

Date: 15 May 2023



TRADING CONDUCT REPORT

Market Monitoring Weekly Report

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1. Overview for week of 7 – 13 May 2023

- 1.1. Price volatility was high this week with low off-peak prices due to increased hydro storage and generation, with significant price spikes occurring at peak times when additional thermal generation was needed to meet demand. Demand significantly increased from Wednesday due to a drop in temperatures. Transpower issued two low residual customer advice notices for the peak demand times of Thursday evening and Friday morning. On Tuesday, Thursday, and Friday prices breached the 90th percentile. On Tuesday the high prices were mainly due to high thermal outages and reserve deficit. During Thursday and Friday, high demand due to low temperatures, and low wind generation also contributed.

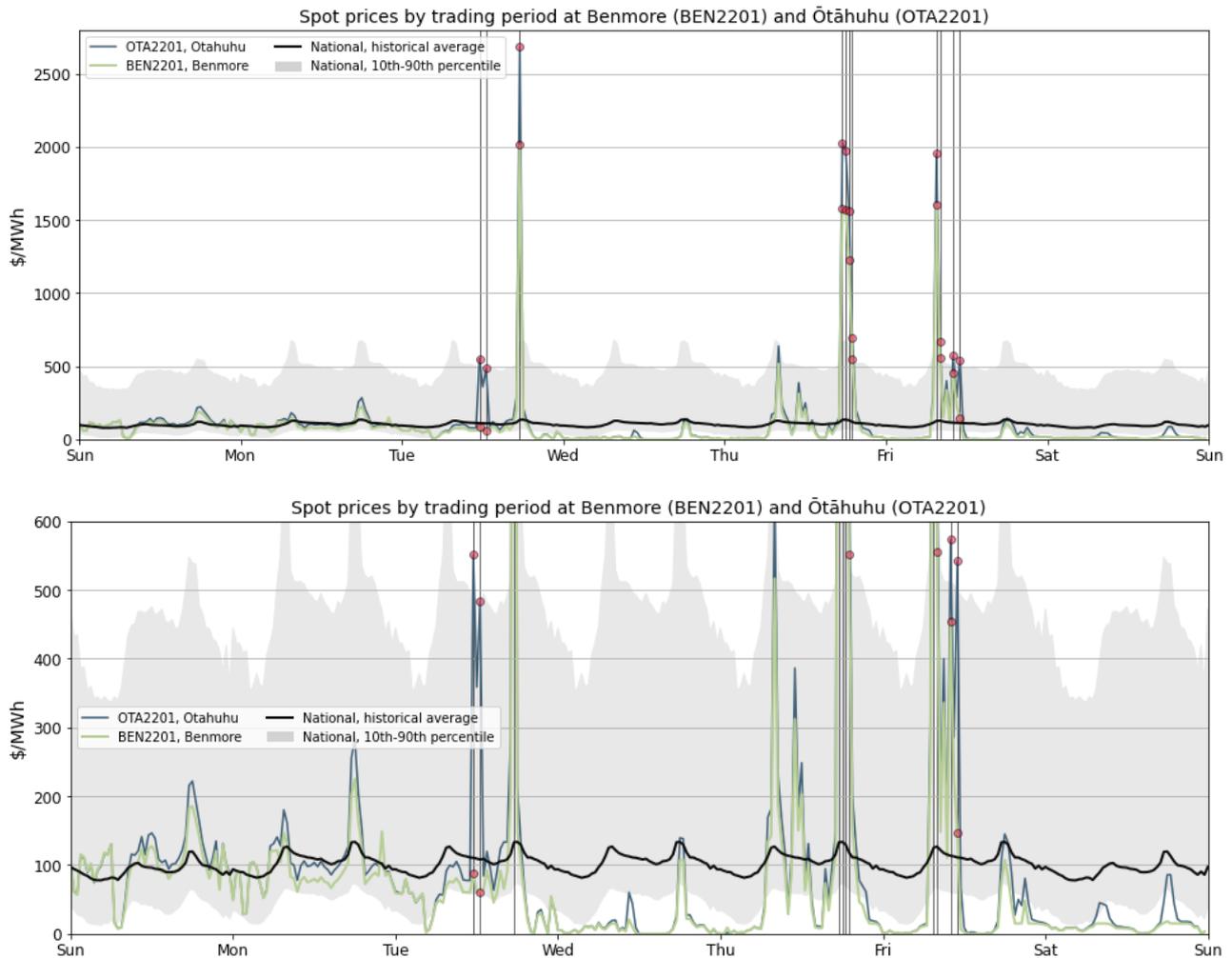
2. Spot Prices

- 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 7 – 13 May 2023:
 - (a) The average wholesale spot price across all nodes was \$95/MWh.
 - (b) 95 percent of prices fell between \$0/MWh and \$538/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. Most prices were below or around the historic average and fell below \$200/MWh, however, there were significant price spikes.
- 2.5. Prices were low at the start of the week. On Tuesday 9 May, there was a price separation during the day, with prices reaching \$551/MWh at Ōtāhuhu while prices at Benmore were \$88/MWh. Furthermore, on Tuesday during the peak demand time at 5:30 pm the power system was short of low-priced energy so run on reserve deficit. This gave us prices of \$2,684/MWh at Ōtāhuhu and \$2,012 at Benmore with SIR prices of \$2,016/MWh for the North Island and \$1,842 for the South Island. At that time Whirinaki and McKee were both constrained on by the system operator's discretion. The residual was also low for the period, reached to 91.3 MW at 5:50 pm. This might be due to high thermal outages (Huntly 1,2,4,6, and TCC were on outage).
- 2.6. From Wednesday onwards there were low prices outside peak times due to high hydro storage, with spilling likely started at Pūkaki on Friday. During Wednesday and Saturday, prices were below the 10th percentile for most of the day.
- 2.7. Transpower issued two Customer Advice Notices (CAN) for low residuals as below.
 - (a) Thursday, 11 May 2023 from 5:30-7:30 pm.
 - (b) Friday, 12 May 2023 from 7:30-8:30 am.
- 2.8. On Thursday at 5:30 pm the residual was forecast to drop below 200 MW due to the cold snap spreading across the country. Wind was extremely variable with a considerable difference between the forecasted and actual wind. Whirinaki started up just after 5:30 pm

and had two of the three units running. This resulted in significant spot price spikes. The spot price reached up to \$2,028/MWh at Ōtāhuhu and \$1,580/MWh at Benmore.

- 2.9. On Friday during the morning (7:30 am) peak, the combination of high demand, low wind generation, and low residuals resulted in prices at Ōtāhuhu peaking at \$1,953/MWh and reaching \$1,608/MWh at Benmore. The reserve prices reached \$2,142/MWh at Haywards during some 5-minute periods, and Huntly 4 was dispatched in its \$1,100/MWh energy offer tranche.

Figure 1: Wholesale Spot Prices between 7 May (Sunday) – 13 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

¹ [Quartile - Wikipedia](#)

were lower than prices in late February and early March, due to increased hydro generation as lake levels have recovered.

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

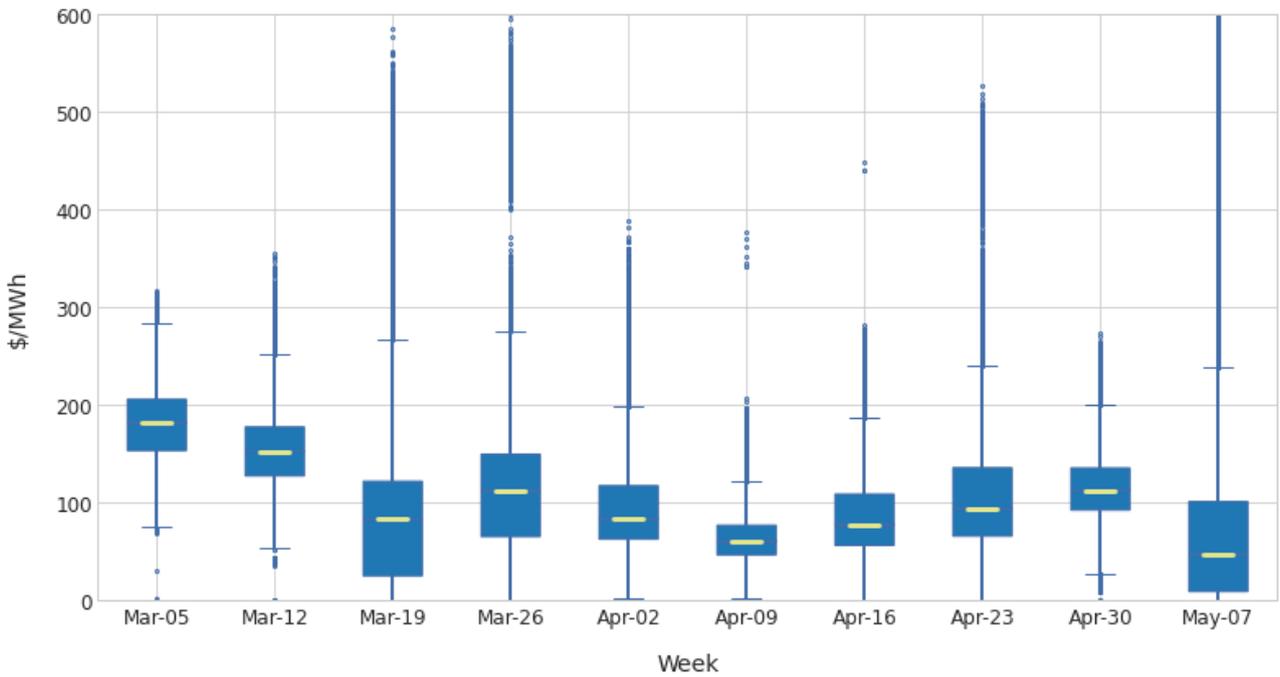
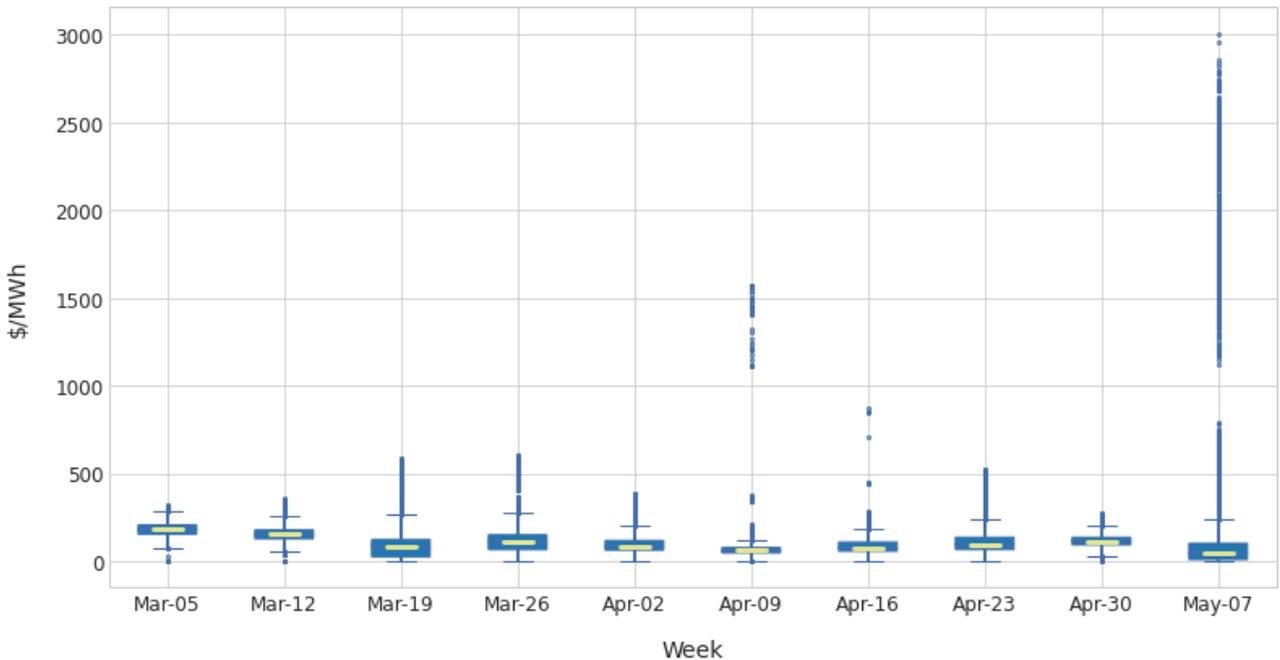


Figure 2b: Boxplots showing the volatility in spot prices this week compared to the previous nine weeks.

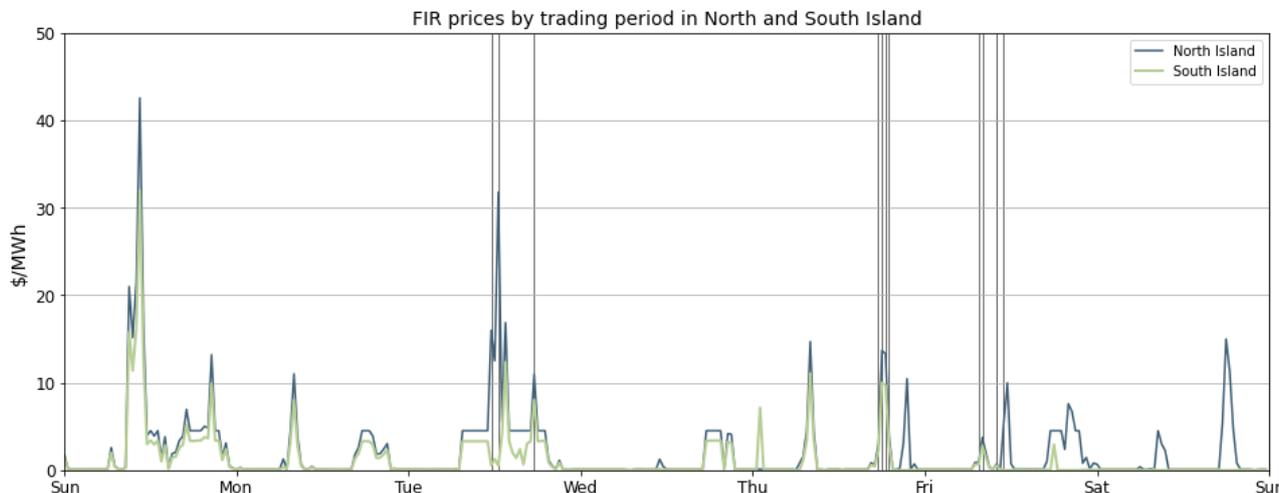


3. Reserve Prices

- 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 two price spikes above \$20/MWh. The first FIR price spike occurred on Sunday, 7 May at 10:30 when North Island prices reached \$42/MWh and South Island to \$32/MWh. Second on

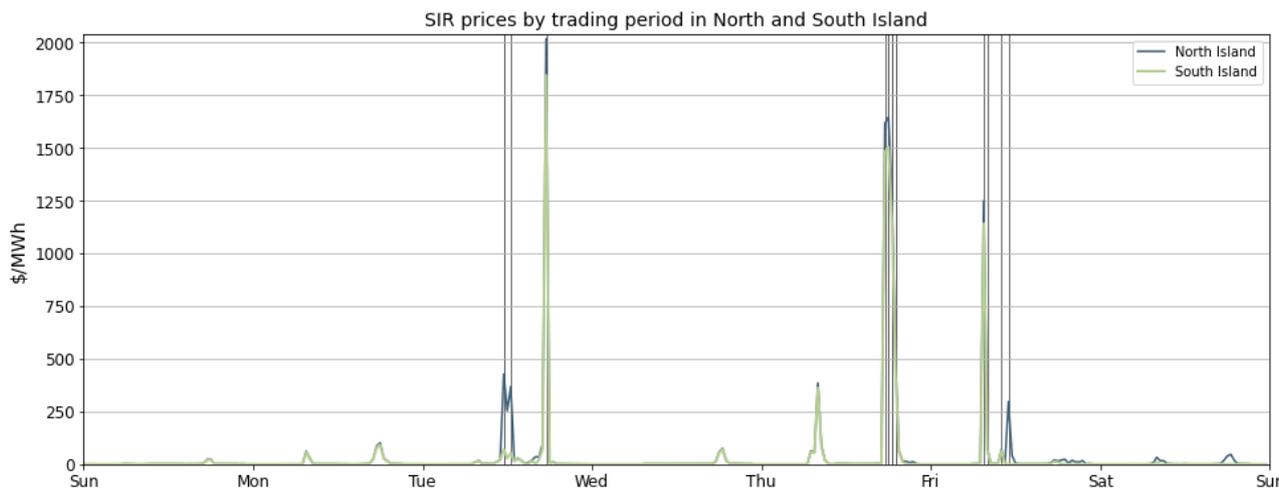
Tuesday, 9 May at 12:30 pm when North Island prices went to \$32/MWh while South Island price was at \$0.5/MWh.

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, the highest of which was a North Island SIR prices of \$2016/MWh on Tuesday which coincided with high energy prices. The high SIR prices on Thursday and Friday coincided with the CAN notice period for low residual situations. The 5-minute real time price for SIR reached \$3000/MWh on both Tuesday and Thursday, indicating reserve shortfall. This is the first time reserve scarcity pricing has occurred since the introduction of real time pricing.

Figure 4: SIR prices by trading period and Island.

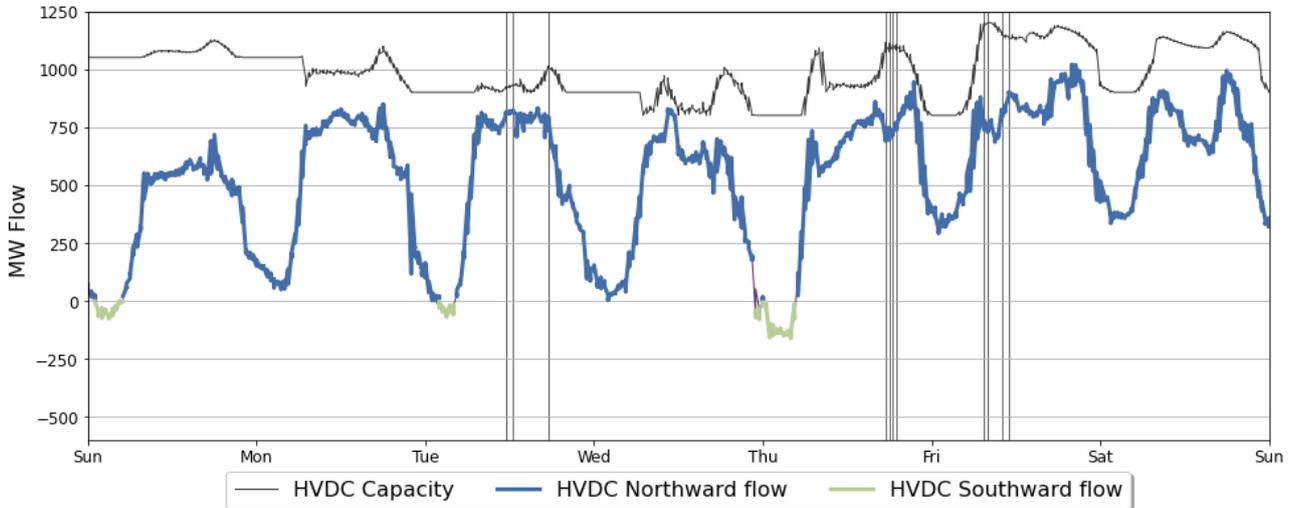


4. HVDC

4.1. Figure 5 shows HVDC flow between 7–13 May. HVDC flows were mostly northward during both daytime and night-time, reaching up to 940 MW during the daytime. Northward flows

were particularly high from Thursday when wind generation was low. On Thursday afternoon and Friday morning, the flow was reaching capacity. There was some small HVDC flow southward overnight on Sunday, Tuesday, and Thursday.

Figure 5: HVDC northward flow and capacity.

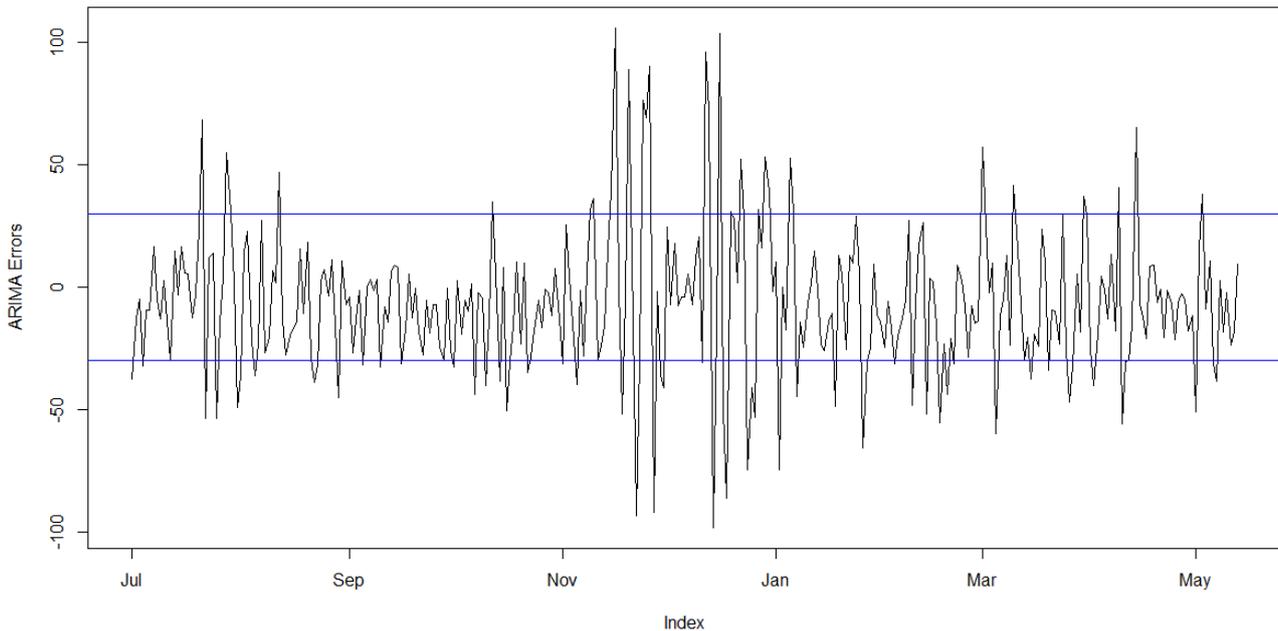


5. Regression Residuals

- 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 A² 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 prices on those dates appear to be largely aligned with market conditions. Despite the price spikes this week, there were no residuals above or below the one standard deviation of the data as the daily average prices were relatively low.

² <https://www.ea.govt.nz/assets/dms-assets/29/Appendix-A-Regression-Analysis.pdf>

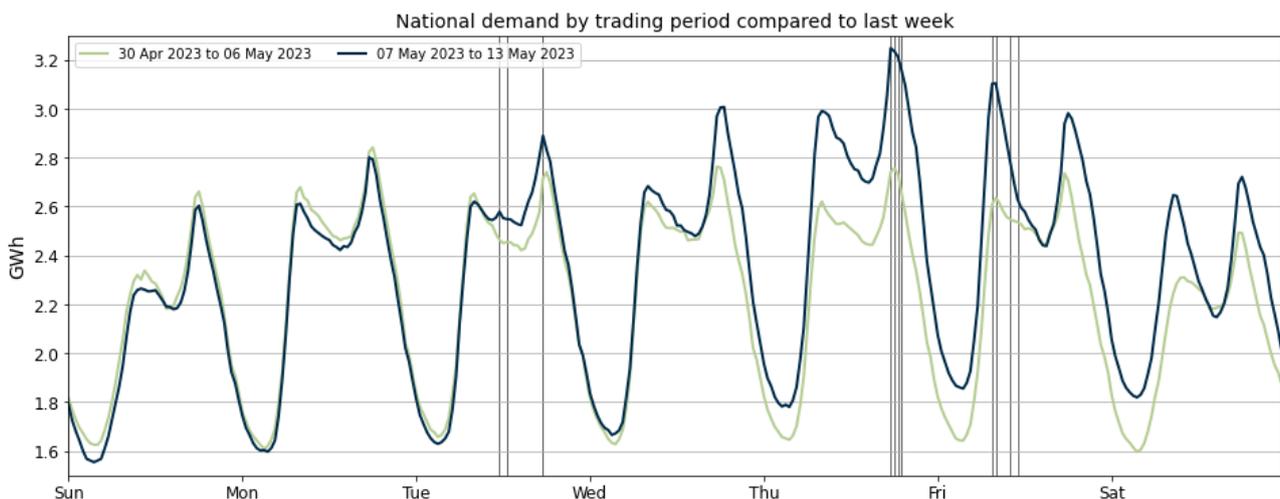
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 13 May 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

- 6.1. Figure 7 shows national grid demand between 7 – 13 May, compared to the previous week. Overall, demand was higher this week compared to the previous week. The week began with similar demand, but it started increasing from Tuesday evening. Additionally, lower temperatures on Thursday and Friday led to a significant increase in demand.

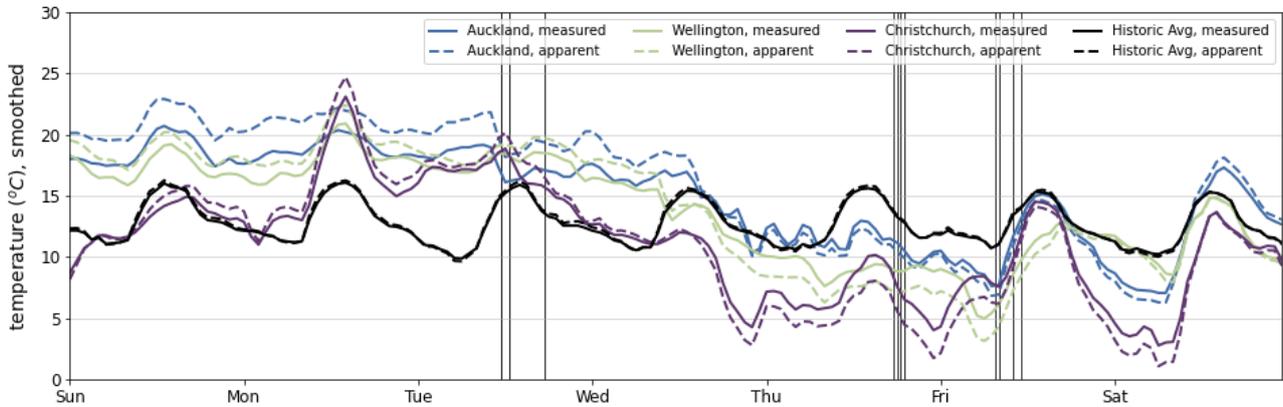
Figure 7: National demand by trading period compared to the previous week.



- 6.2. Figure 8 shows hourly temperatures at the three main population centres between 7 – 13 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 all three main centres were generally above or around the historic average, ranging from 12 to 25 degrees. However, temperatures

began to decrease from Wednesday and remained mostly below the historic average. Christchurch experienced the greatest variation, with apparent temperatures dropping to around 1 degree.

Figure 8: Temperatures across main centres.



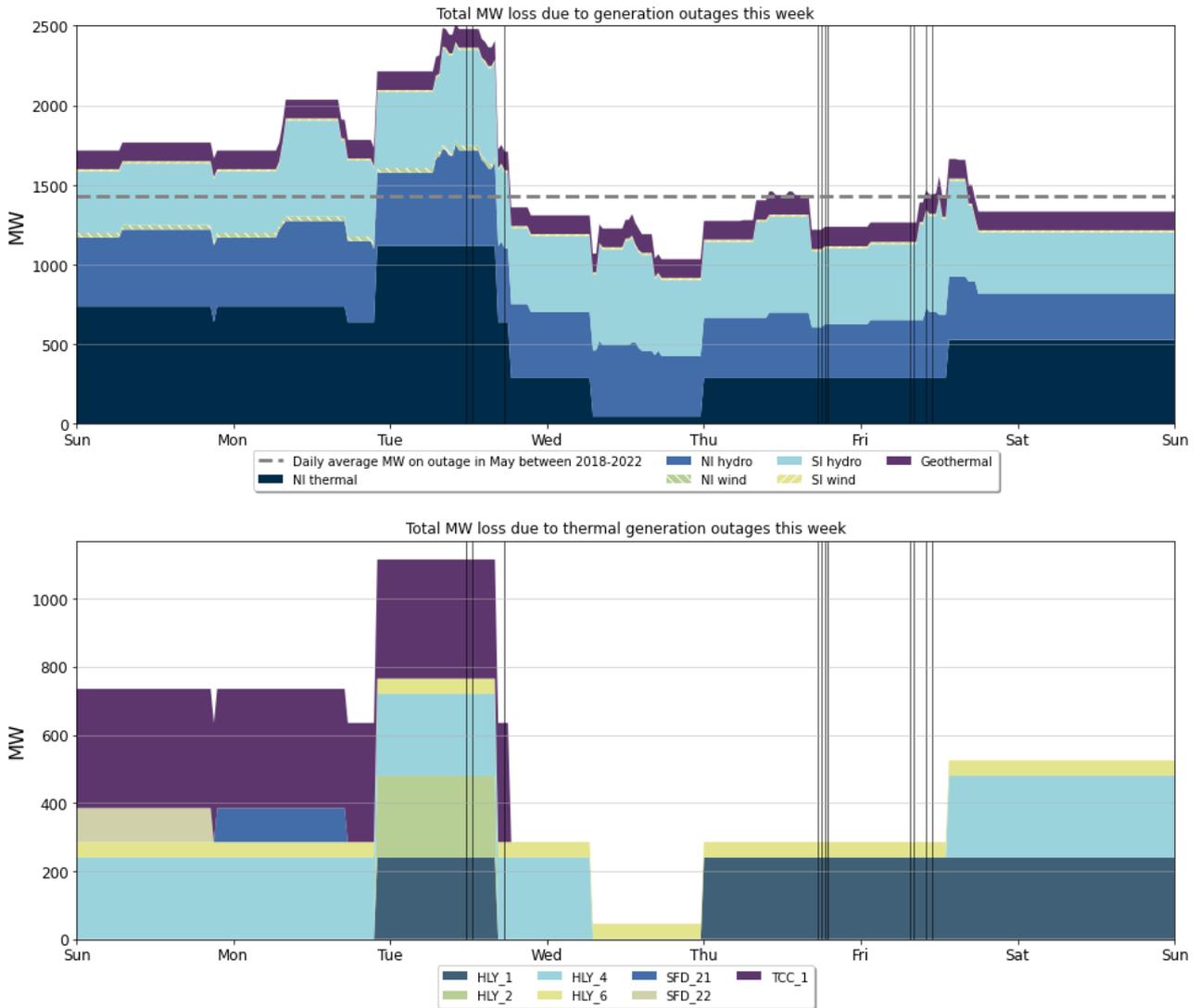
7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 7 – 13 May ranged between ~1,000 – 2,500 MW. At the start of the week, generation capacity on outages was above the average outage capacity due to TCC outage. Outages were highest on Tuesday when they reached 2500MW when several Huntly units went on outage.

7.2. Notable outages include:

- (a) Huntly 1 was on outage on 9 May and on outage from 11-31 May.
- (b) Huntly 2 was on outage on Tuesday, 9 May.
- (c) Huntly 4 came back from outage on 10 May but again went back on outage from 12-15 May.
- (d) Huntly 6 is on outage until 19 May.
- (e) TCC returned from outage on 9 May.
- (f) The Geothermal plant Kawerau remains on outage until 7 June.
- (g) Various North and South Island hydro units were on outage this week.

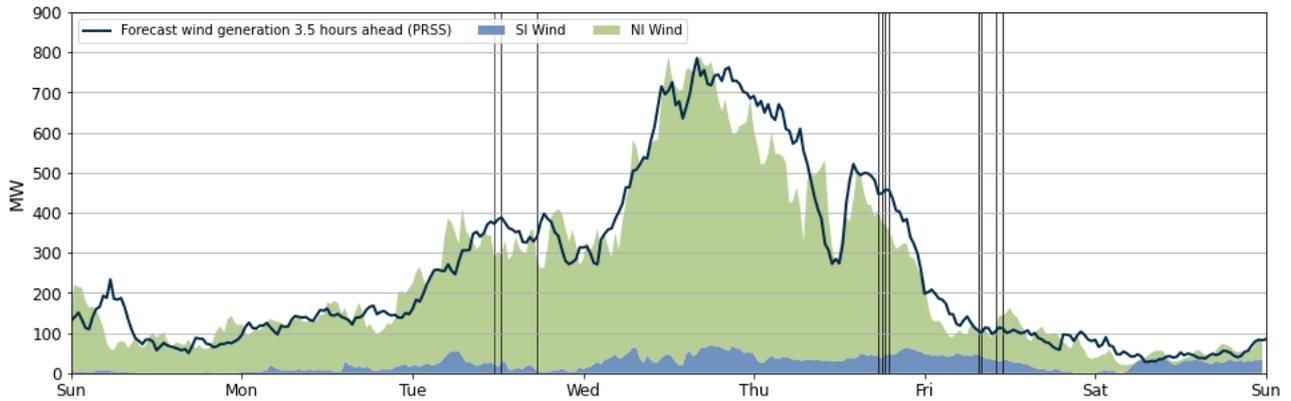
Figure 9: Total MW loss due to generation outages.



8. Generation

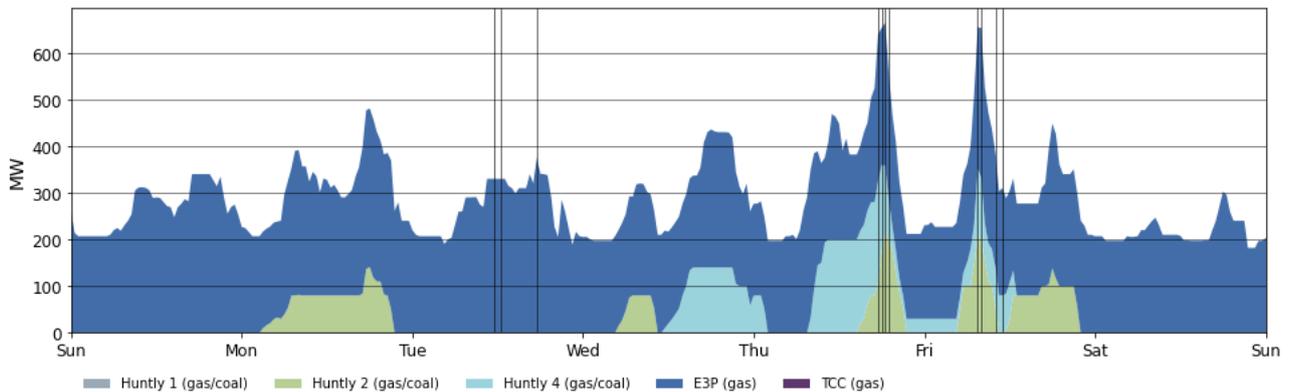
- 8.1. Wind generation, between 7 – 13 May, varied between 20-790 MW (Figure 10). Wind generation was relatively low at the start of the week, below 200 MW but increased steadily, peaking at 790 MW on Wednesday. Wind dropped significantly on Thursday and was below forecast during the evening price spike. Wind was very low on Friday and Saturday, with generation below 150 MW during price spikes on Friday.

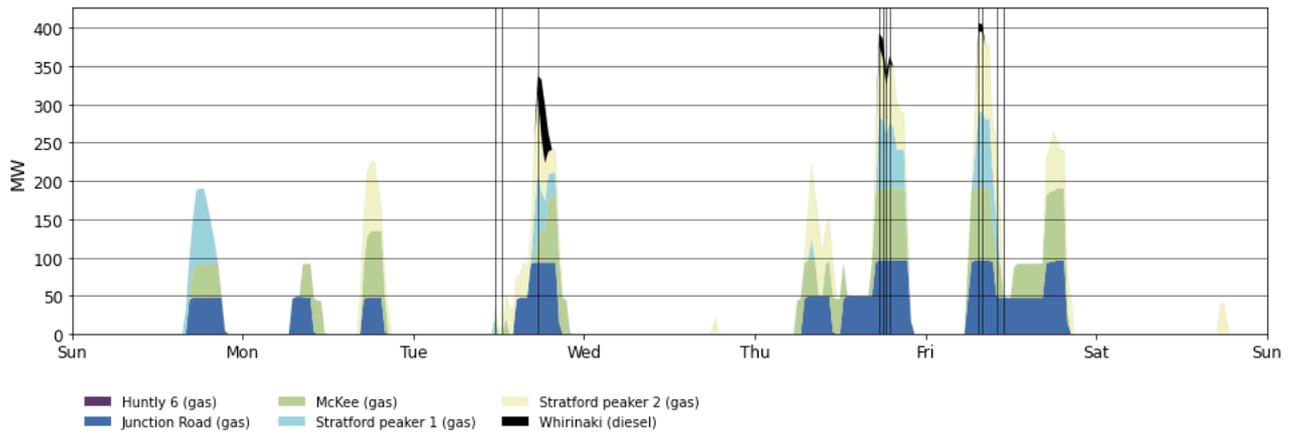
Figure 10: Wind Generation and forecast.



- 8.2. Figure 11 shows generation of thermal baseload and thermal peaker plants between 7 – 13 May. Thermal generation increased during the low wind generation and high peak demand times. E3P (Huntly 5) ran all week as baseload. Huntly 2 and Huntly 4 ran from Wednesday to Friday, with Huntly 2 additionally ran on Monday as well. Huntly 4 was on outage during those days when it wasn't running. However, Huntly 1, 2 and 4 all were on outage on Tuesday.
- 8.3. TCC, a slow start baseload thermal unit, returned from outage on the evening of 9 May. However, TCC has not been restarted, likely because spot prices have typically been below \$100/MWh. As a result, the market was dependent on thermal peakers to meet peak demand this week.
- 8.4. All peakers ran for the Tuesday, Thursday and Friday peaks, except Huntly 6 as it was on outage. Junction Road, McKee, and Stratford peakers also ran on Sunday and Monday. However, peakers ran with some constraints as per the system operator's discretion.

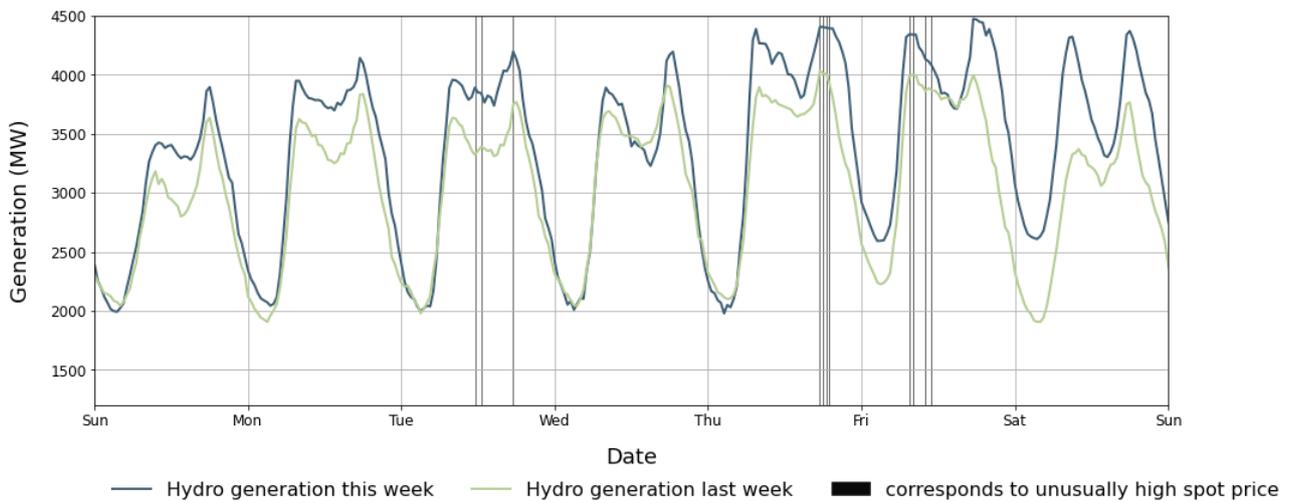
Figure 11: Thermal Generation.





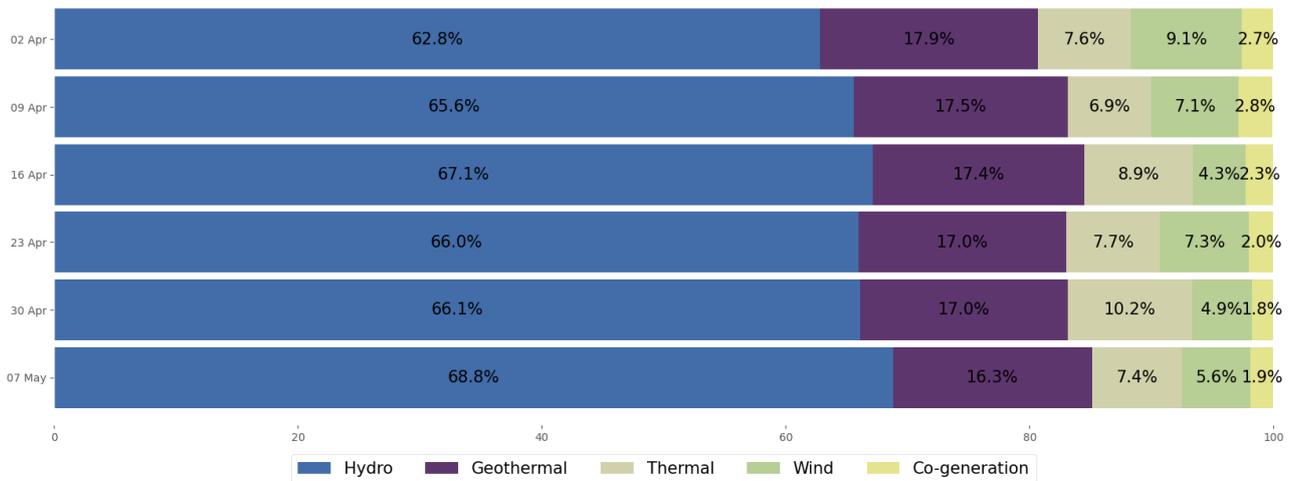
8.5. Figure 12 shows total hydro generation in MW produced each trading period, compared to the same time in the previous week. Hydro generation saw an overall increase compared to the previous week, primarily driven by higher demand. Additionally, the lakes levels increased from recent rainfall, leading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

Figure 12: Hydro generation between 7 – 13 May compared to the previous week.



8.6. As a percentage of total generation, between 7 – 13 May, total weekly hydro generation totalled 68.8 percent, geothermal 16.3 percent, thermal 7.4 percent, wind 5.6 percent, and co-generation 1.9 percent.

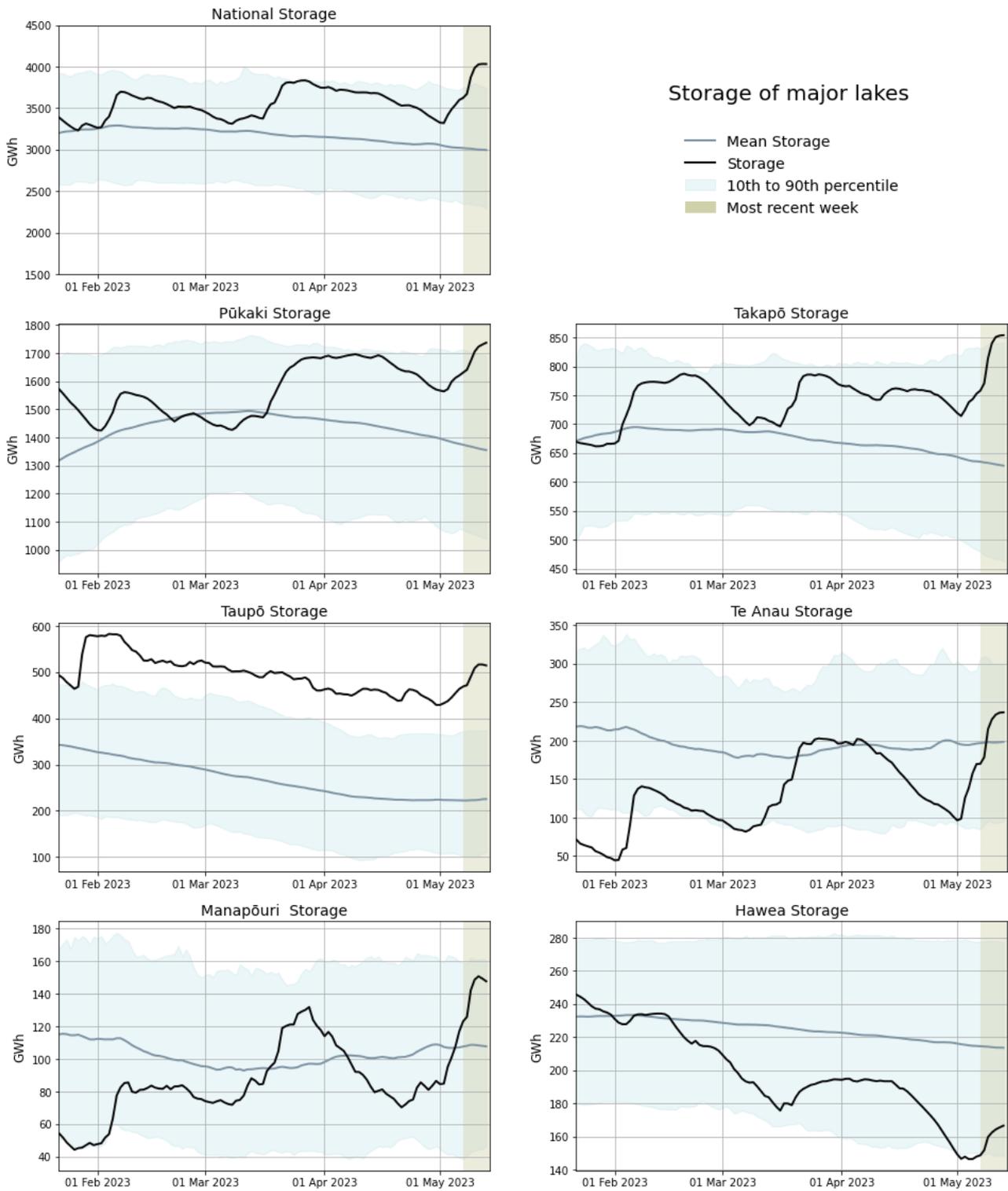
Figure 13: Total generation as a percentage each week between 2 April and 13 May 2023.



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 about to reach its historic 90th percentile. Total national storage is around 95.6 percent of nominal full as of 13 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. There may be a high risk of spilling at Pūkaki in the coming weeks. Lakes Te Anau and Manapōuri storage significantly increased with both above their historic average. Hawea storage also increased and is above its 10th percentile.

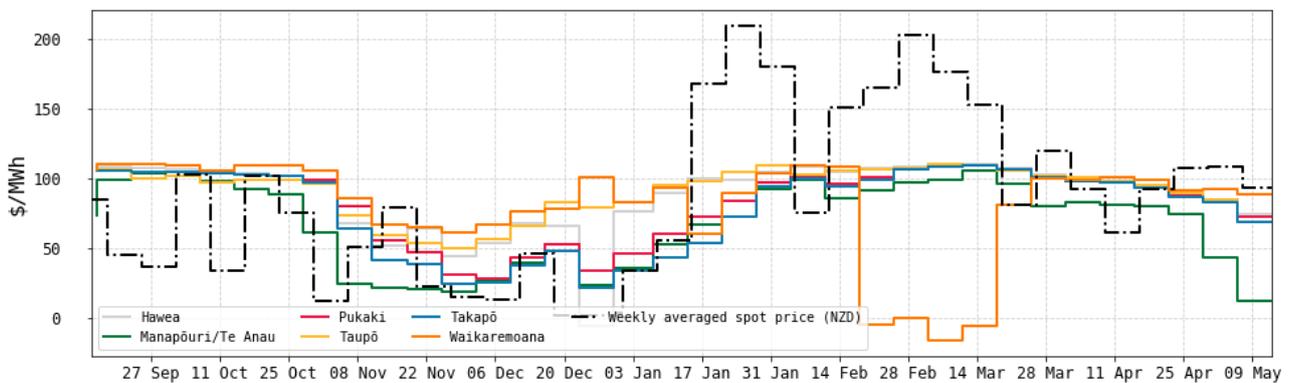
Figure 14: Hydro Storage.



10. JADE Water Values

- 10.1. The JADE³ 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 13 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 B⁴ 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 13 May 2023.



11. Prices versus estimated costs

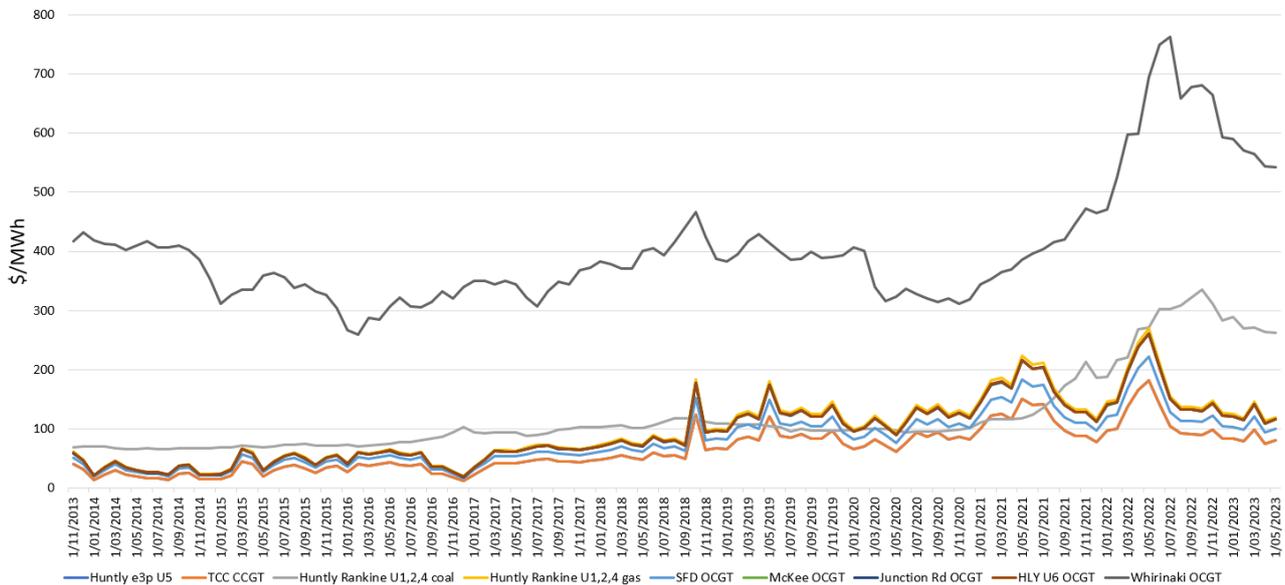
- 11.1. In a competitive market, prices should be close to (but not necessarily at) the short run marginal cost (SRMC) of the marginal generator (where SRMC includes opportunity cost).
- 11.2. The SRMC (excluding opportunity cost of storage) for thermal fuels is estimated using gas and coal prices, and 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 <https://www.ea.govt.nz/assets/dms-assets/29/Appendix-B-JADE-water-value-model.pdf>

- 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 C⁵ on the trading conduct webpage.

Figure 16: Estimated monthly SRMC for thermal fuels.

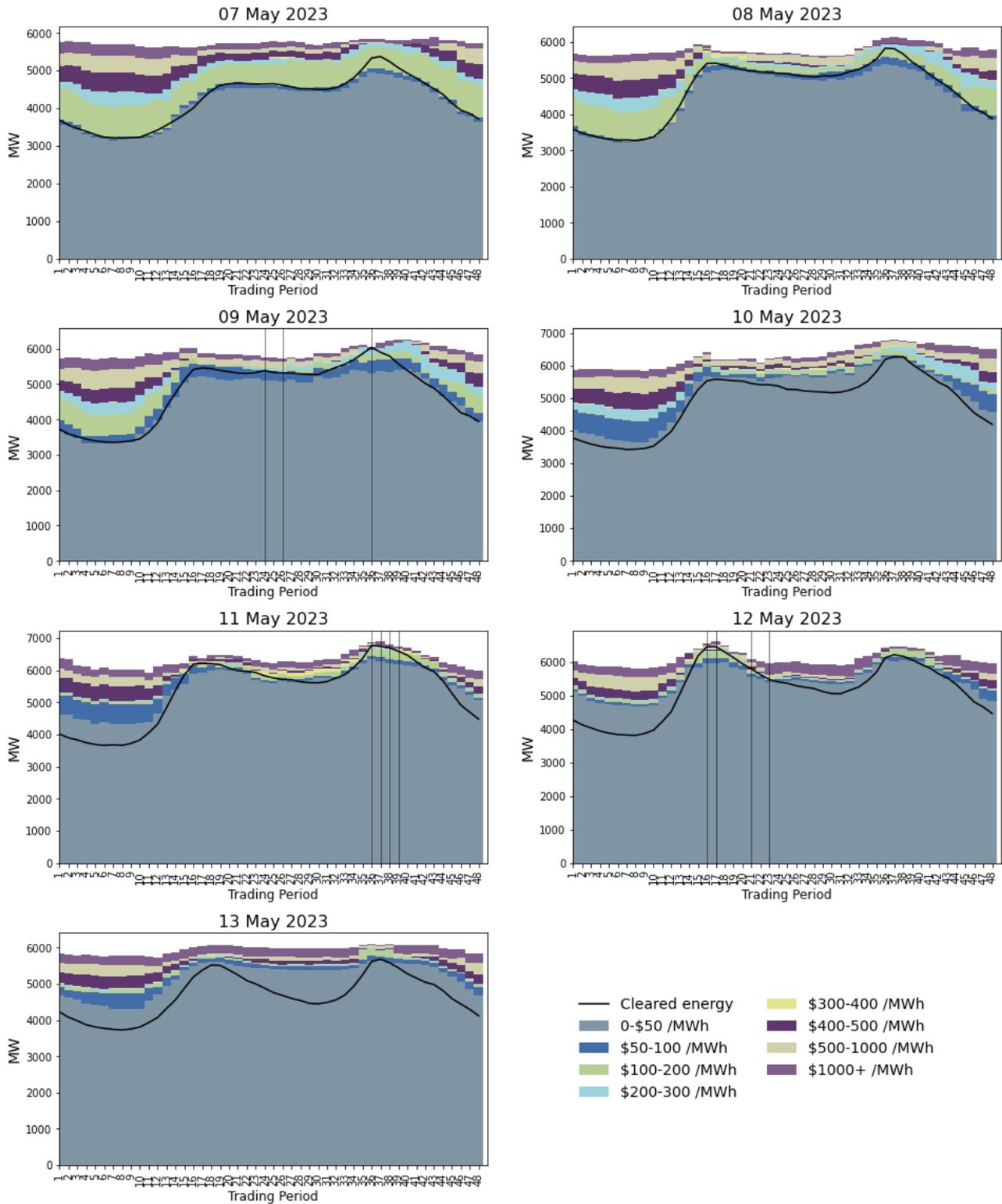


12. Offer Behaviour

- 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 and Monday fell between \$0 and \$200/MWh. However, during the peak demand on Tuesday evening, energy cleared at higher price band as well.
- 12.3. On Wednesday cleared energy remained primarily within the \$0-50/MWh price range due to high wind and high hydro generation.
- 12.4. Thursday afternoon and Friday morning saw a significant increase in the cleared energy due to considerably high demand and low wind generation.
- 12.5. On Saturday, the price of cleared energy once again dropped within the range of \$0-50/MWh due to lower demand.

⁵ <https://www.ea.govt.nz/assets/dms-assets/30/Appendix-C-Calculating-thermal-SRMCs.pdf>

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, are offer changes at Huntly 4 which we are analysing further. Additionally, we are

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
12/05/2023	16-17	Further Analysis	Contact	Roxburgh	High energy prices associated with hydro offers.