Date: 8 May 2023

TRADING CONDUCT REPORT

Market Monitoring Weekly Report

TRADING CONDUCT REPORT

1. Overview for week of 30 April – 6 May 2023

1.1. Spot prices hovered around the historic mean prices, with some deviations. The peaks in the reserve prices on Friday were likely due to the high northwards HVDC flow to cover the risk, and on Saturday were likely due to relatively low forecasted demand compared to actual demand. Otherwise, demand remained consistent compared to previous week. Low wind generation contributed to higher thermal generation during peak demand periods. Hydro storage increased in most lakes. 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. Prices above the historic 90th percentile are highlighted with a translucent green line (if any). Other notable prices, but which did not breach the 90th percentile, are marked in black dashed lines (if any).

2.2. Between 30 April – 6 May 2023:

(a) The average wholesale spot price across all nodes was $112/MWh.

(b) 95 percent of prices fell between $27/MWh and $182/MWh.

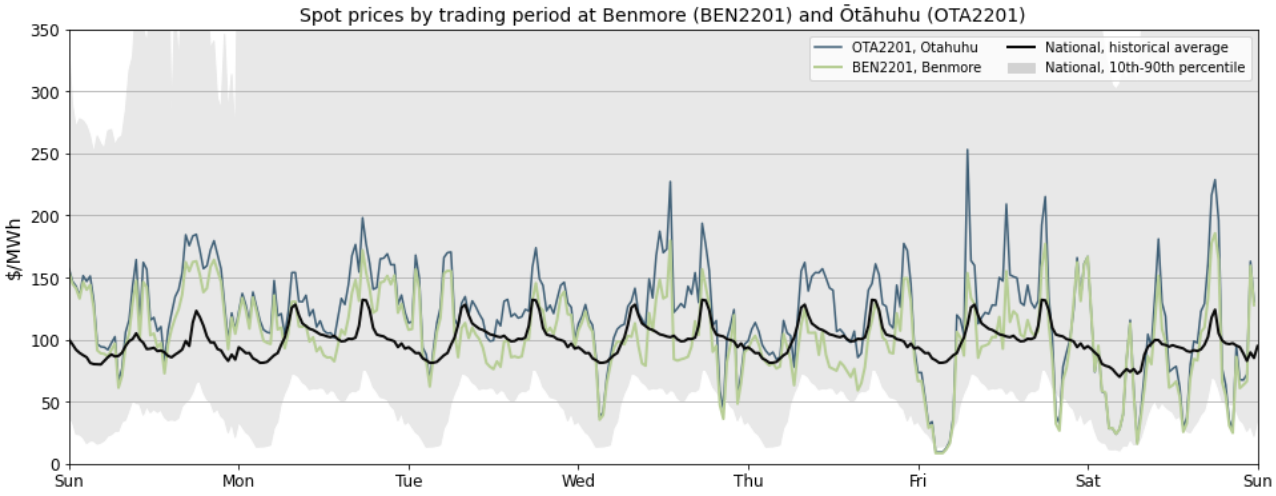
2.3. Figure 1 shows spot prices at Benmore and Ōtāhuhu alongside their historic median and historic 10th - 90th percentiles adjusted for inflation.

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. Prices were more variable towards the end of the week, with prices reaching the historic 10th percentile at times and several peaks above $200/MWh on the 5 and 6 May. Hydro inflows increased from 3 May, which increased hydro generation and decreased thermal generation. However, this resulted in a tighter market when actual demand was higher than forecast, resulting in price spikes.

2.6. There were some price separations between the Islands this week, although smaller than last week. The largest of those was on Friday at 7:00 am where the price at Ōtāhuhu was around $253/MWh and the price at Benmore was around $153/MWh. At that time HVDC northwards flow was high and close to the reduced capacity due to some continued work on circuits at Haywards.

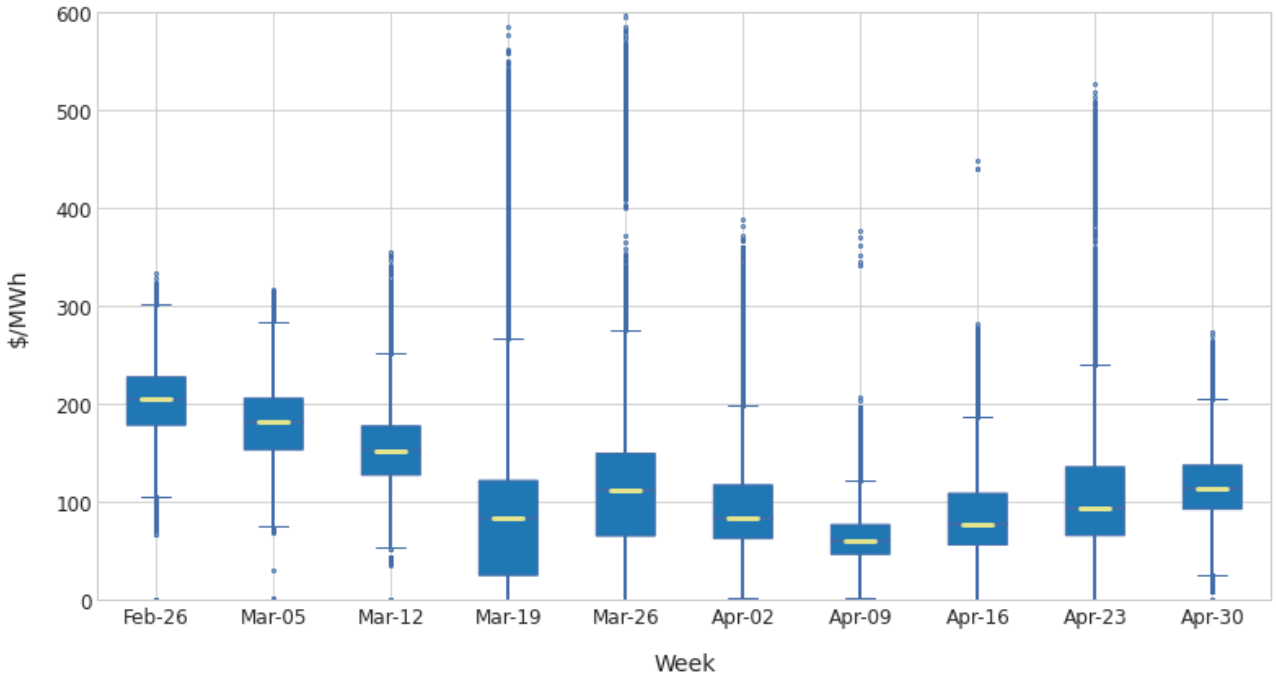
Figure 1: Wholesale Spot Prices between 30 April (Sunday) – 6 May (Saturday) 2023.



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

2.8. This week, the median was slightly higher when compared to the week before. The price increase was driven by relatively low wind generation and no overnight southwards flow. 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.

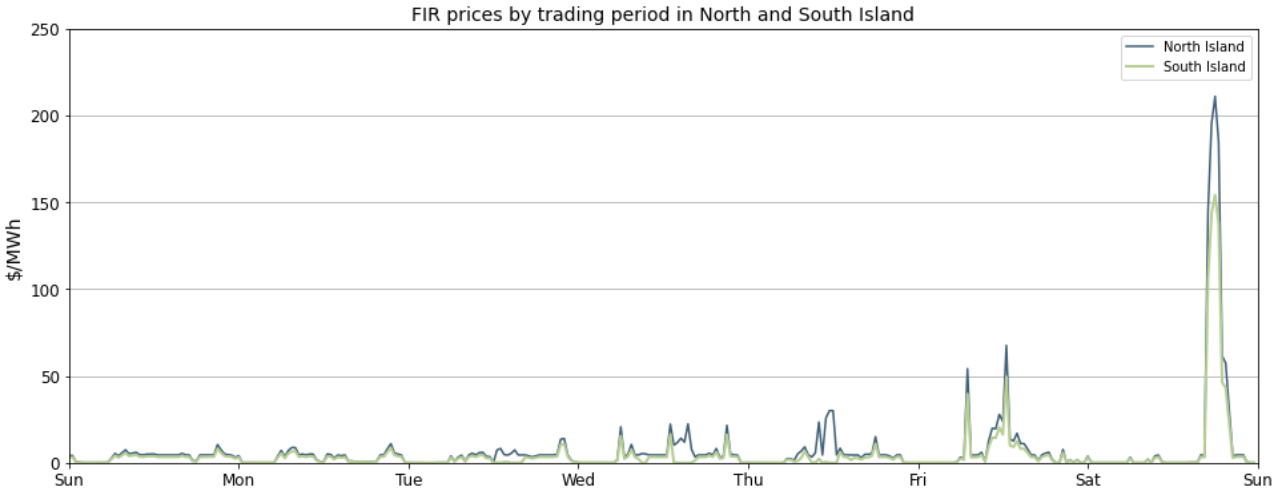


[1] Quartile - Wikipedia

3. Reserve Prices

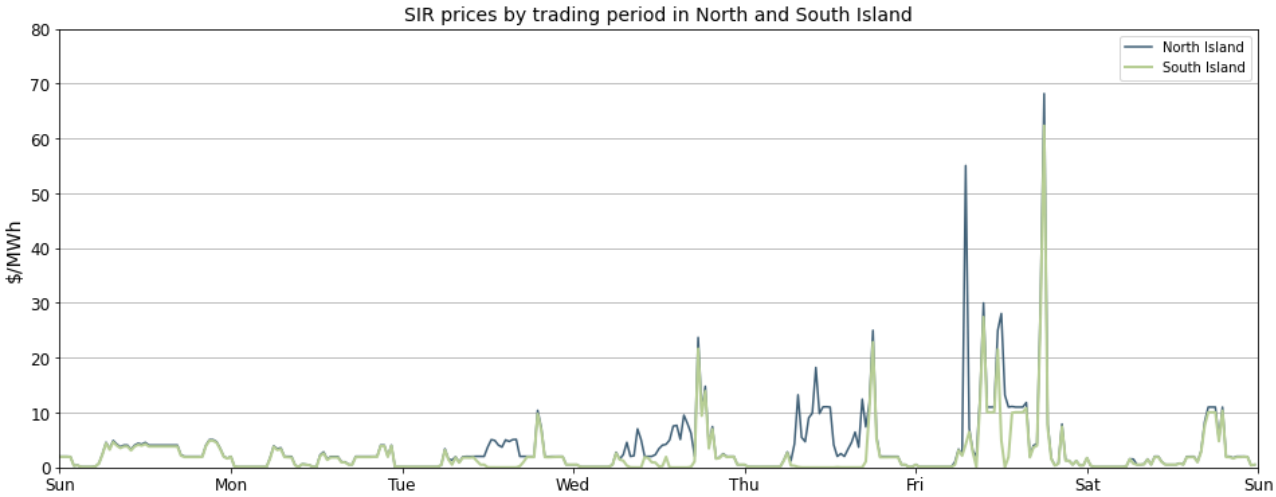
3.1. Fast instantaneous reserve (FIR) prices for the North and South Islands are shown below in Figure 3. SIR prices were mostly below $15/MWh at the start of the week and slightly increased on Friday to cover the risk of the HVDC in the North Island. Between 5:00 and 7:00 pm on Saturday the FIR prices reached up to $211/MWh for the North Island and $154/MWh for the South Island, when actual demand was higher than forecast, which also increased required FIR.

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 at the start of the week and increased on Friday to cover the risk of the HVDC in the North Island.

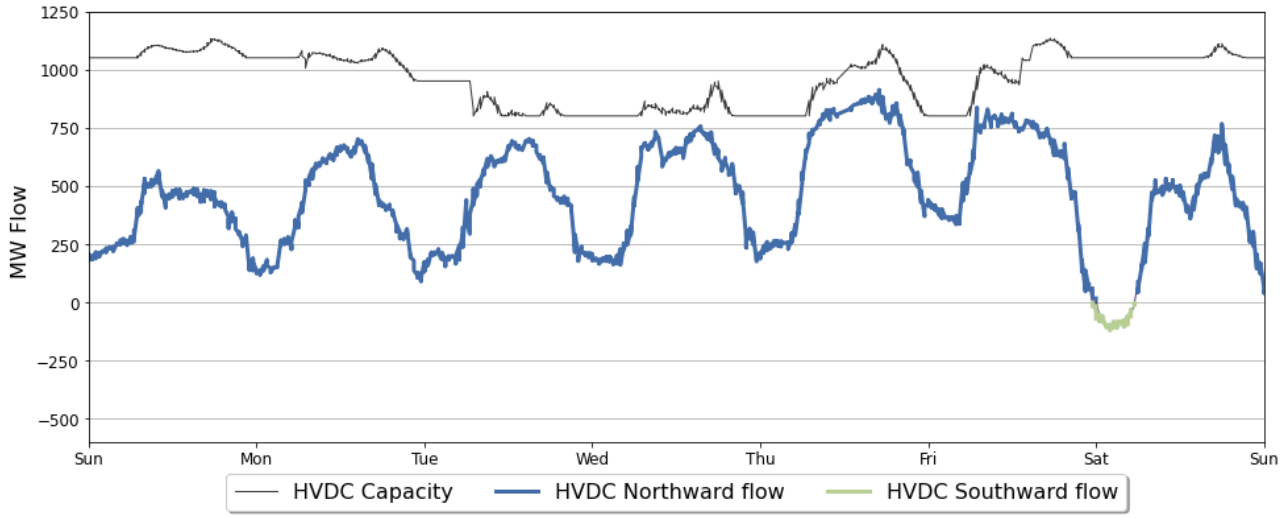
Figure 4: SIR prices by trading period and Island.



4. HVDC

4.1. Figure 5 shows HVDC flow between 30 April – 6 May. Outages in the lower North Island limited northward HVDC capacity from Tuesday to Friday. HVDC flows were mostly northward during both daytime and night-time, reaching up to 850 MW during the daytime. Northward flows were particularly high on Thursday, when wind generation was low. On Friday morning, the flow was reaching capacity. There was some small HVDC flow southward overnight on Saturday.

Figure 5: HVDC northward flow and capacity.



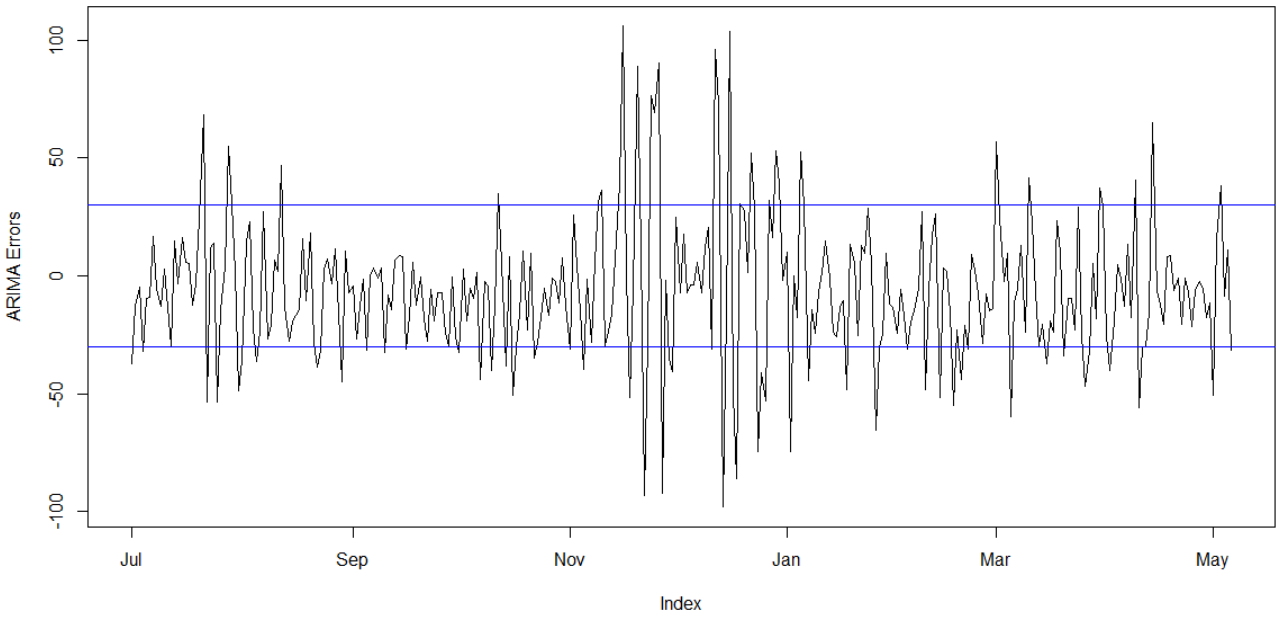
5. Regression Residuals

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. There was one residual above, and one below the one standard deviation of the data, but all are small. These small deviations reflect market variations that may not be controlled for in the regression analysis. Note that the positive residual indicates that the modelled price was lower than the actual prices and vice versa.

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

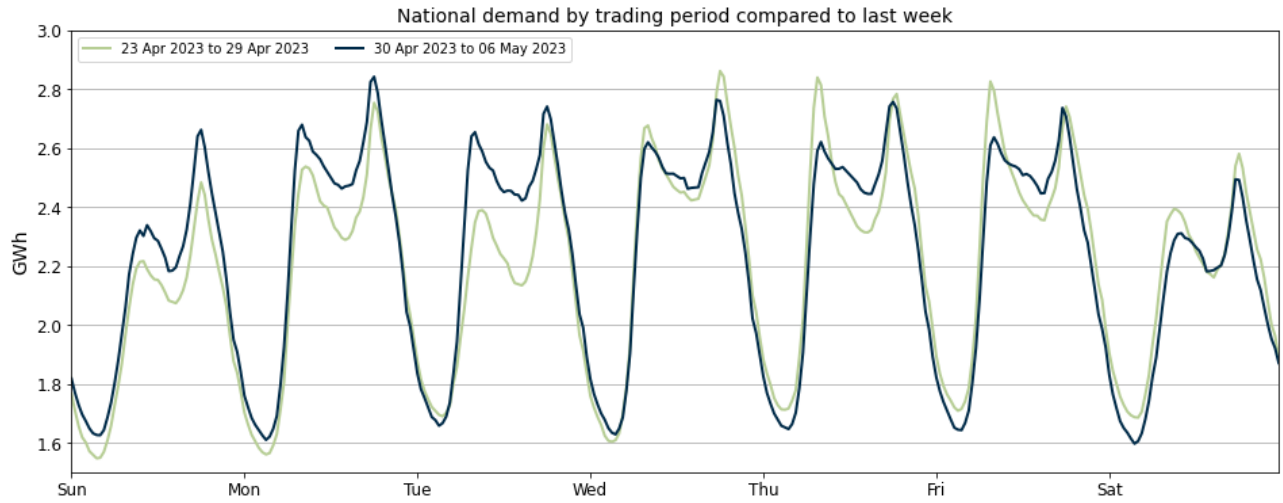
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 6 May 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 30 April – 6 May, compared to the previous week. Demand was higher at the start of the week due to return from school holidays. There were also some lower temperatures over Sunday, particularly in Christchurch which contributed to the increase in demand on Sunday. From Wednesday onwards there was lower demand during the morning peak due to relatively high temperatures compared to last week.

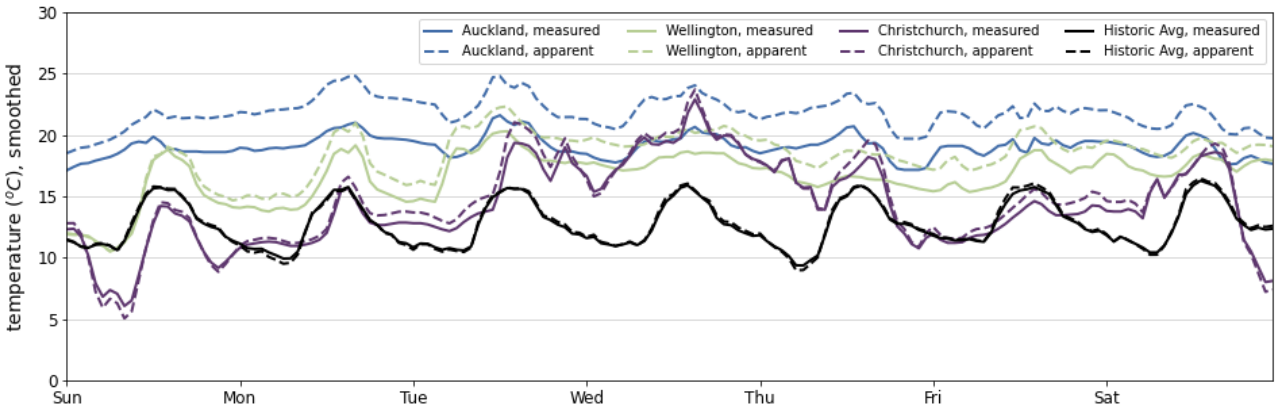
Figure 7: National demand by trading period compared to the previous week.



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 30 April – 6 May, temperatures in all three main centres were mostly above or around the historic average, ranging between 5 and 25 degrees. Temperatures in Auckland were above average for the week with apparent temperatures mostly above 20 degrees. Temperatures in Wellington were also above average for most of the week ranging between 10-22 degrees. Christchurch started and ended the week with low temperatures and again saw the most variation with apparent temperatures ranging from 5 to 23 degrees.

Figure 8: Temperatures across main centres.



7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 30 April – 6 May ranged between ~1,200 – 2,000 MW. From Wednesday, the generation capacity on outages was above the average outage capacity due to TCC going back on outage until 14 May. A few peakers had short outages this week, including Stratford 1 peaker on outage during the day on 3 May, and came back around 5:00 pm, running during the evening peak that day.

7.2. Notable outages include:

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

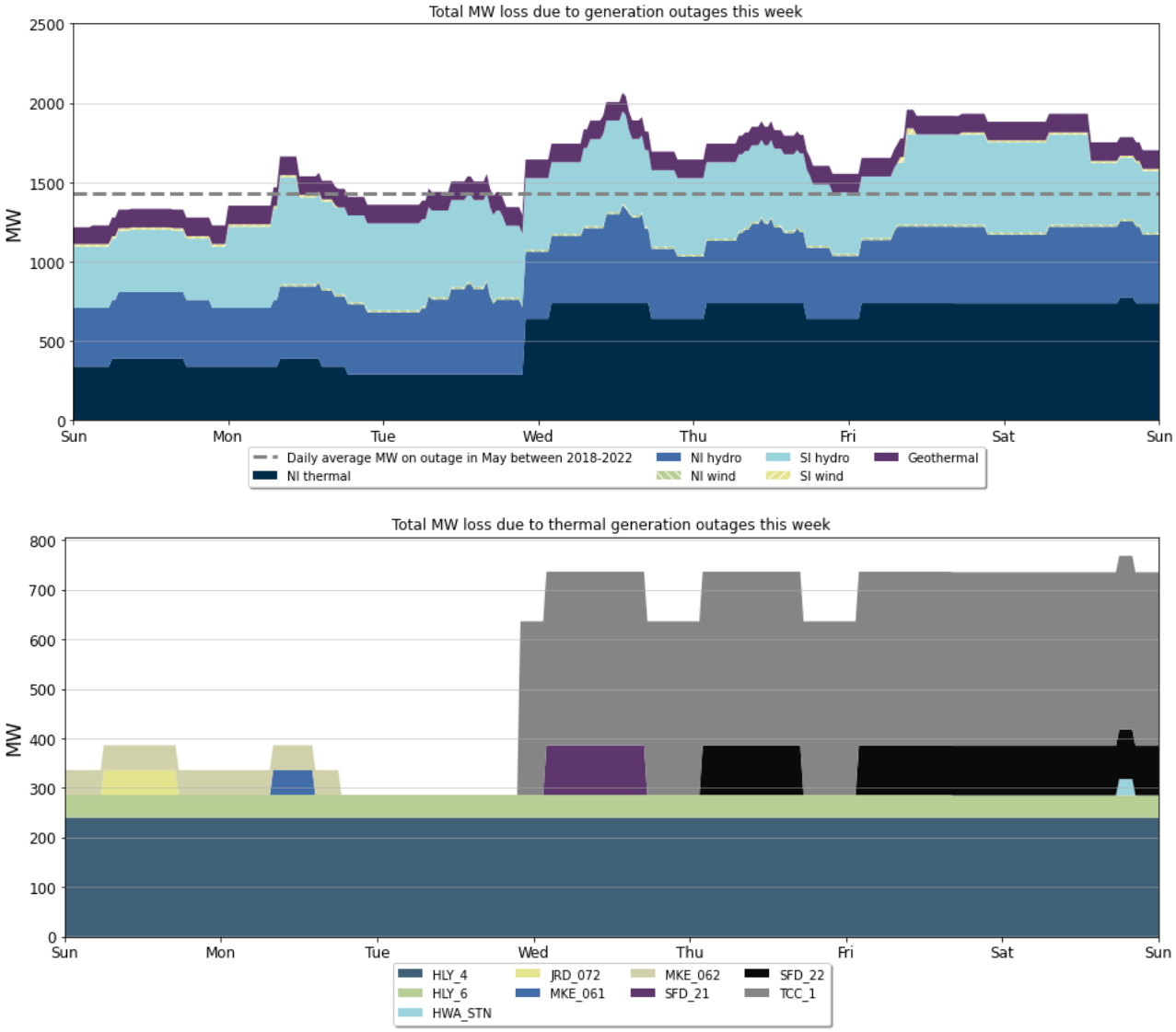
(b) Huntly 6 is on outage until 19th May.

(c) TCC went back on outage until 14th May.

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

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

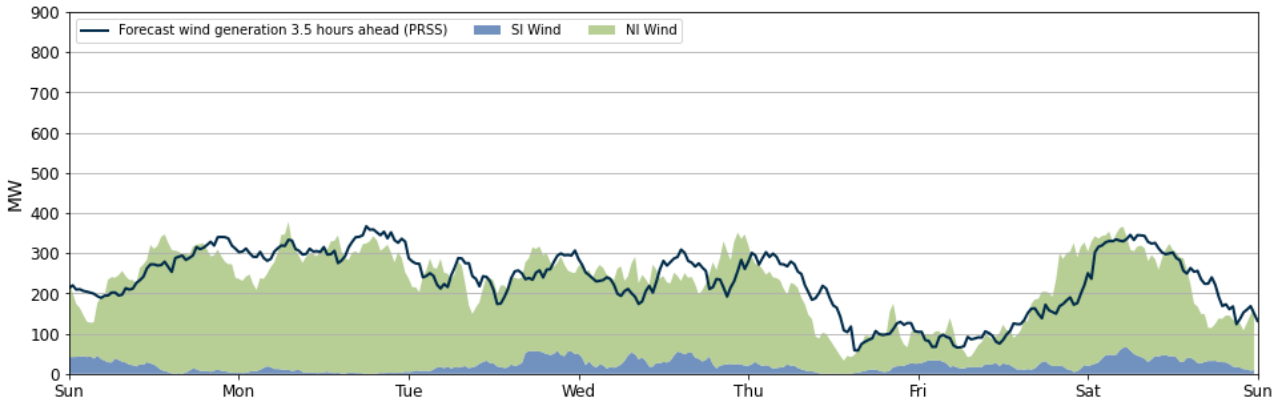
Figure 9: Total MW loss due to generation outages.



8. Generation

8.1. Wind generation, between 30 April – 6 May, varied between 5-350 MW (Figure 10) this week. Wind was relatively low during the week. From Sunday to Thursday morning wind generation was mostly between 250 - 300MW. There were a few instances where there was a large drop off in wind, particularly on Thursday afternoon dropping to below 50 MW. Generation remained low over the afternoon and into Friday morning at around 100MW before increasing again on Friday afternoon into Saturday morning reaching between 300 - 350MW.

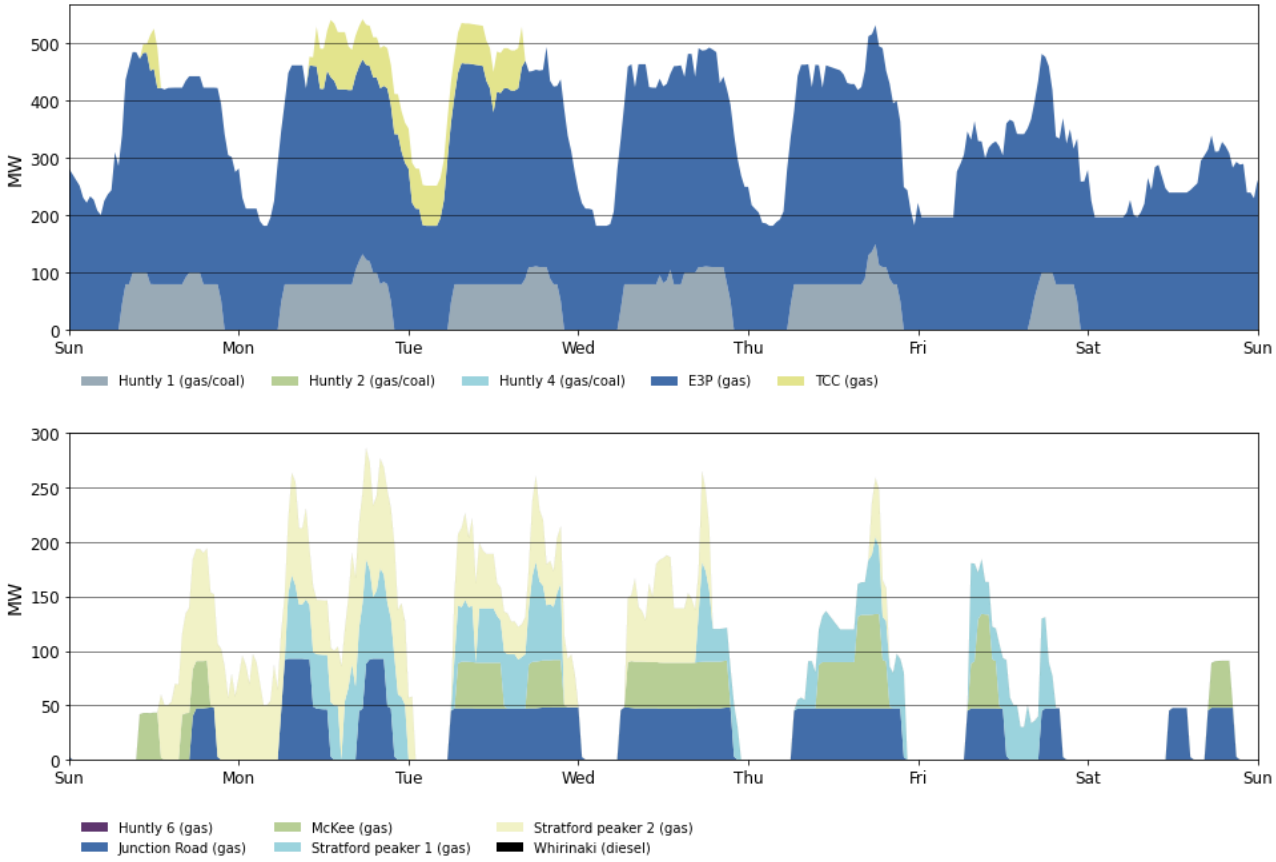
Figure 10: Wind Generation and forecast.



8.2. Figure 11 shows generation of thermal baseload and thermal peaker plants between 30 April – 6 May. Thermal generation increased during the low wind generation times. E3P (Huntly 5) ran all week as baseload. Huntly 1 ran from Sunday to Friday. TCC ran briefly at the start of the week before going back on outage.

8.3. Junction Road and McKee ran most days. Both Stratford peakers ran during the week with Stratford 2 running from Sunday afternoon, overnight and all-day Monday. Stratford 2 was on outage during the day on 4 May but ran again in the evening before going back on outage at the end of the week.

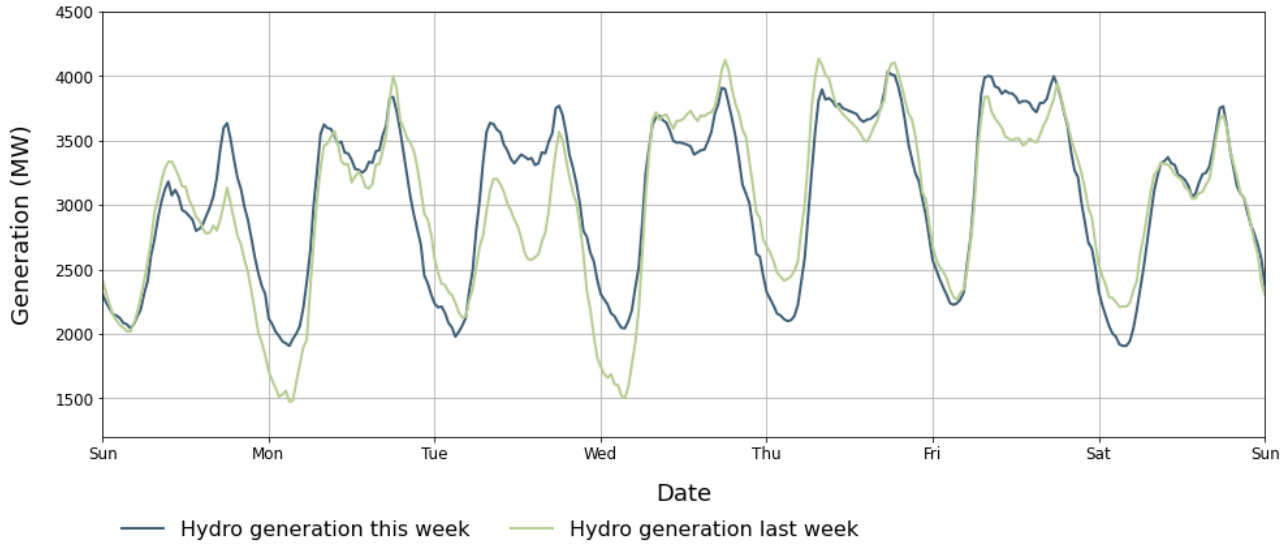
Figure 11: Thermal Generation.



8.4. Figure 12 shows total hydro generation in MW produced each trading period, compared to the same time in the previous week. Overall, hydro generation was similar to last week.

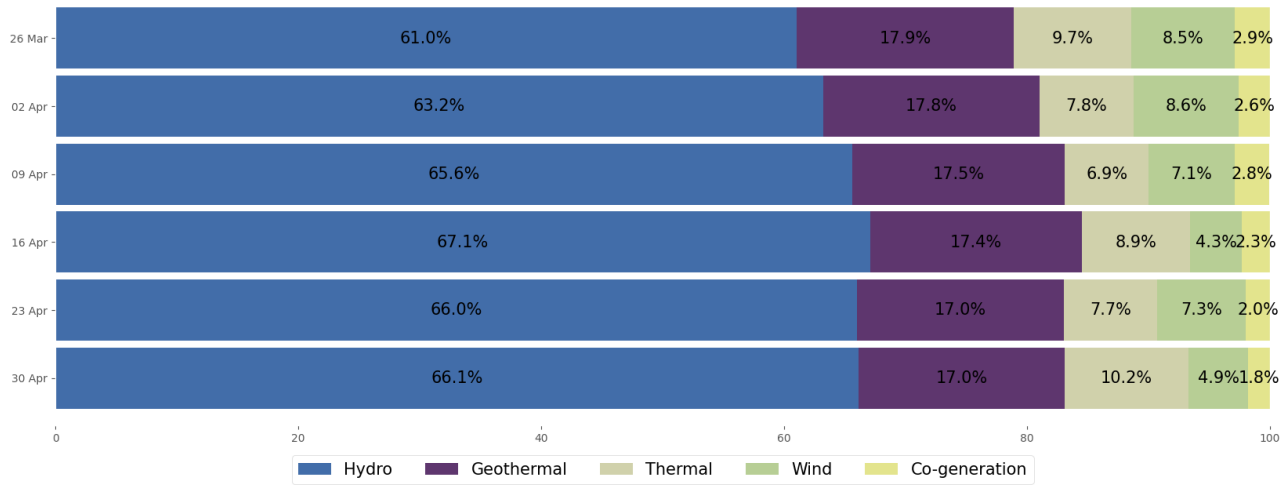
There was some higher generation than the previous week during the Sunday evening peak and over the say on Tuesday and Friday. Tuesday's increase was due to the previous week being a public holiday.

Figure 12: Hydro generation between 30 April – 6 May compared to the previous week.



8.5. As a percentage of total generation, between 30 April – 6 May, total weekly hydro generation totalled 66.1 percent, geothermal 17 percent, thermal 10.2 percent, wind 4.9 percent, and co-generation 1.8 percent.

Figure 13: Total generation as a percentage each week between 26 Mar and 6 May 2023.



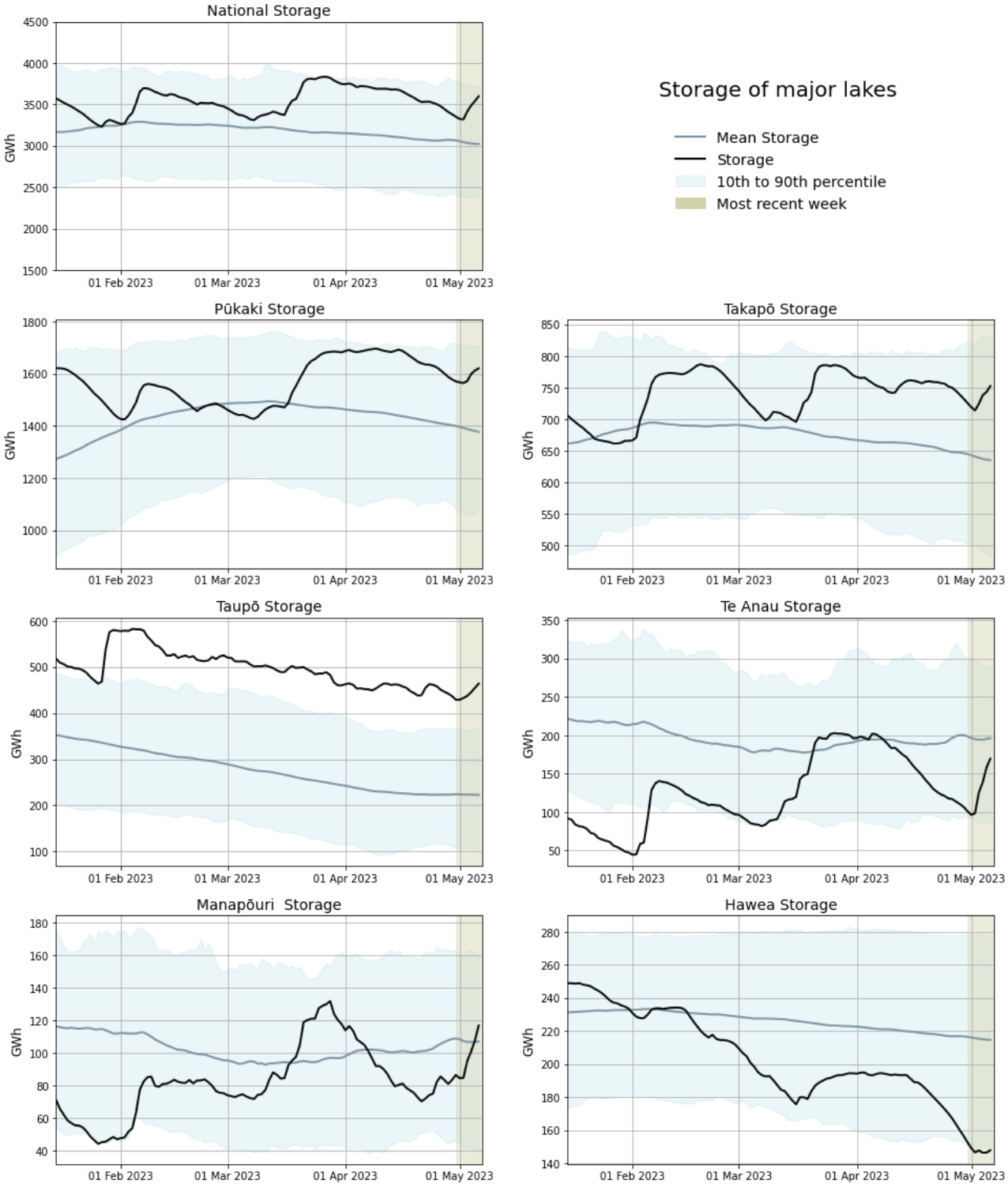
9. Storage/Fuel Supply

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 86.6 percent of nominal full as of 6 May.

9.3. Most lakes are starting to show an increase in storage levels. Storage at lakes Pūkaki, Takapō and Taupō increased, though all remain above their historic mean, with Taupō's storage above its historic 90th percentile. Lakes Te Anau and Manapōuri storage significantly increased with Manapōuri storage slightly above the historic average. However, Hawea storage remained below its 10th percentile.

Figure 14: Hydro Storage.

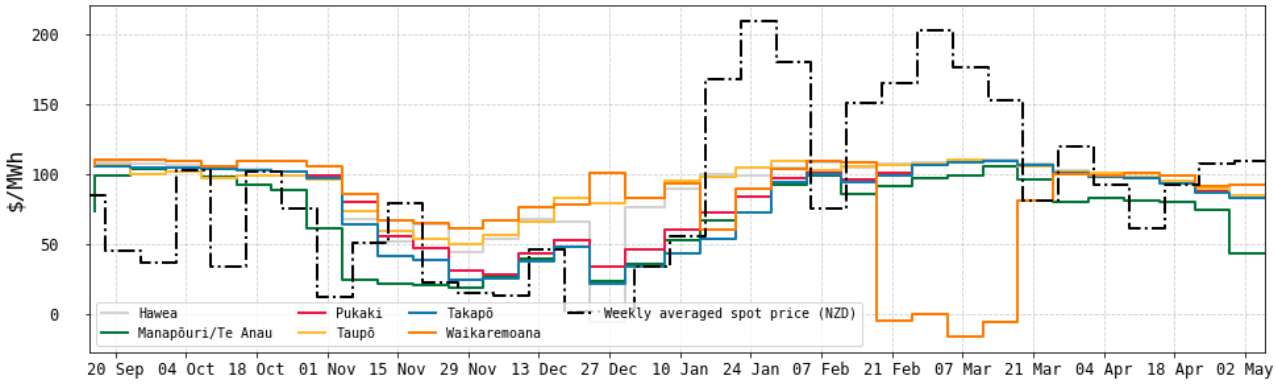


10. JADE Water Values

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 6 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. Water values across all lakes slightly decreased last week. Water values at Te Anau and Manapōuri dropped significantly due to the 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 6 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.

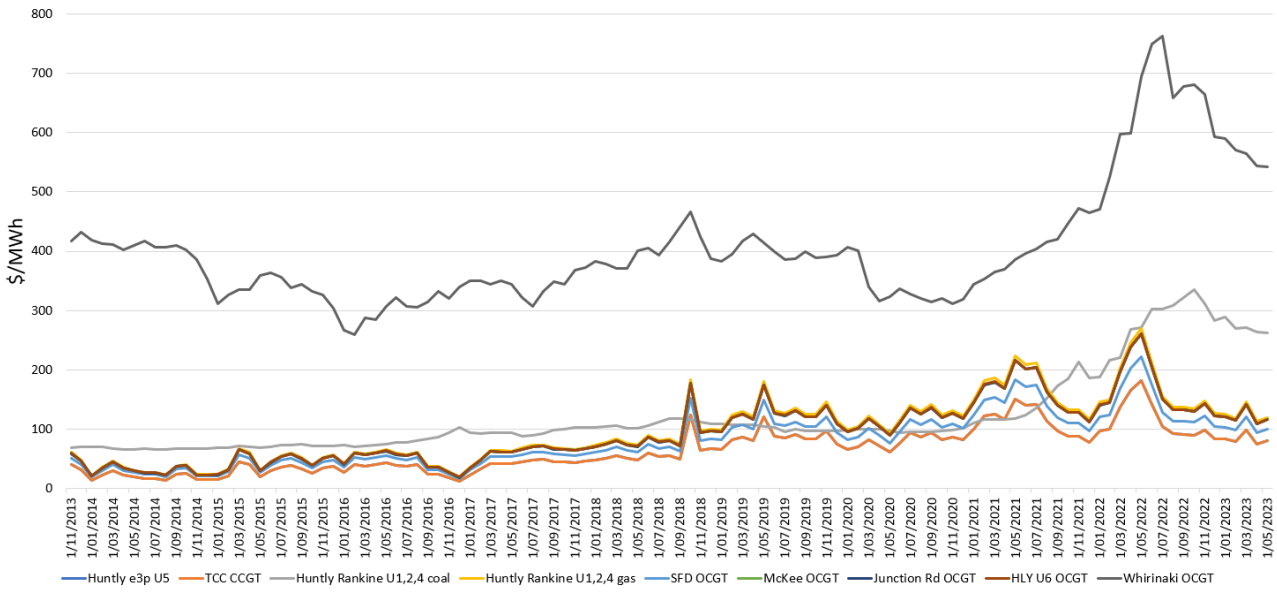
11.6. The SRMC of gas run thermal plants decreased and is between $80/MWh and $120/MWh, likely due to a decrease in gas demand.

[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.

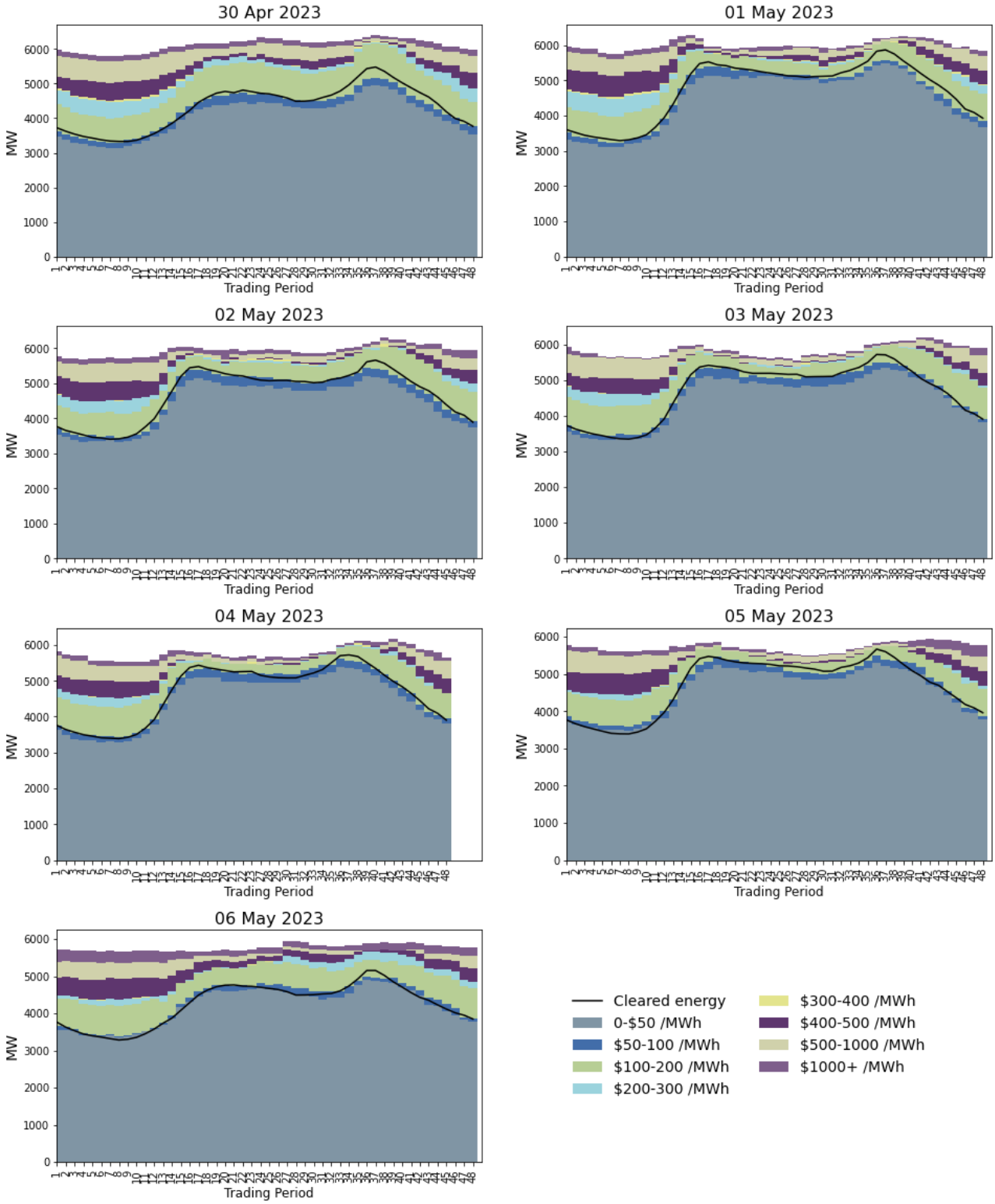


12. Offer Behaviour

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. However, the evening peak demands saw mostly the generation cleared between $100 and $200/MWh band.

[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	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.
12/4/2023	36-39	Further analysis	Genesis	Tuai	Prices change for final energy tranche.
17/4/2023	48	Further analysis	Contact	Clyde and Roxburgh.	Offer changes.
18/4/2023	17	Further analysis	Genesis	Takapō A and B	Offer changes.
19/4/2023	27	Further analysis	Contact	Clyde and Roxburgh.	Offer changes.