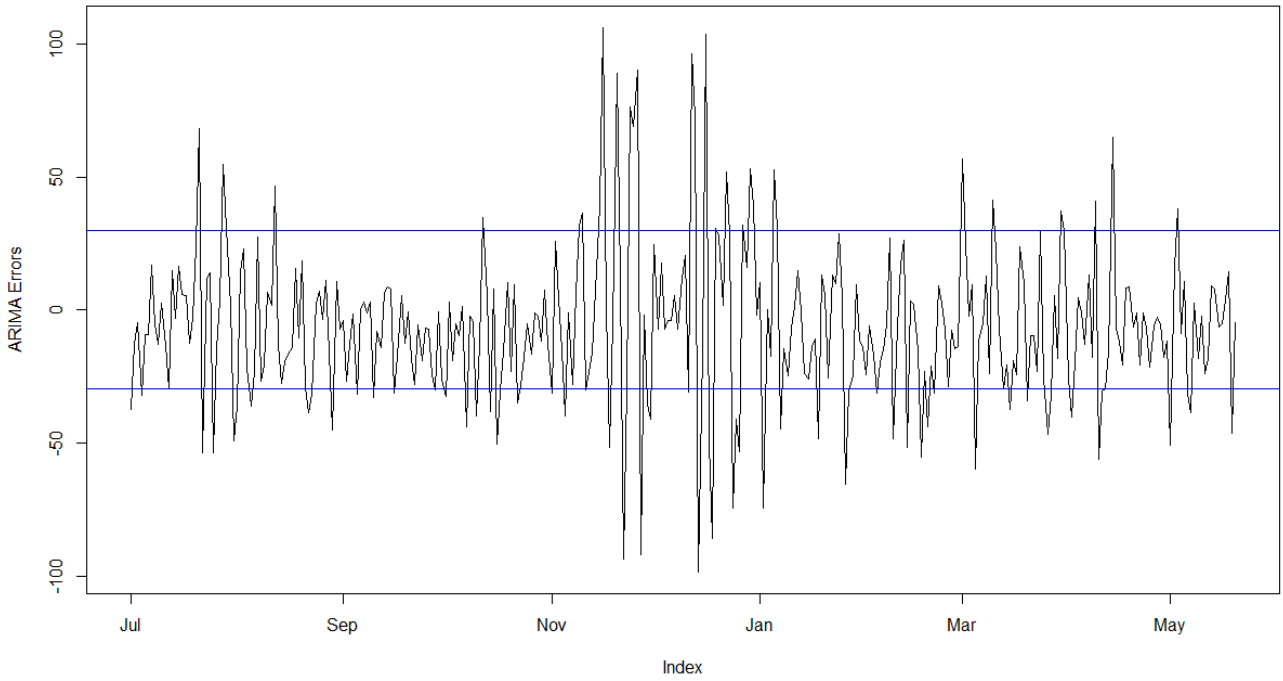
5. Regression Residuals

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[2] 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. Despite the price spikes this week, the only residual outside one standard deviation was for Friday when the modelled price was higher than the actual prices on that day.

[2] Appendix_A_Regression_analysis_V500y1B.pdf (ea.govt.nz)

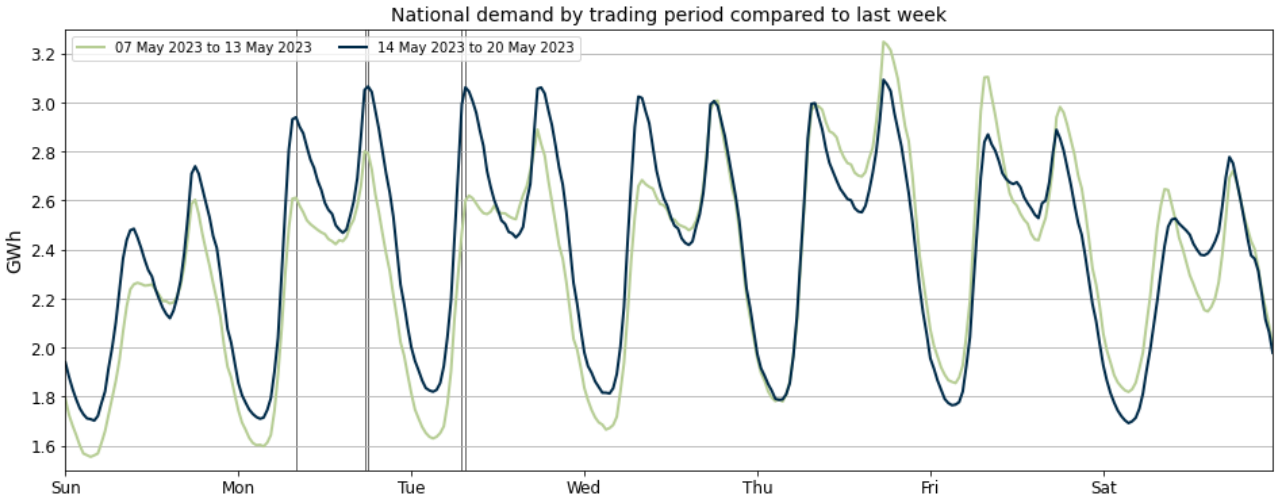
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 20 May 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 14 – 20 May, compared to the previous week. Overall, demand was higher this week compared to the previous week. The week began with significantly higher demand due to low temperatures. Peak demand was high for Monday and Tuesday aligning with the high spot prices. On Friday the demand decreased as temperatures shifted to above or close to mean historic temperatures.

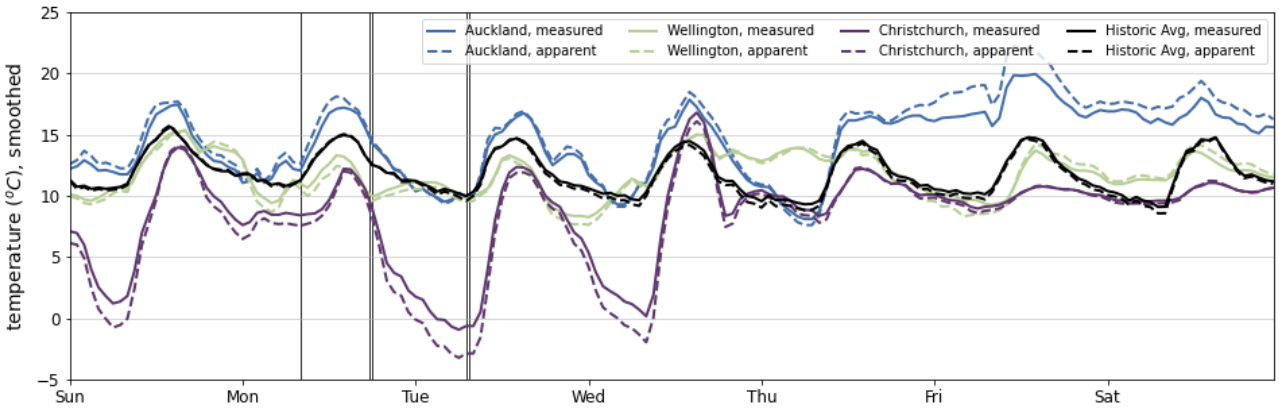
Figure 7: National demand by trading period compared to the previous week.



6.2. Figure 8 shows hourly temperatures at the three main population centres between 14 – 20 May. 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.

6.3. At the beginning of the week, temperatures in Auckland, and Wellington were above or close to the historic average, ranging from 10 to 20 degrees. Auckland temperature were above average from Thursday. However, Christchurch experienced the greatest variation, with apparent temperatures dropping to below zero degrees at the start of the week and hovering around the historic mean from Thursday onwards.

Figure 8: Temperatures across main centres.



7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 14 – 20 May ranged between ~1,100 – 1,500 MW.

7.2. Notable outages include:

(a) Huntly 1 is on outage until 31 May.

(b) Huntly 4 came back from outage on 15 May but again went back on short outage on Tuesday.

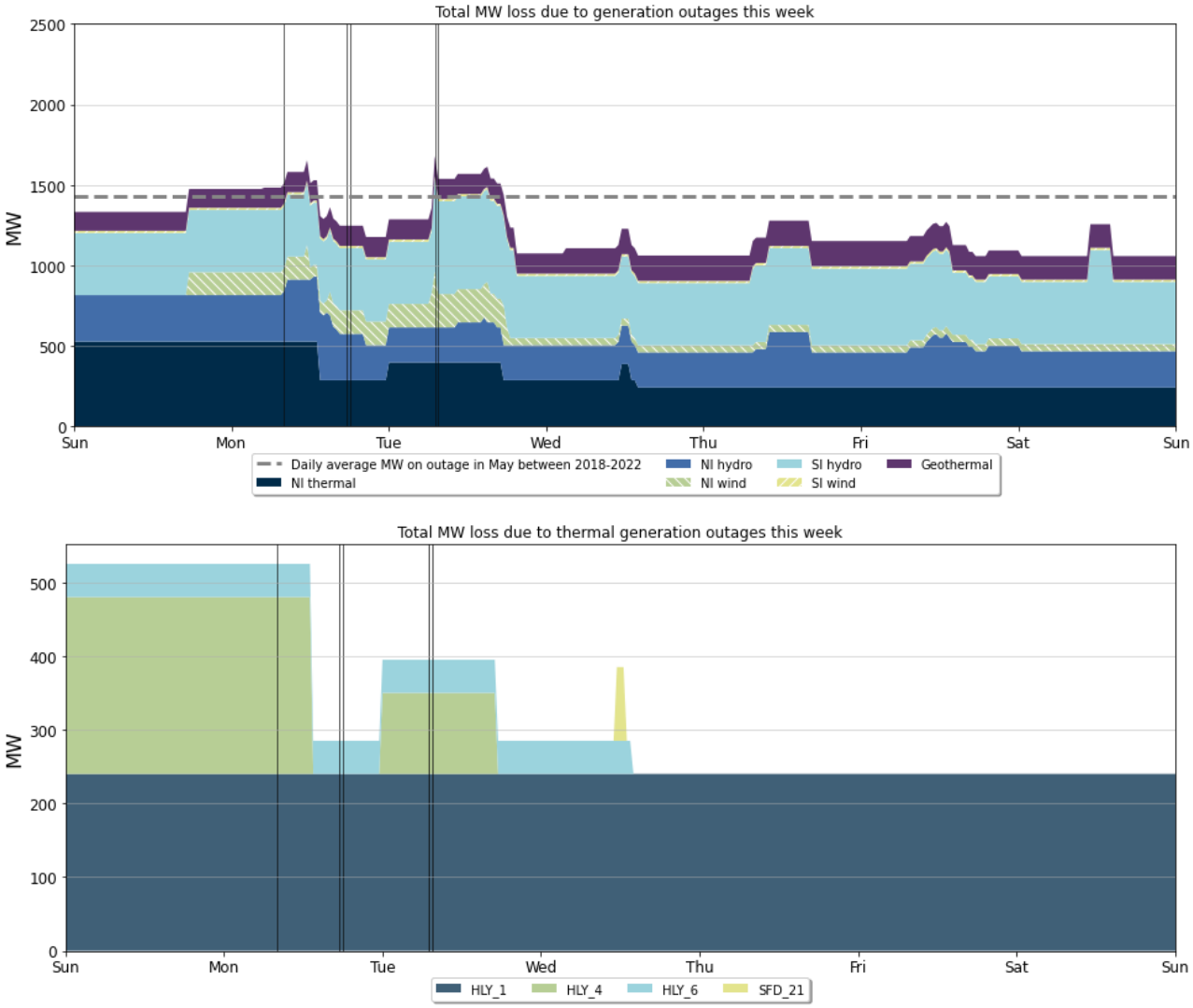
(c) Huntly 6 came back from outage on 19 May.

(d) The Geothermal plant Kawerau remains on outage until 7 June.

(e) West wind was on outage between 14-16 May and now a unit is on outage until 24 November.

(f) Various North and South Island hydro units were on outage this week.

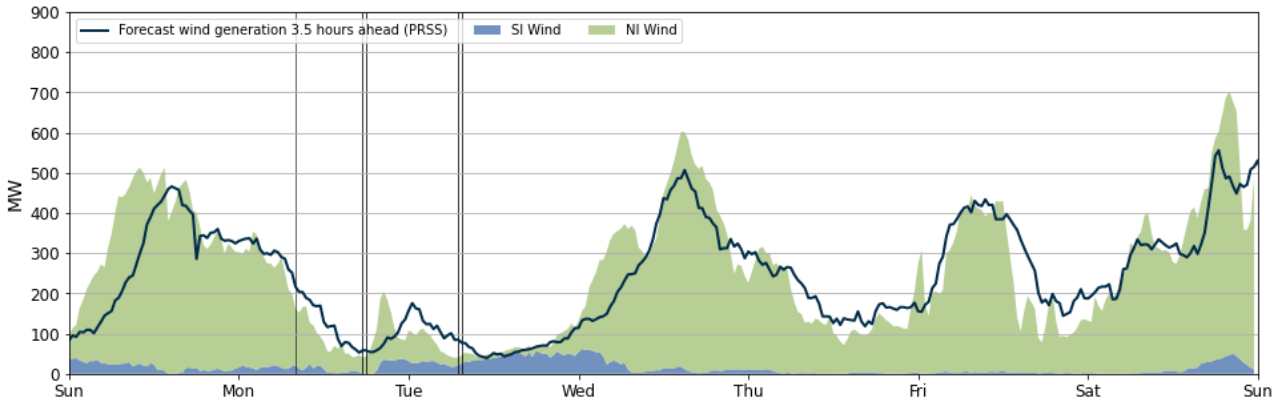
Figure 9: Total MW loss due to generation outages.



8. Generation

8.1. Wind generation, between 14 – 20 May, varied between 40-700 MW (Figure 10). Wind generation was around 500 MW at the start of the week and dropped to around 50 MW between Monday and Tuesday, West Wind farm was also on outage which also contributed to low generation. Subsequently, wind increased steadily, peaking at 600 MW on Wednesday. Wind again dropped on Thursday and was below forecast during the Thursday price fluctuations. Wind peaked on Saturday and reached up to 700 MW.

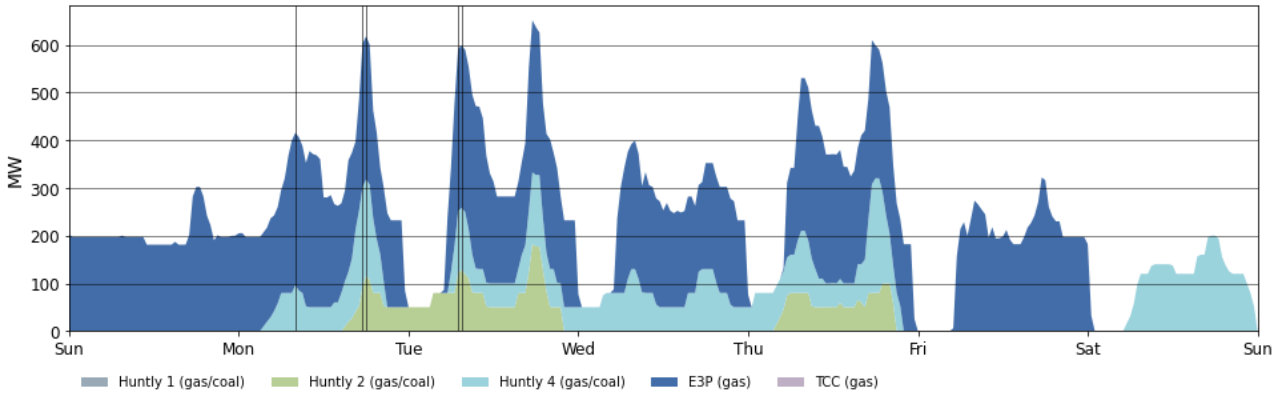
Figure 10: Wind Generation and forecast.

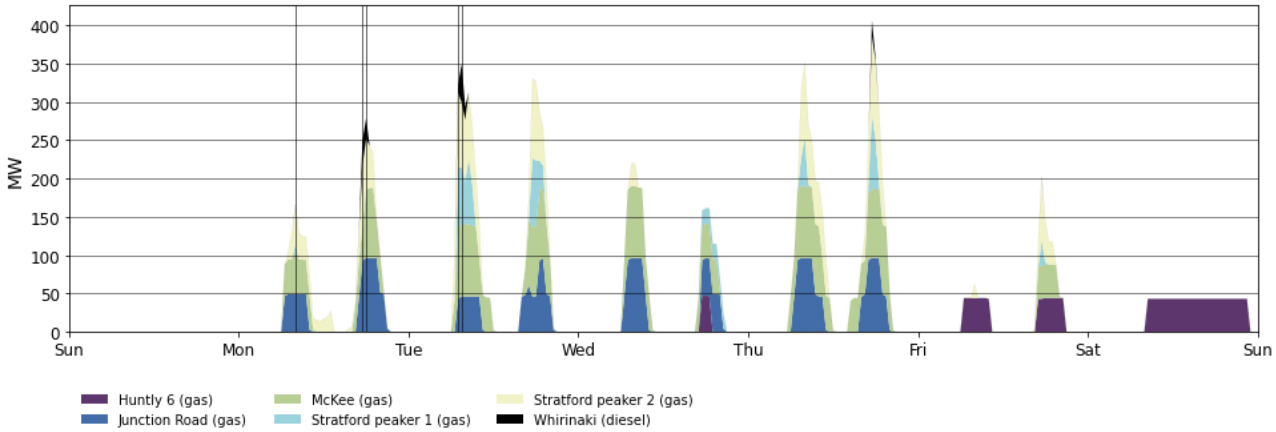


8.2. Figure 11 shows generation of thermal baseload and thermal peaker plants between 14 – 20 May. Thermal generation increased during the low wind generation and high peak demand times. E3P (Huntly 5) ran all week except on Saturday. Huntly 4 ran from Monday to Thursday, and on Saturday as well. However, Huntly 2 ran on Monday, Tuesday, and Thursday.

8.3. All peakers ran for the Tuesday peaks, except Huntly 6 as it was on outage. Junction Road, McKee, and Stratford peakers also ran from Monday to Thursday during the peak demand time. However, Huntly 6 ran during the Wednesday evening peal, and on Friday and Saturday.

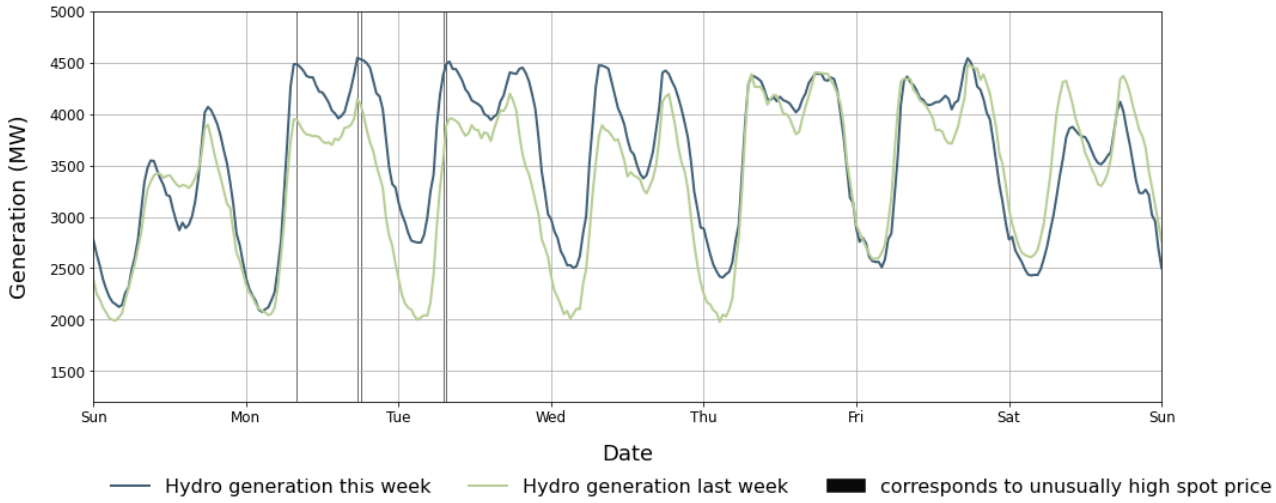
Figure 11: Thermal Generation.





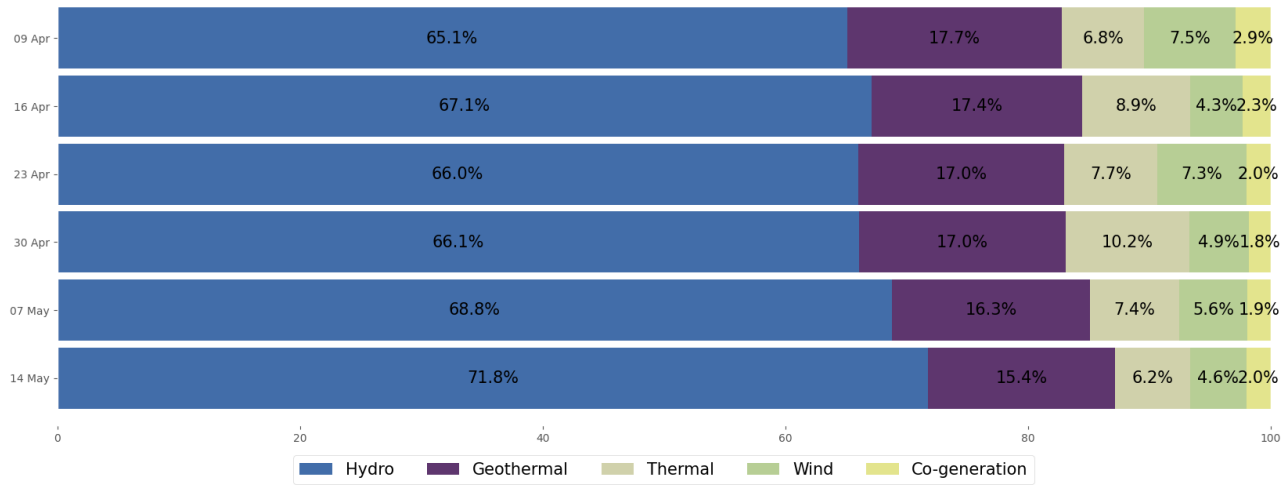
8.4. Figure 12 shows total hydro generation in MW produced each trading period, compared to the same time in the previous week. Hydro generation saw an overall increase compared to the previous week, primarily driven by higher demand. Additionally, the lakes levels increased from recent rainfall, leading to an increase in hydro generation.

Figure 12: Hydro generation between 14 – 20 May compared to the previous week.



8.5. As a percentage of total generation, between 14 – 20 May, total weekly hydro generation totalled 71.8 percent, geothermal 15.4 percent, thermal 6.2 percent, wind 4.6 percent, and co-generation 2 percent.

Figure 13: Total generation as a percentage each week between 2 April and 20 May 2023.



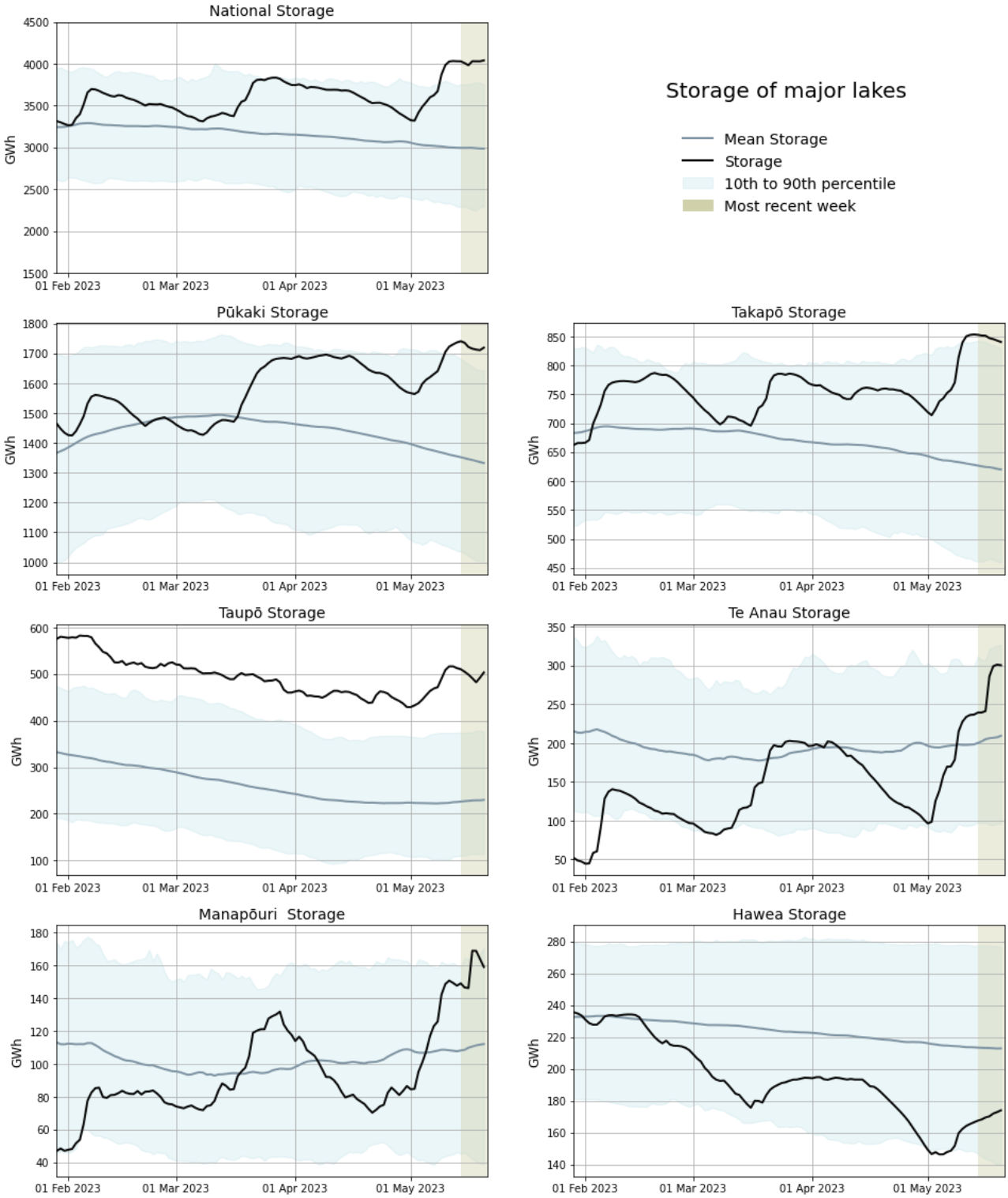
9. Storage/Fuel Supply

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. Overall, national hydro storage increased over the week and is well above its historic 90th percentile. Total national storage is around 96.4 percent of nominal full as of 20 May.

9.3. All lakes are showing a significant increase in storage levels. Storage at lakes Pūkaki, Takapō and Taupō are above their respective historic 90th percentile. Lake Pūkaki experienced some spilling this week. Lakes Te Anau and Manapōuri storage significantly increased and touched their respective historic 90th percentile. Lake Manapōuri is experiencing some spilling as well. Hawea storage also increased and is above its 10th percentile and well below its historic average.

Figure 14: Hydro Storage.

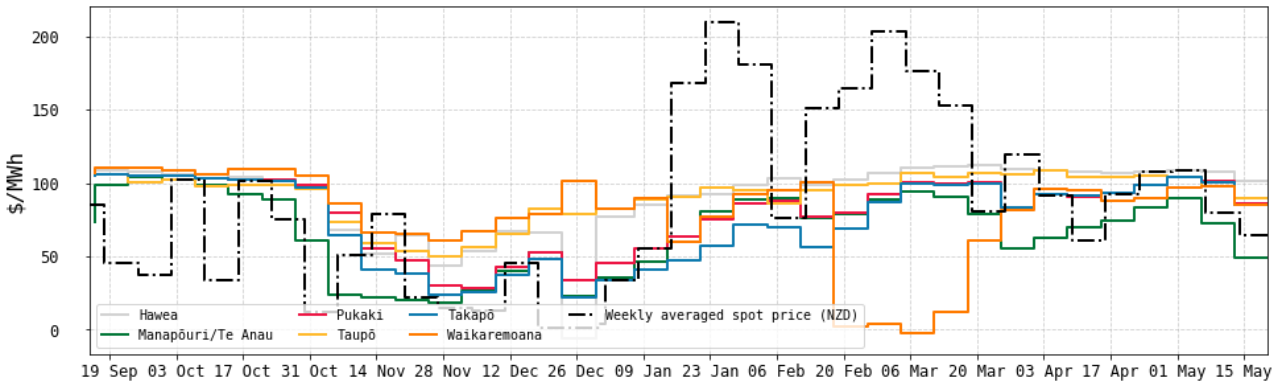


10. JADE Water Values

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 15 shows the national water values between 15 September 2022 and 20 May 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[4] on the trading conduct webpage.

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. Last week, there was a notable decrease in water values across all lakes, primarily attributed to a significant rise in storage levels. Specifically, the water values at Te Anau and Manapōuri experienced a drastic drop following the recent increase in storage. Note that the water value for Waikaremoana dropped to below zero during February and March when it was full and was only able to supply parts of Hawkes Bay.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 20 May 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 May 2023. The SRMC of diesel plants has significantly decreased, 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 April Indonesian coal stayed at around ~$450/tonne (NZD) putting the latest SRMC of coal-fuelled Huntly generation at ~$262/MWh.

11.5. The SRMC of Whirinaki has decreased to ~$542/MWh.

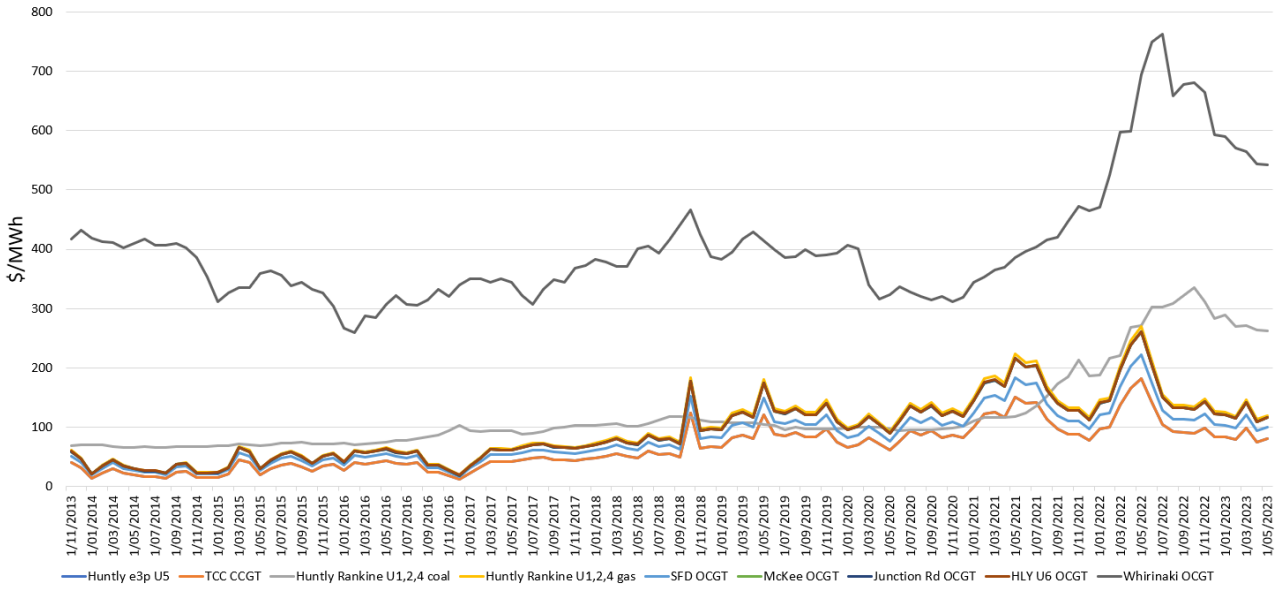
[3] JADE (Just Another DOASA Environment) is an implementation of the Stochastic Dual Dynamic Programming (SDDP) algorithm of Pereira and Pinto. JADE was developed by researchers at the Electric Power Optimisation Centre (EPOC) for the New Zealand electricity market.

[4] Appendix_B_JADE_water_value_model.pdf (ea.govt.nz)

11.6. The SRMC of gas run thermal plants decreased and is between $80/MWh and $120/MWh, likely due to a decrease in gas demand.

11.7. More information on how the SRMC of thermal plants is calculated can be found in Appendix C[5] on the trading conduct webpage.

Figure 16: Estimated monthly SRMC for thermal fuels.



12. Offer Behaviour

12.1. Figure 17 shows this week's national daily offer stacks. The black line shows cleared energy, indicating the range of the average final price.

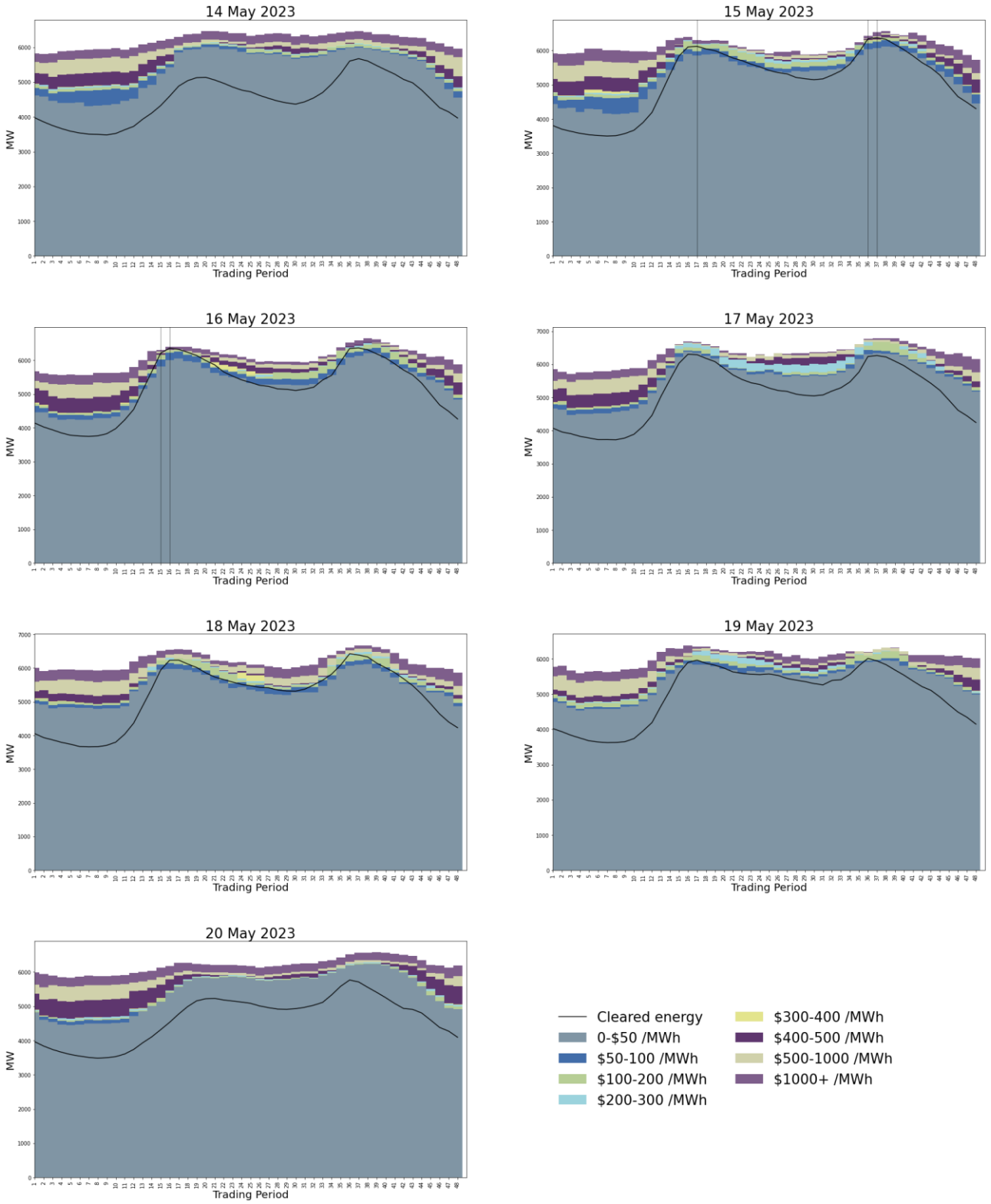
12.2. The majority of cleared energy on Sunday fell between $0 and $50/MWh due to low demand. However, during the peak demand on Monday and Tuesday, energy cleared at higher price band as well. On Wednesday cleared energy remained primarily within the $0-50/MWh price range due to high wind and high hydro generation.

12.3. On Thursday, during peak demand, the cleared energy prices ranged between $100-200/MWh due to high demand and low wind generation. During off-peak hours, the cleared energy prices were lower, ranging from $0-50/MWh. On Friday, with lower demand, the cleared energy prices remained in the lower range.

12.4. On Saturday, the price of cleared energy again dropped within the $0-50/MWh range due to lower demand.

[5] Appendix_C_Calculating_thermal_SRMC_o2b3l0j.pdf (ea.govt.nz)

Figure 17: Daily offer stacks.



13. Ongoing Work in Trading Conduct

13.1. This week, prices generally appeared to be consistent with supply and demand conditions. However, there appear to be offer changes which may have resulted in instances of higher prices at Benmore this week. These are being further looked into.

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