Date: 1 May 2023

TRADING CONDUCT REPORT

Market Monitoring Weekly Report

TRADING CONDUCT REPORT

1. Overview for week of 23 – 29 April 2023

1.1. Demand relatively increased due to the low temperatures and ending of school holidays. Price separation on Wednesday in the energy and reserve markets was likely due to high northward HVDC transfer and reduced HVDC capacity due to transmission outages. Low wind generation on Thursday contributed to higher thermal generation and a price spike. However, there was sufficient generation available in both islands.

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. Note that this week, prices above the historic 90th percentile are highlighted with a translucent green line. Other notable prices, but which did not breach the 90th percentile, are marked in black dashed lines (if any).

2.2. Between 23 – 29 April 2023:

(a) The average wholesale spot price across all nodes was $97/MWh.

(b) 95 percent of prices fell between $2/MWh and $236/MWh.

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

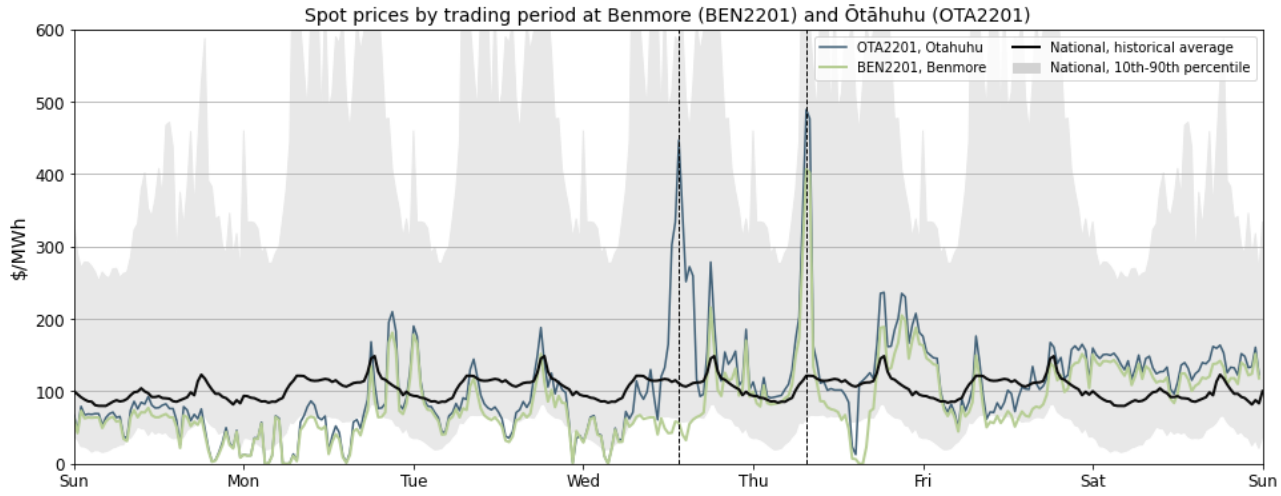
2.4. Overall, the prices were below or around the historic average and mostly fell below $200/MWh. Prices remained well below the historic 90th percentile, with some prices dropping below the historic 10th percentile at Benmore.

2.5. The week's highest price occurred on Thursday, 27 April at 7:30 (black dashed line) and 8:00 am when the price at Ōtāhuhu was around $488/MWh and the price at Benmore was $400/MWh. At that time the forecasted demand was much lower than the actual demand due to low temperatures in the South Island. There was also low wind generation and peakers were ramped up to cover the high morning demand peak.

2.6. Price separation between Benmore and Ōtāhuhu was observed on Wednesday, 26 April, due to transmission outages in the lower North Island which lowered the northward HVDC capacity, and hence reserve sharing. The largest instance of price separation occurred on Wednesday at 1:30 pm (black dashed line) when the price at Ōtāhuhu reached $447/MWh and at the same time the Benmore price was $57/MWh. These occurred when the northward transfer across the HVDC reached the lowered transfer limit. This caused prices to separate as cheaper South Island capacity was unable to be used to meet North Island demand for both electricity and reserve.

2.7. Note, there were also some offer changes which may have resulted in instances of higher prices at Benmore this week. The monitoring team is analysing this further.

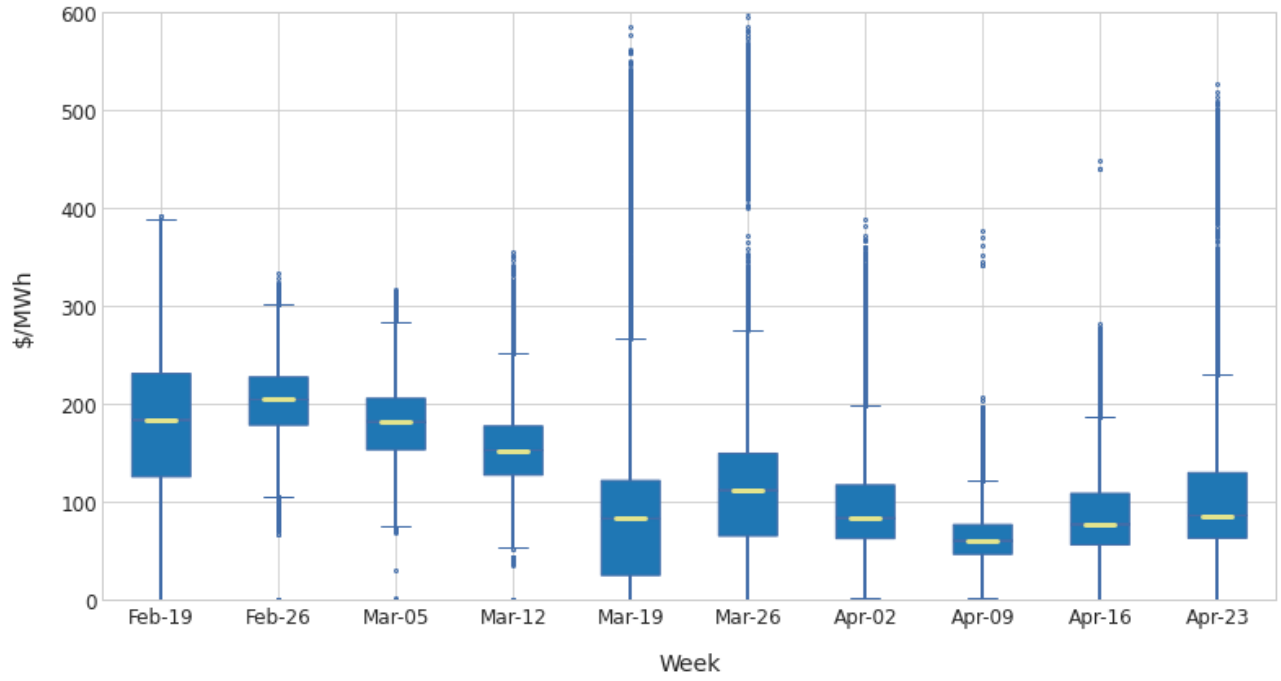
Figure 1: Wholesale Spot Prices between 23 April (Sunday) – 29 April (Saturday) 2023.



2.8. 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)[1] of the lower and upper quartile, and then observations that fall outside this range are displayed independently.

2.9. This week, the median was slightly higher when compared to the week before. The price increase was largely driven by the price separations between the islands. Prices were lower than prices in late February and early March, due to increased hydro generation as lake levels have recovered.

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

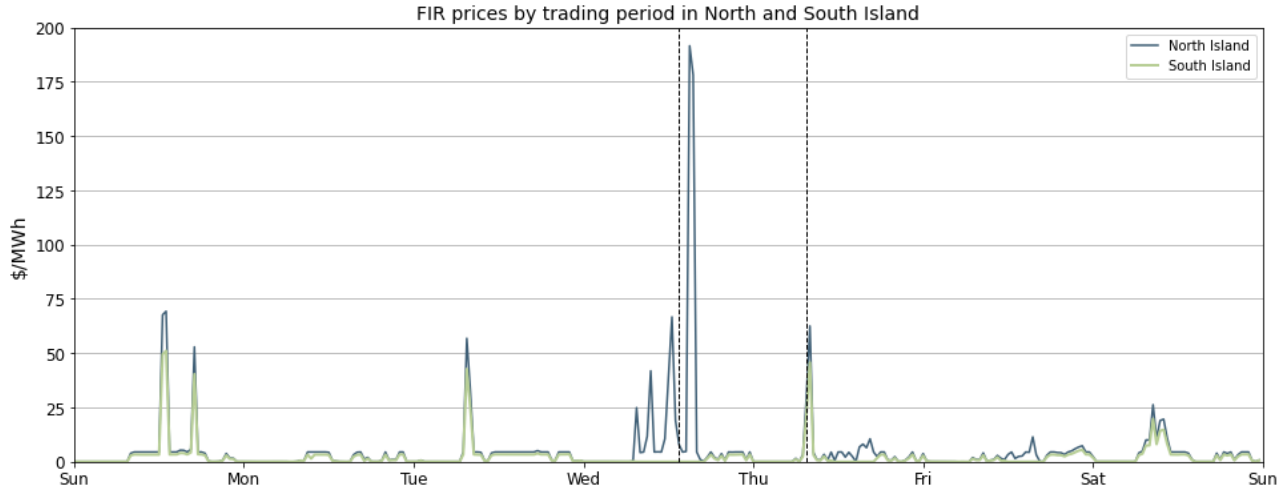


[1] Quartile - Wikipedia

3. Reserve Prices

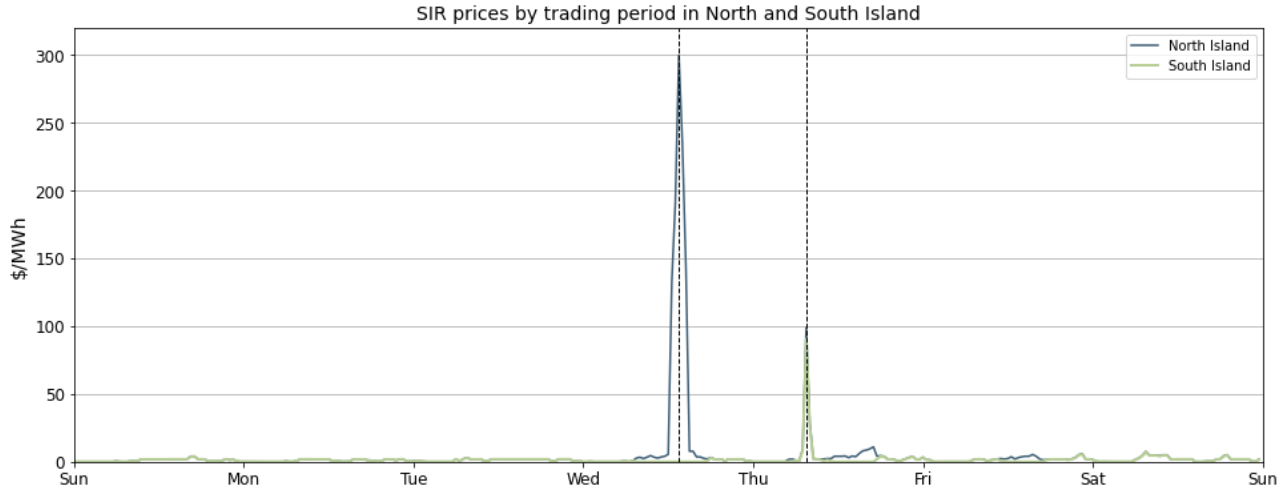
3.1. Fast instantaneous reserve (FIR) prices for the North and South Islands are shown below in Figure 3. FIR prices were relatively higher for the North Island on Wednesday. These high price spikes reflect the high requirements of reserve needed to cover the risk of the HVDC in the North Island, as it was running close to capacity.

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 $5/MWh, except on Wednesday, 26 April. Between 12:30 and 2:30 pm on Wednesday the SIR prices for the North Island increased up to $300/MWh to cover the risk of the HVDC in the North Island.

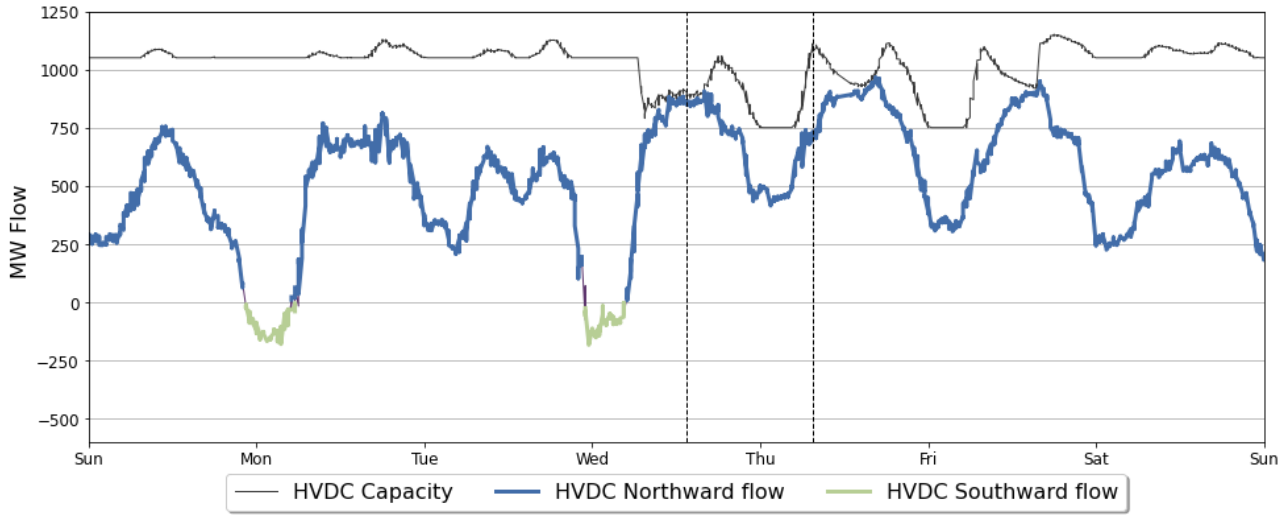
Figure 4: SIR prices by trading period and Island.



4. HVDC

4.1. Figure 5 shows HVDC flow between 23 – 29 April. Outages in the lower North Island limited northward HVDC capacity. HVDC flows were mostly northward during both daytime and night-time, reaching up to 1,000 MW during the daytime. Northward flows were particularly high on Wednesday and Thursday, when wind generation was low. There was some small HVDC flow southward overnight on Monday and Wednesday.

Figure 5: HVDC northward flow and capacity.



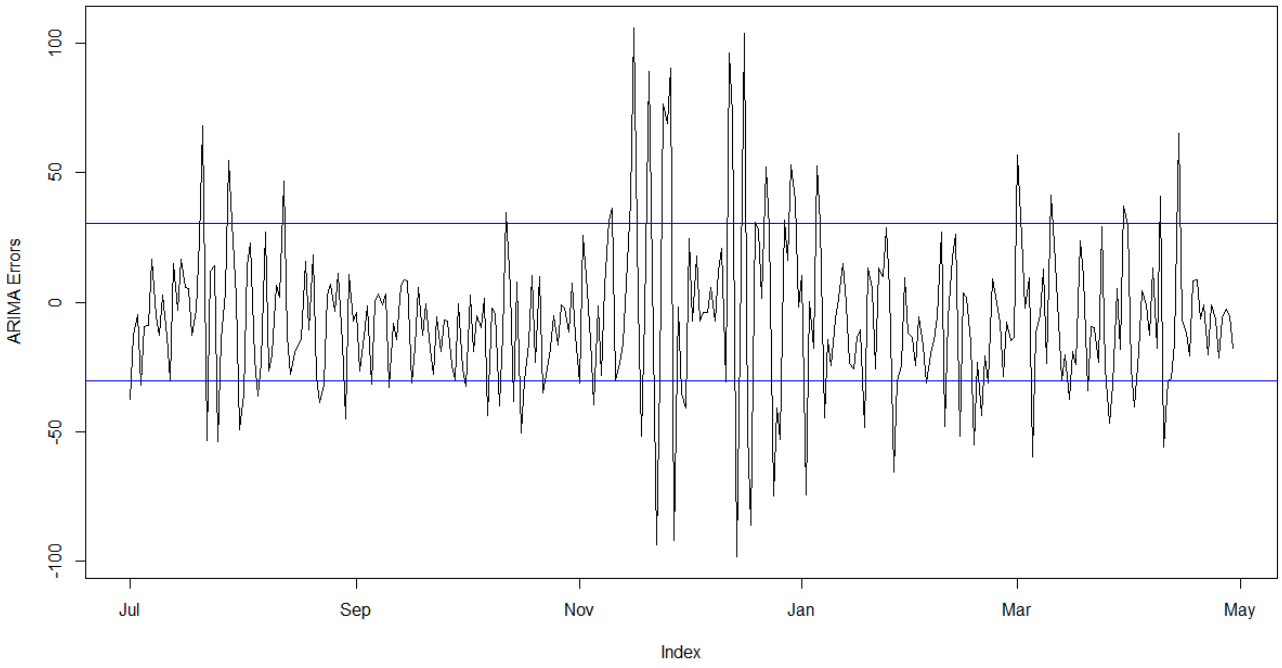
5. Regression Residuals

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 prices on those dates appear to be largely aligned with market conditions. This week there wasn't any residual above or below the one standard deviation of the data.

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

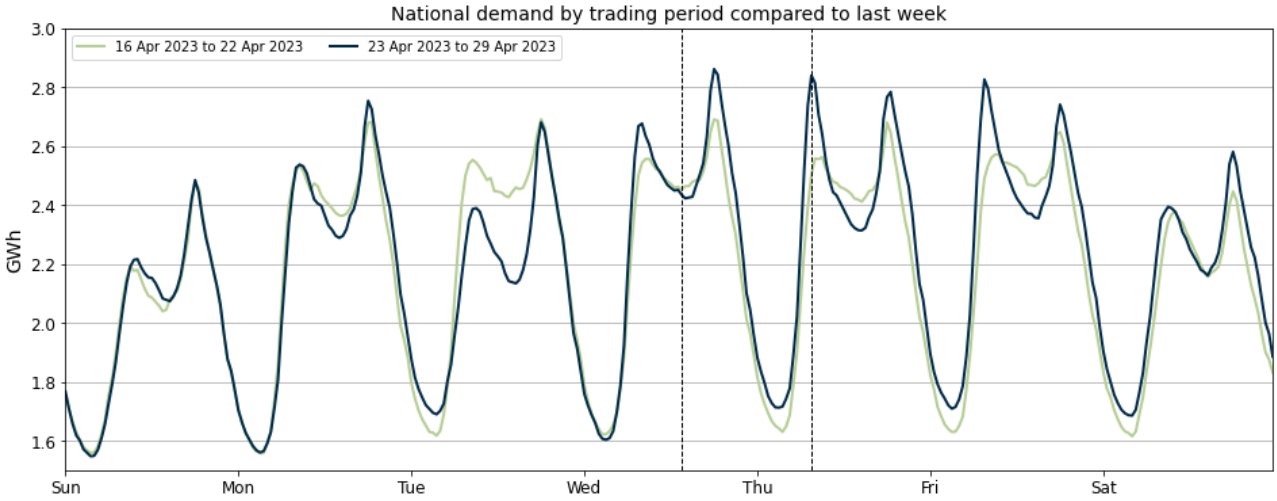
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 29 April 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 23 – 29 April, compared to the previous week. Demand was similar at the start of the week to the previous week, with Tuesday morning having a lower peak due to the public holiday. From Wednesday onwards there was higher demand during the morning compared to last week with schools returning. Overall demand also increased due to low temperatures.

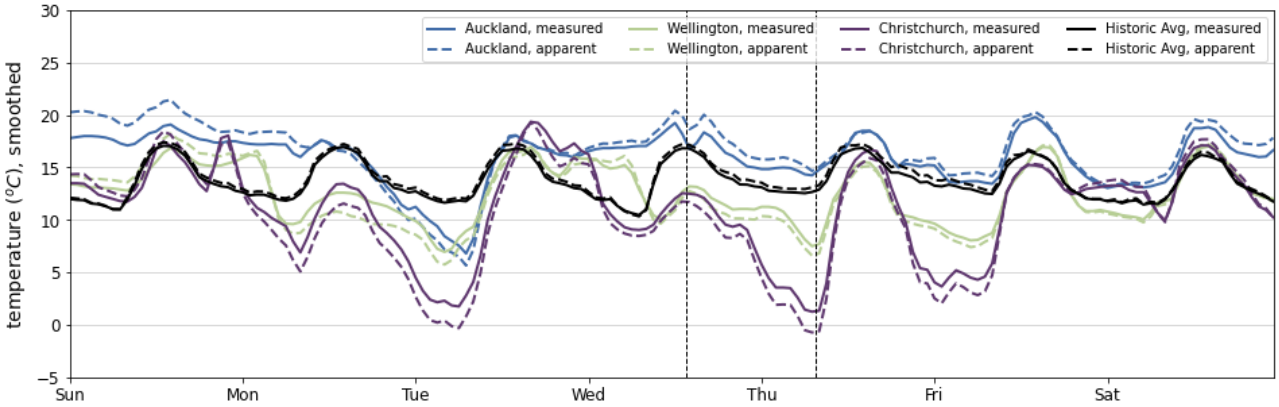
Figure 7: National demand by trading period compared to the previous week.



6.2. Figure 8 shows hourly temperatures at the three main population centres. 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. Between 23 - 29 April, temperatures in all three main centres were mostly above or around the historic average, ranging between 0 and 20 degrees. Temperature in Auckland was generally on or above average for most of the week, except Tuesday morning where it dropped to around 6 degrees. On Tuesday morning, temperatures across all main centres were low with the coldest in Christchurch, where apparent temperatures were around 0 degrees. Temperatures in Wellington were below average for most of the week. However, Christchurch experienced the largest range in temperatures across the week.

Figure 8: Temperatures across main centres.



7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 23 – 29 April ranged between ~1,200 – 1,700 MW.

7.2. Notable outages include:

(a) Huntly 4 prolonged outage until 10 May 2023.

(b) McKee unit was on outage until 1 May 2023.

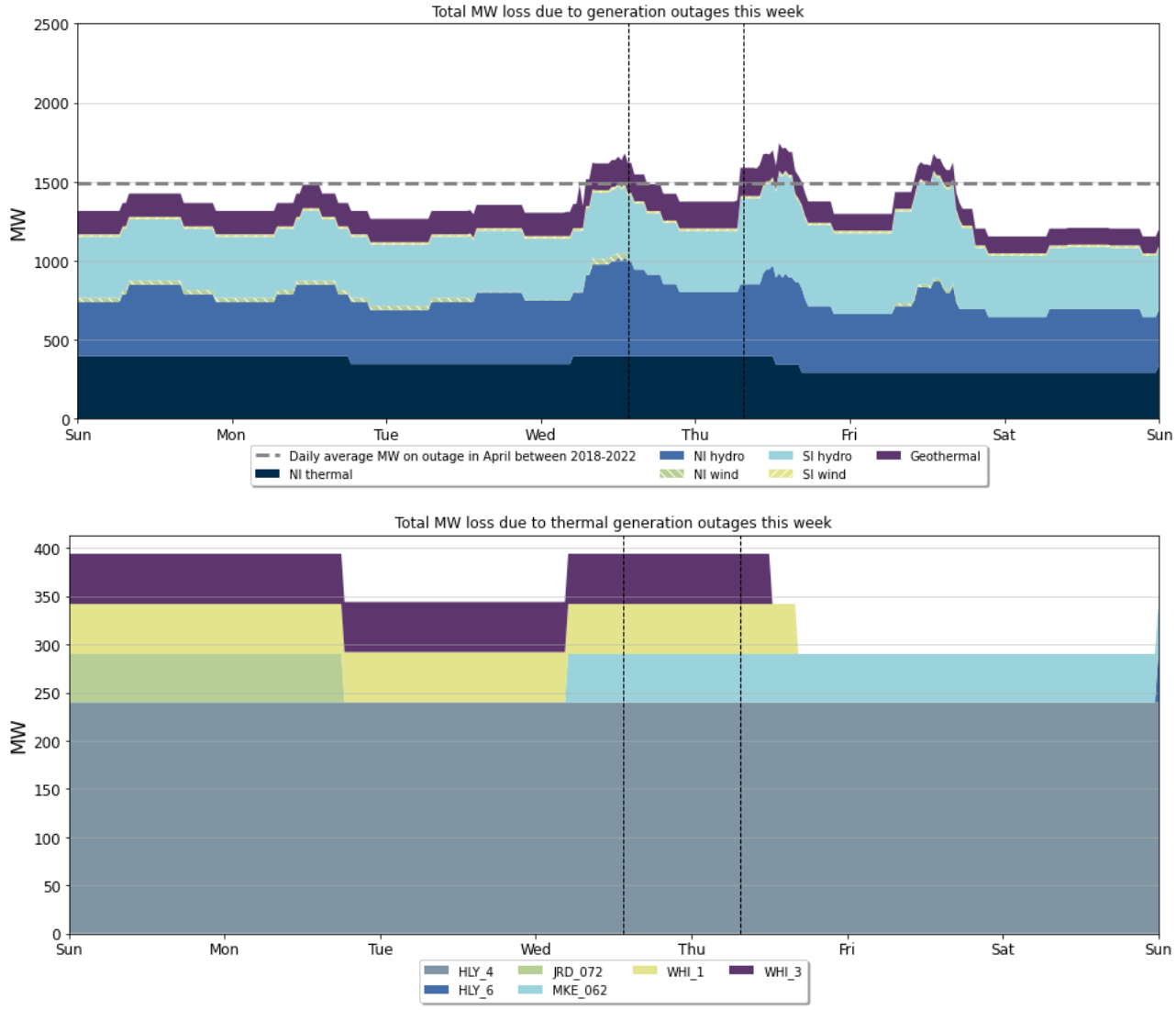
(c) Two Whirinaki units came back from outage on 27 April 2023.

(d) The Geothermal plant Kawerau was on outage all week.

(e) Transmission outages in the lower North Island from Wednesday to Friday.

(f) Various North and South Island hydro units continue to be on outage this week.

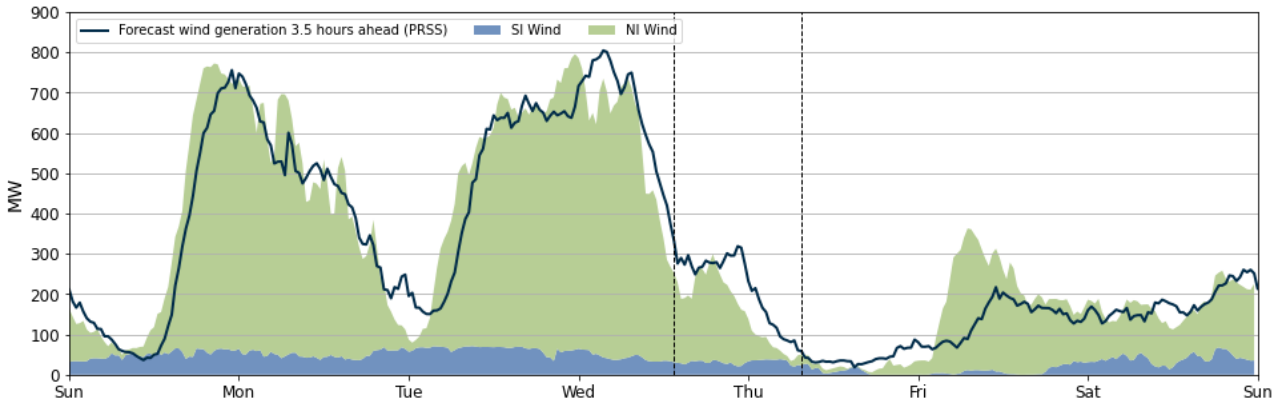
Figure 9: Total MW loss due to generation outages.



8. Generation

8.1. Wind generation, between 23 – 29 April, varied between 6-795 MW (Figure 10) this week. Wind was relatively low during the week. There were a few instances where there was a large drop off in wind, particularly on Monday night and then again on Wednesday afternoon. Wind generation was low all day on Thursday which coincided with a high morning peak when temperatures in the South Island were very low. Low wind generation meant both hydro and thermal generation were ramped up during Thursday's peak demand times.

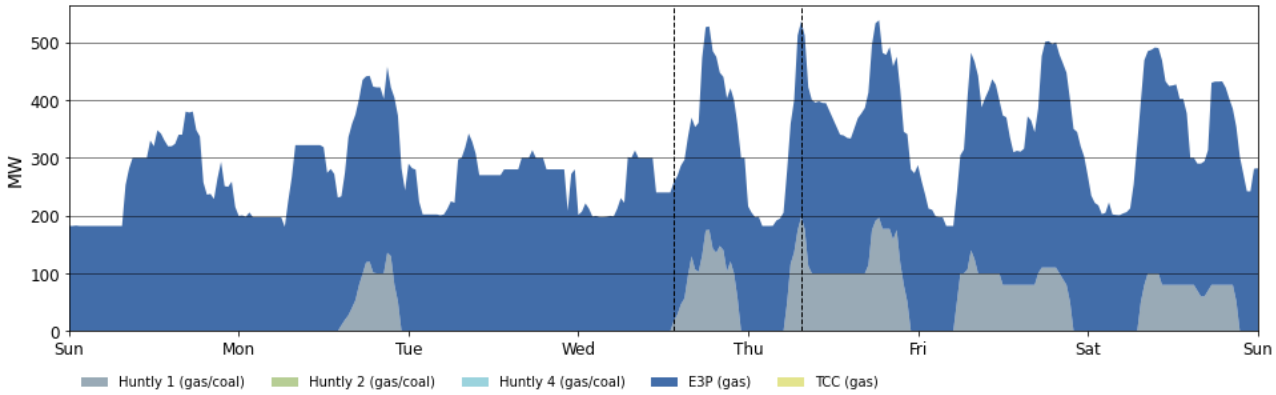
Figure 10: Wind Generation and forecast.

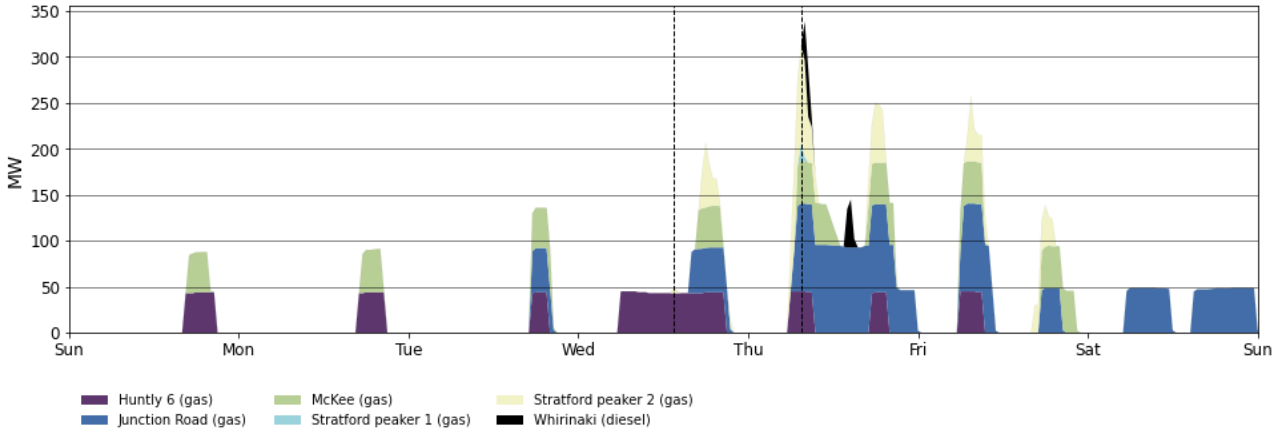


8.2. Figure 11 shows generation of thermal baseload and thermal peaker plants between 23 – 29 April. Thermal generation increased during the low wind generation times. E3P (Huntly 5) ran all week as baseload. Huntly 1 ran during Monday and Wednesday evening peaks and then from Thursday to Sunday over the main daily demand period.

8.3. Huntly 6 and McKee ran most days, mainly covering evening peaks at the beginning of the week. Junction Road ran from Tuesday to Saturday during peak times. Stratford 2 ran covering Wednesday evening and Thursday and Friday's increased demand periods. Stratford 1 ran briefly on Thursday morning when prices were high. While Whirinaki ran on Thursday morning, its cleared offers were well below the spot prices. The same offers appeared again when it ran again in the afternoon. This was likely Contact conducting testing at Whirinaki - as the unit returned from outage.

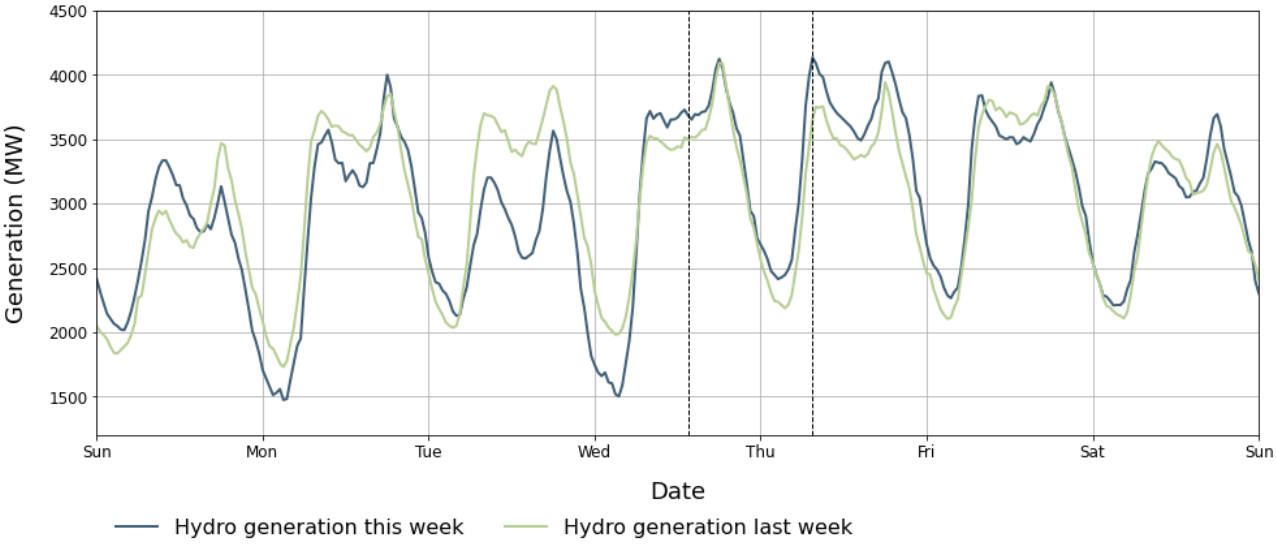
Figure 11: Thermal Generation.





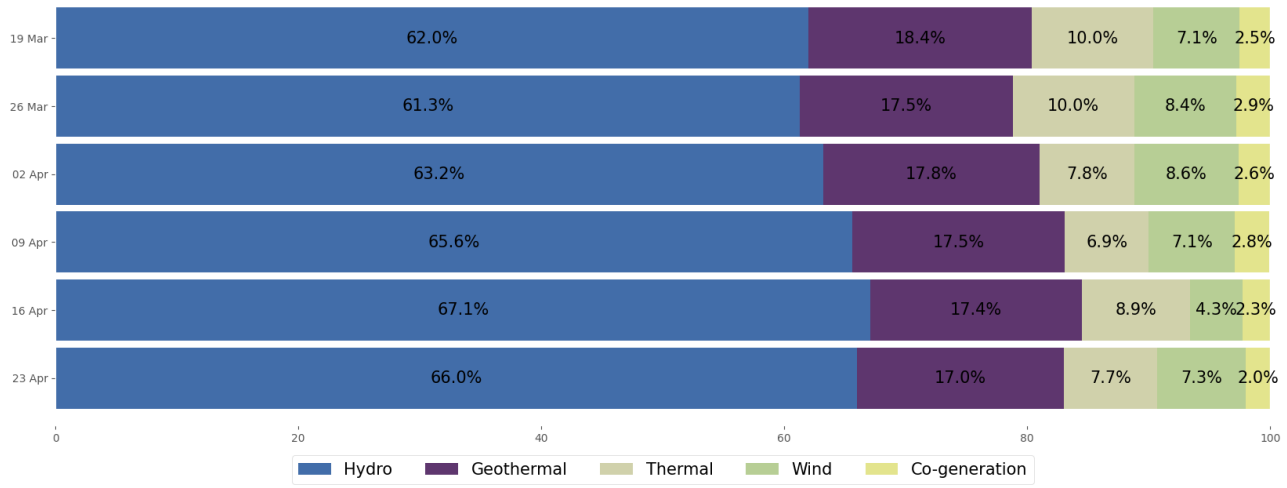
8.4. Figure 12 shows total hydro generation in MW produced each trading period, compared to the same time in the previous week. Hydro generation overall was slightly lower than the previous week, with much lower generation seen on Tuesday due to lower demand because of ANZAC day. Thursday saw an increase in generation compared to last week due to the higher demand likely caused by lower temperatures mainly in the South Island at these times.

Figure 12: Hydro generation between 23 – 29 April compared to the previous week.



8.5. As a percentage of total generation, between 23 – 29 April, total weekly hydro generation totalled 66 percent, geothermal 17 percent, thermal 7.7 percent, wind 7.3 percent, and co-generation 2 percent.

Figure 13: Total generation as a percentage each week between 26 Feb and 29 April 2023.



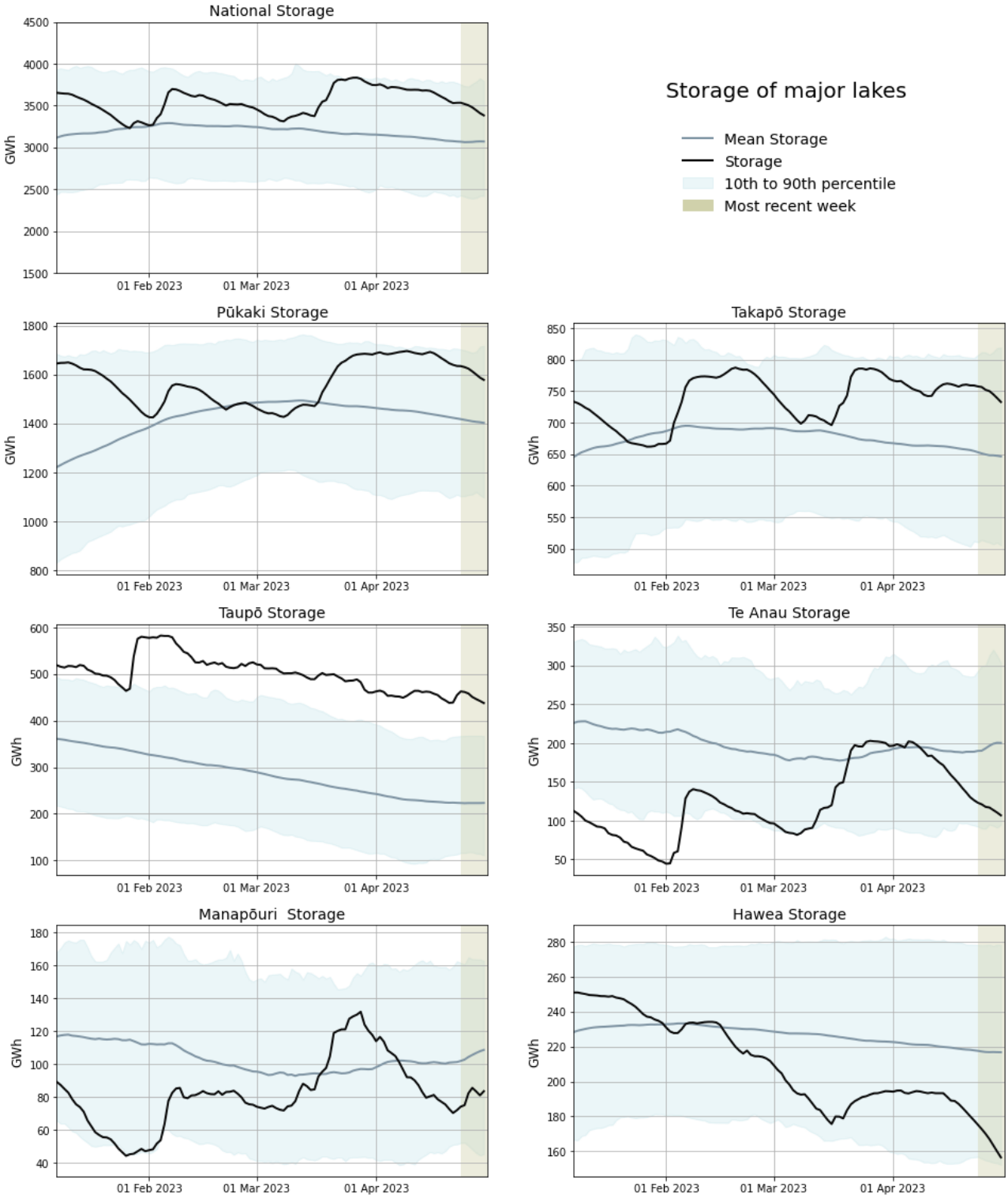
9. Storage/Fuel Supply

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 slightly decreased over the week and is below its 90th percentile. Total national storage is around 84 percent of nominal full as of 29 April.

9.3. Most lakes are starting to show a decrease in storage levels. Storage at lakes Pūkaki, Takapō and Taupō decreased, though all remain above their historic mean, with Taupō's storage above its historic 90th percentile. Lakes Hawea and Te Anau storage significantly fell and are approaching their respective historic 10th percentile. However, Manapōuri storage showed a slight increase in storage last week though it remained below its historic average.

Figure 14: Hydro Storage.

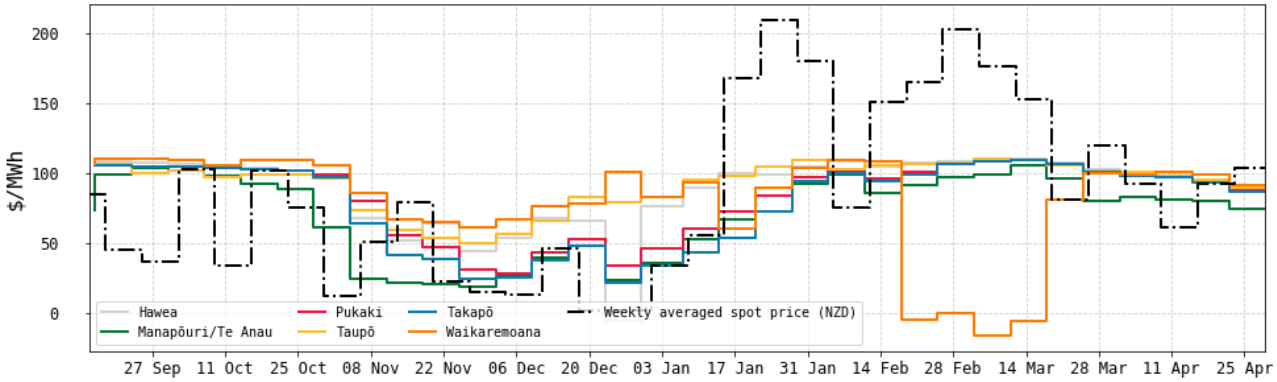


10. JADE Water Values

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 29 April 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. Water values across all lakes remained steady last week. 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 29 April 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 April 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 ~$557/MWh.

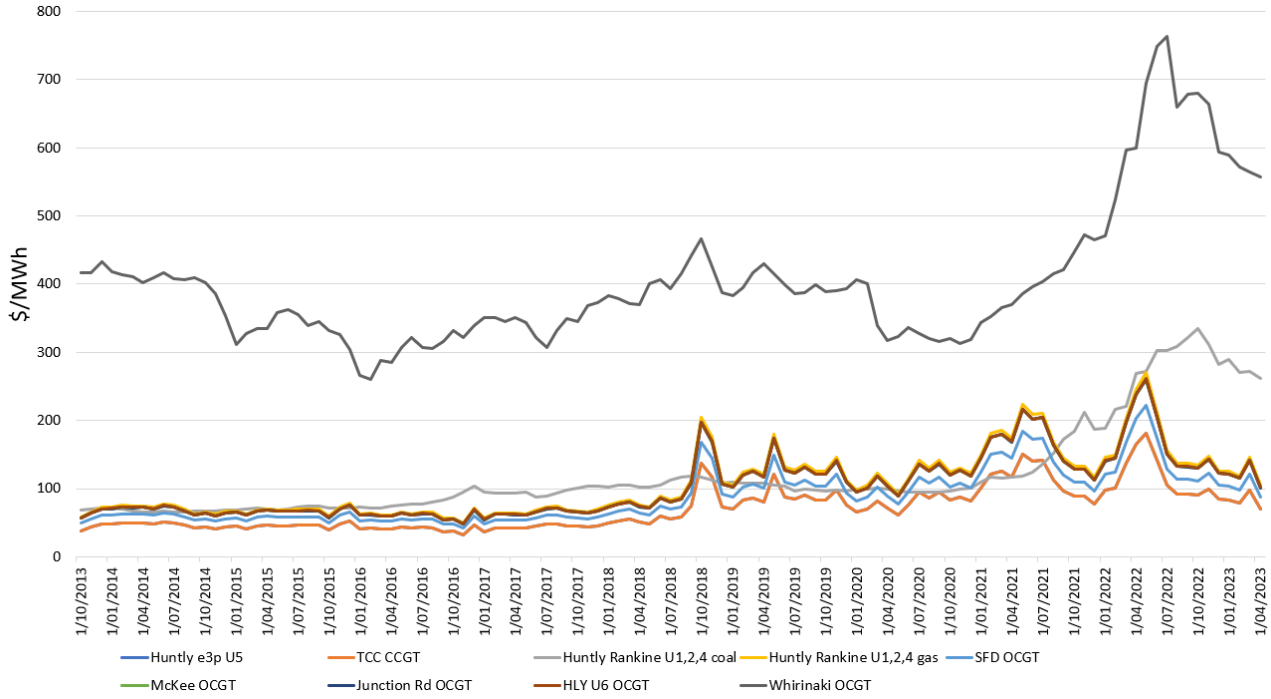
11.6. The SRMC of gas run thermal plants decreased to between $70/MWh and $105/MWh, likely due to a decrease in gas demand.

[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

11.7. 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.



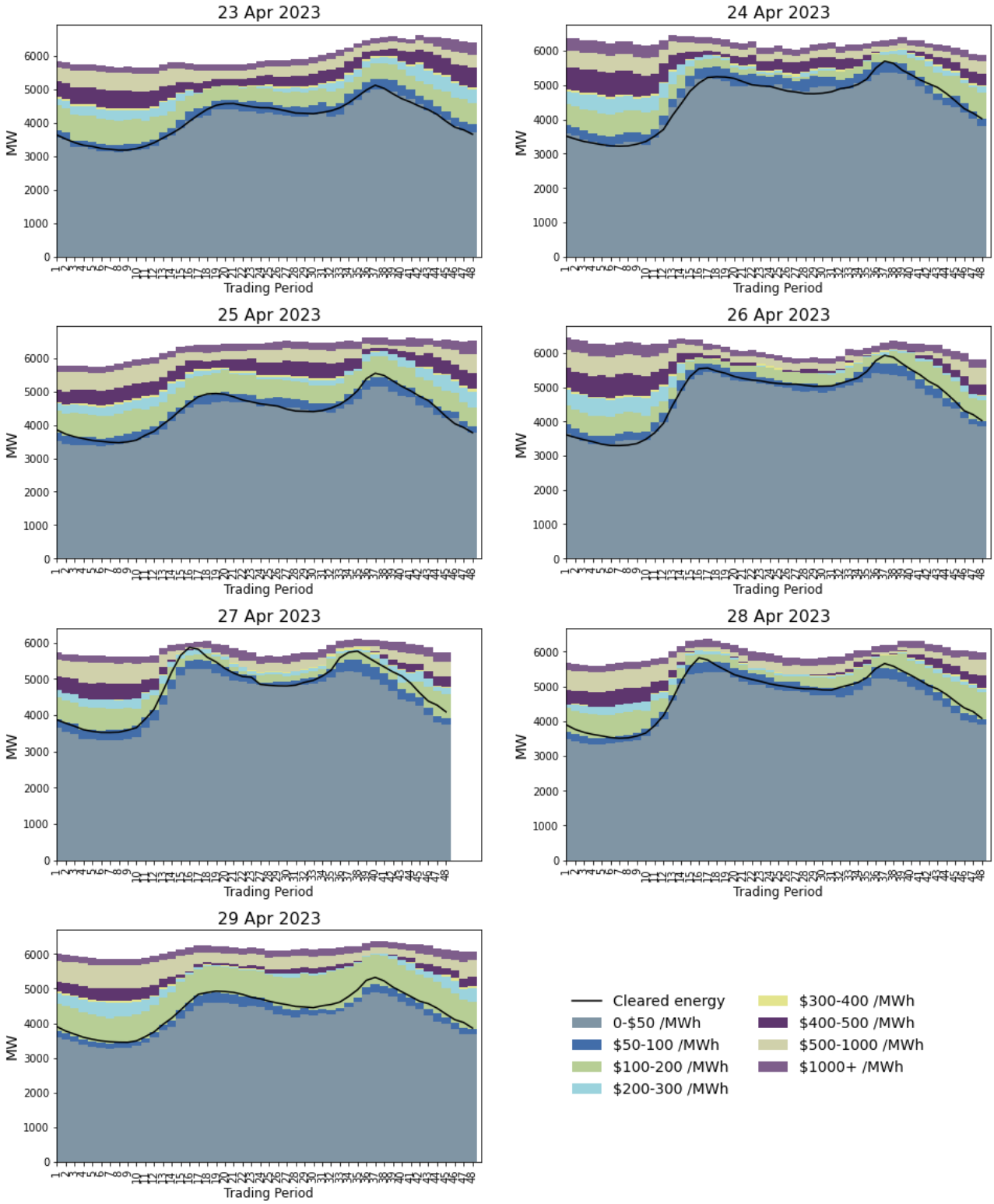
12. Offer Behaviour

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. Most of the time energy cleared in between $0 and $100/MWh early in the week.

12.2. The evening peak demands saw generation clear between $100 and $200/MWh band on Tuesday. During the mornings on Wednesday, more energy cleared in the $200-$300 band, and during the evening peak slightly decreased.

[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, 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	Notes
07/10/2022	15-16	Further analysis	The Monitoring team is making enquires with Genesis regarding offer changes to final tranche prices at Huntly 5 for trading period 15-16.
15/1/2023 4/2/2023	Several	Further analysis	The Authority will continue analysis into the high energy prices associated with high hydro offers.
24/3/2023	17,28	Further analysis	The Authority has made enquires with Nova regarding their offers at McKee and Junction Road
12/4/2023	36-39	Further analysis	The Authority has made enquires with Genesis regarding their offers at Tuai.
17/4/2023	48	Further analysis	The Authority has made enquires with Contact regarding offers at Clyde and Roxburgh.
18/4/2023	17	Further analysis	The Authority has made enquires with Genesis regarding their offers at Takapō A and B.
19/4/2023	27	Further analysis	The Authority has made enquires with Contact regarding offers at Clyde and Roxburgh.