Date: 24 July 2023

TRADING CONDUCT REPORT

Market Monitoring Weekly Report

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1. Overview for week of 16 – 22 July 2023

1.1. During this week, prices remained close to the historical average with no prices above the 90th percentile. Hydro generation decreased as national hydro storage continued to decline. Thermal generation remained steady, with fewer peakers running compared to the previous week. This week, wind generation contributed significantly to the overall energy mix. Towards the end of the week, there was an increase in demand compared to the previous week, primarily due to the low temperatures experienced across the country. In addition, during the same period, wind generation also decreased. The HVDC northward flow stayed below its maximum capacity, while there were southward HVDC flows during the nighttime.

2. Spot Prices

2.1. This report monitors underlying wholesale price drivers to assess whether trading periods require further analysis to identify 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 16 – 22 July:

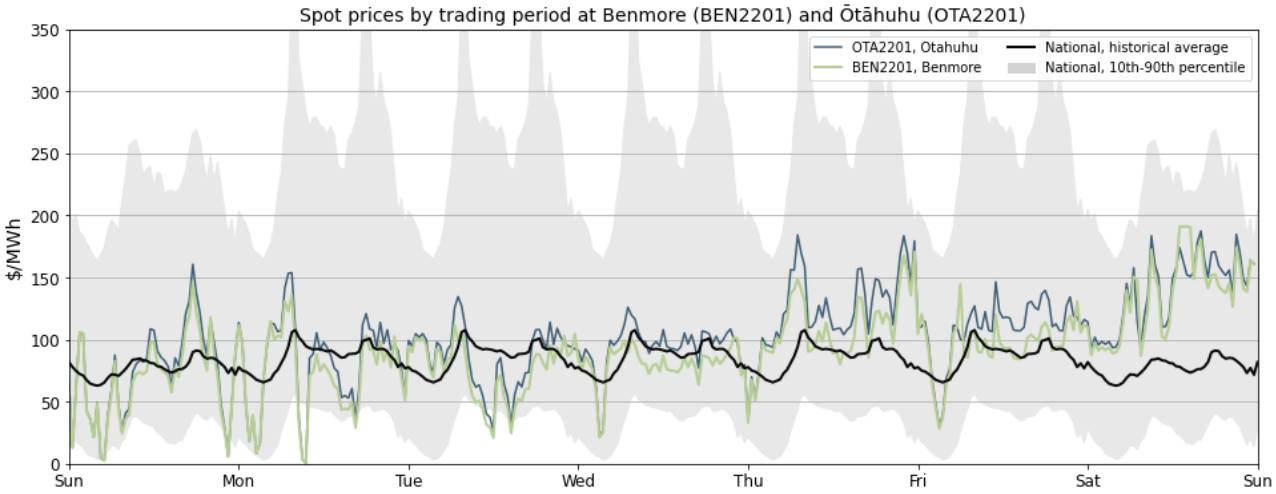
a) The average wholesale spot price across all nodes was $95/MWh.
b) 95 percent of prices fell between $18/MWh and $170/MWh.

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

2.4. Throughout this week, prices once again remained close to the historic average, and there were no observed instances of prices above the 90th percentile. The majority of spot prices fell within the range of $50/MWh to $100/MWh. These average prices can be attributed to the decreasing hydro storage levels, which consequently led to increased reliance on thermal generation.

2.5. At the start of the week, there were instances of low prices, dropping below $1/MWh and falling below the historic 10th percentile. This occurred as wind generation experienced a sudden and significant increase. From Thursday prices were mostly above both the historic mean and $100/MWh as the demand increased due to low temperatures, and also wind generation was low.

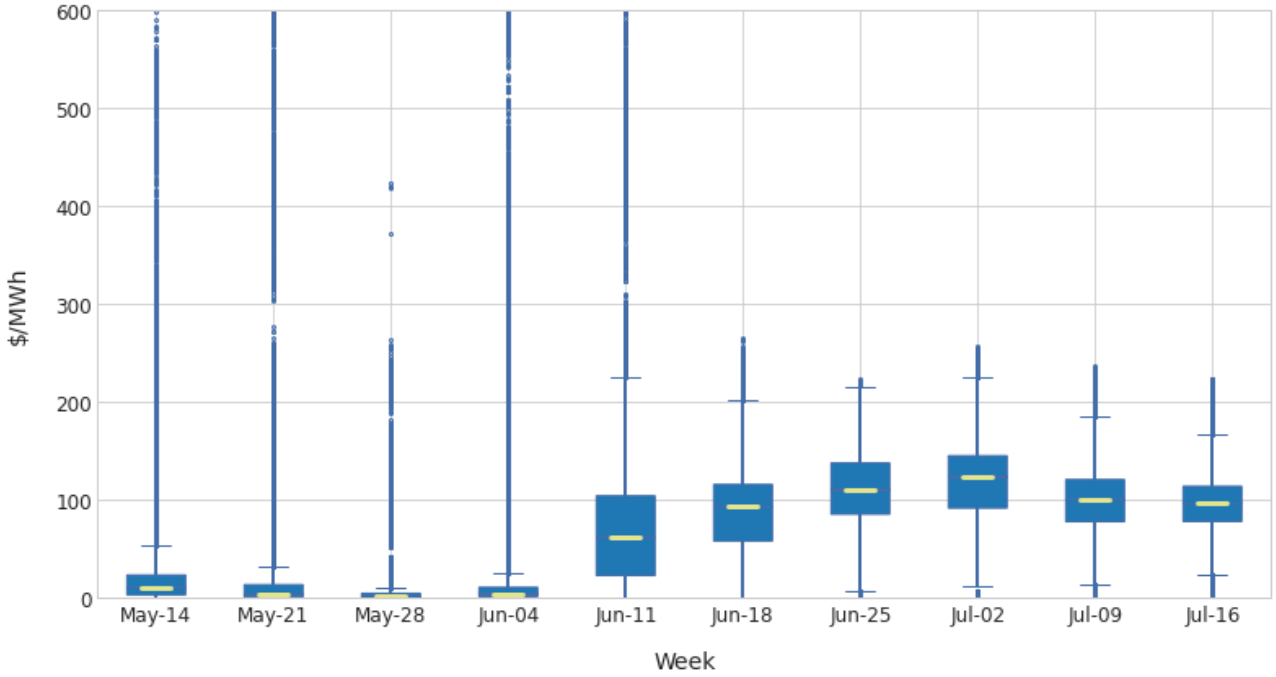
Figure 1: Wholesale Spot Prices between 16 July (Sunday) – 22 July (Saturday) 2023.



2.6. 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.

2.7. During this week, the median and quartile prices experienced a marginal decrease compared to the previous week and remained close to the long-term average. Notably, there were no instances of exceptionally high prices observed throughout the entire week.

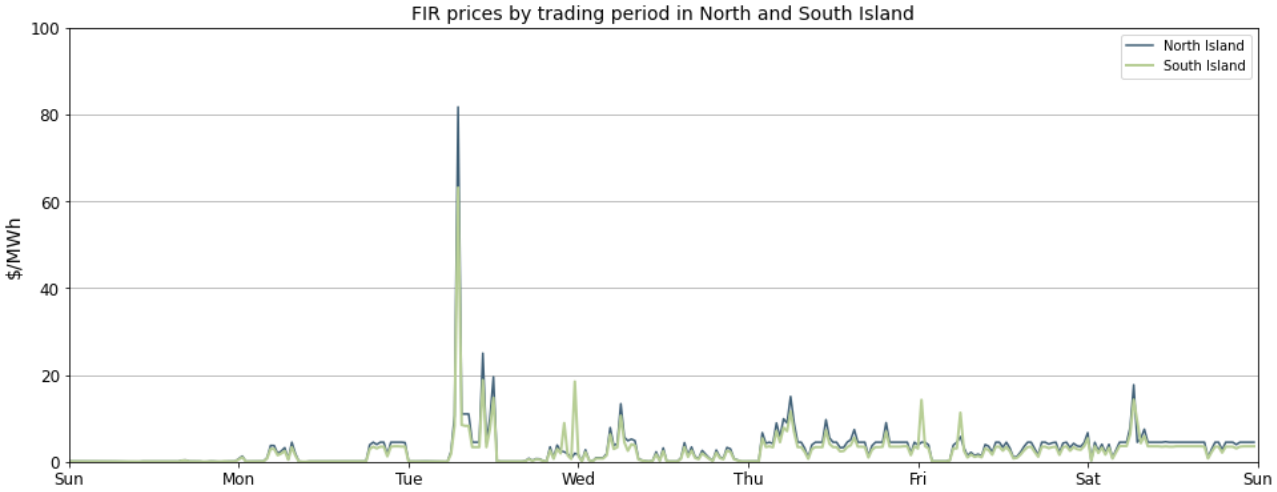
Figure 2: Boxplots showing the distribution of spot prices this week and the previous nine weeks.



3. Reserve Prices

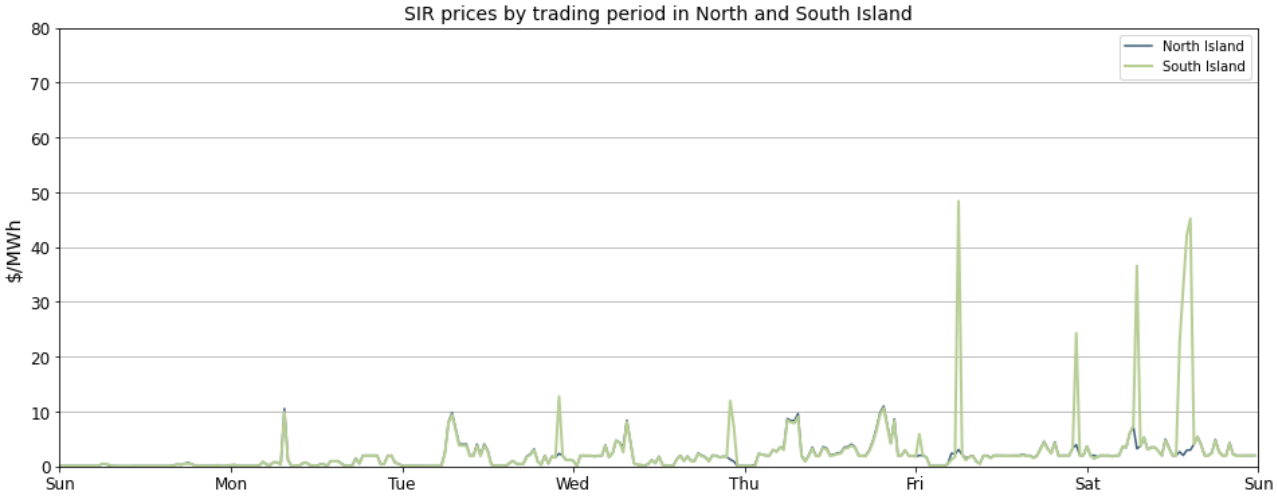
3.1. Fast Instantaneous Reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week the FIR prices were mostly below $20/MWh for both islands. On Tuesday, 18 July at 7:00 am the North Island price was $82/MWh, with the South Island price of $63/MWh when the wind generation was significantly below the forecast.

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 a few price spikes below $50/MWh for the South Island at the end of the week. HVDC switching may have contributed to these small price spikes.

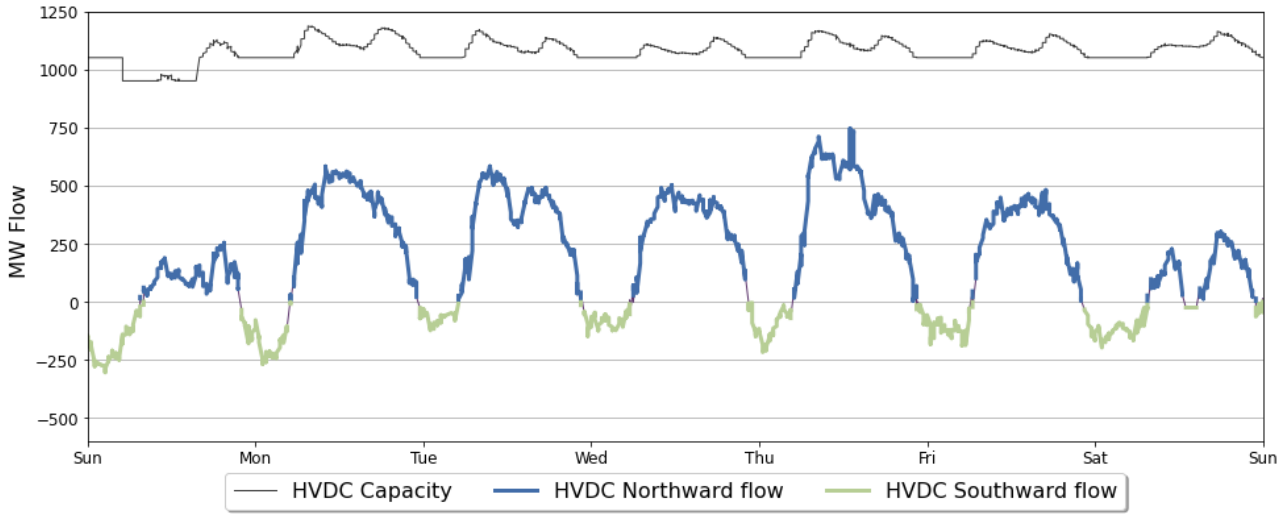
Figure 4: Sustained instantaneous reserve (SIR) prices by trading period and Island.



4. HVDC

4.1. Figure 5 shows HVDC flow between 16 – 22 July. HVDC flows were northward during the daytime and southward during the nighttime. The northward HVDC flow reached up to 750 MW during the daytime, while the southward flow during the nighttime remained below 300 MW. HVDC flow was well below the maximum limits. On Saturday the HVDC flow followed the peak demand pattern as the thermal was running to support the North Island load.

Figure 5: HVDC northward flow and capacity.

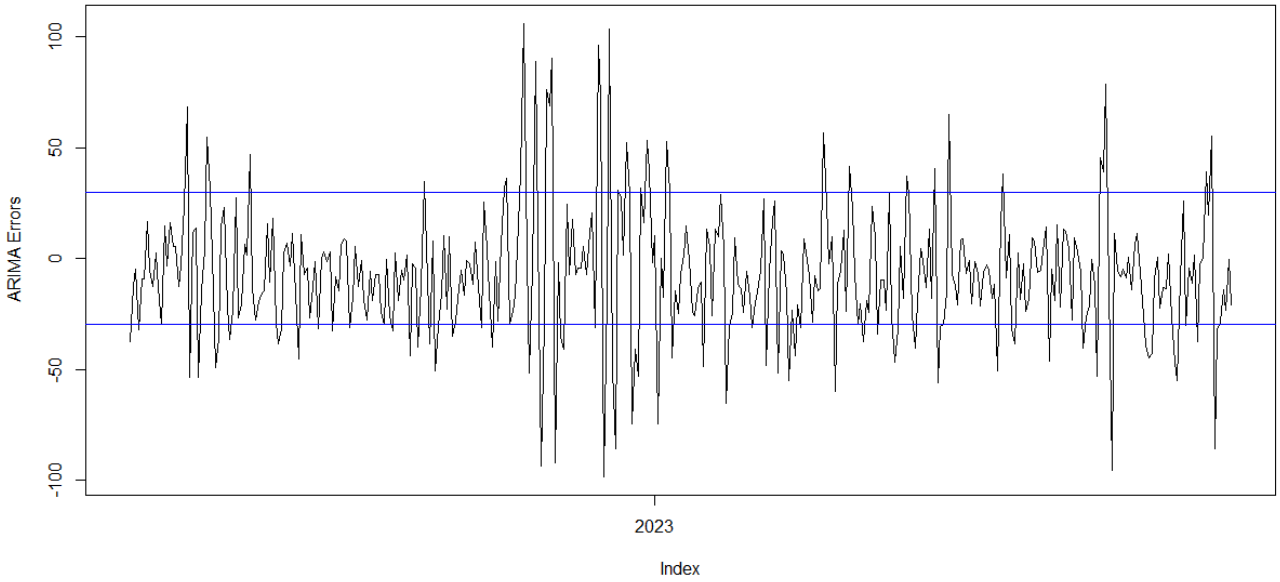


5. Regression Residuals

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 of the data on Monday. This negative residual indicates that the modelled daily price was higher than the actual average daily price, which happened because of a few very low prices (below the 10th percentile) occurring on Monday.

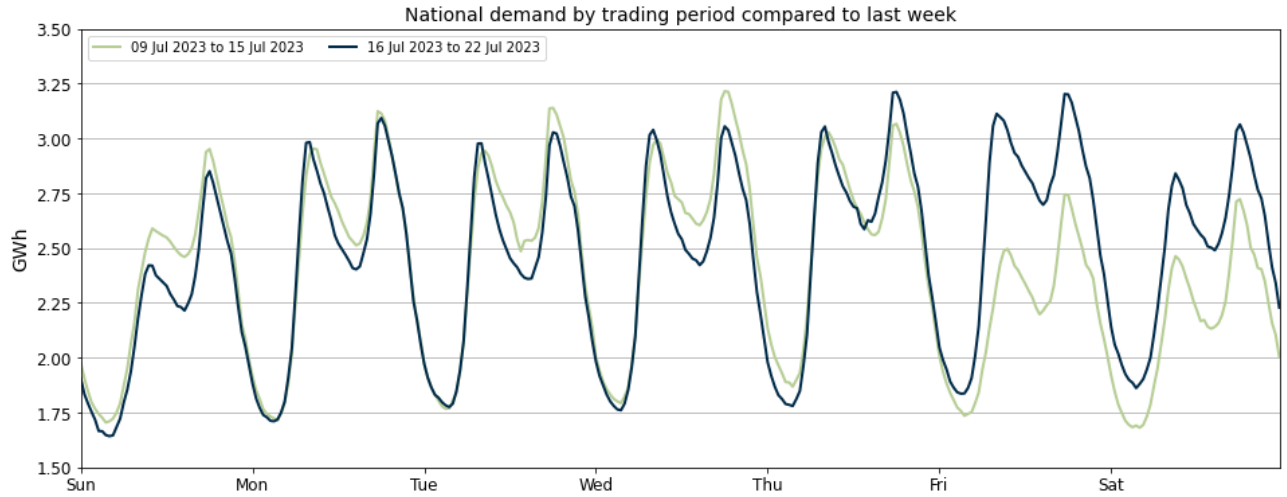
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 22 July 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 16 – 22 July, compared to the previous week. Overall, demand was relatively consistent to the previous week until Friday. On Sunday, the demand was lower, as mild weather conditions prevailed across the country. There were lower evening peaks and reduced off-peak demand on Tuesday and Wednesday. However, on Thursday, the evening peak was higher than usual. On Friday, there was an increase in demand compared to the previous week, due to it being a public holiday last Friday. Moreover, on Saturday, the demand experienced a rise, driven by relatively low temperatures observed during that day.

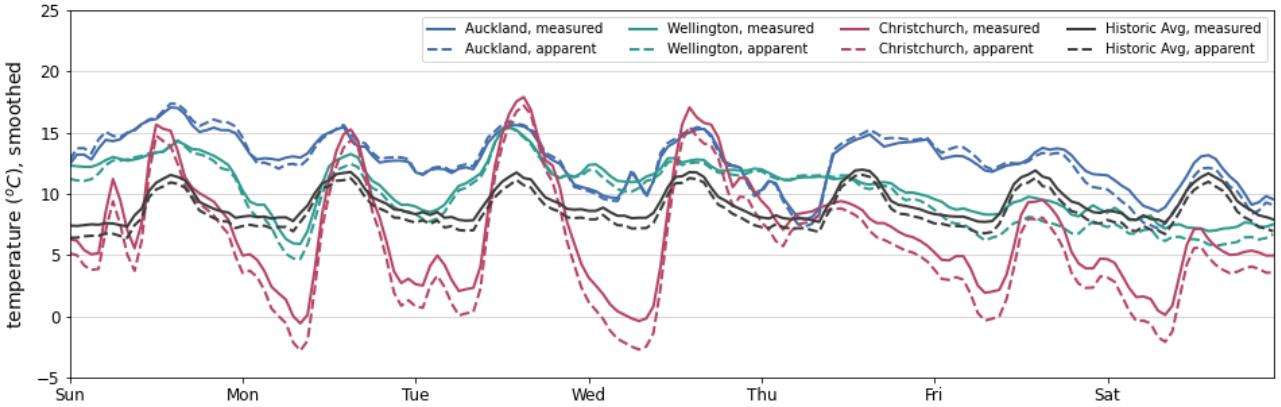
Figure 7: National demand by trading period compared to the previous week.



6.1. Figure 8 shows hourly temperatures at the three main population centres between 16 – 22 July. 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. In Auckland, temperatures remained predominantly above average and consistently above 10 degrees throughout the week, except on Thursday and Saturday when they were lower. Wellington experienced temperatures around or above the historic average for the majority of the week, with a notable drop to around 5 degrees on Monday morning. However, Christchurch witnessed the most significant temperature fluctuations, with morning apparent temperatures dipping below 0 degrees on most days, the apparent temperatures in Christchurch ranged from -3 degrees to 18 degrees.

Figure 8: Temperatures across main centres.



7. Outages

7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 16 – 22 July ranged between ~800 MW and 1300 MW.

7.2. Notable outages include:

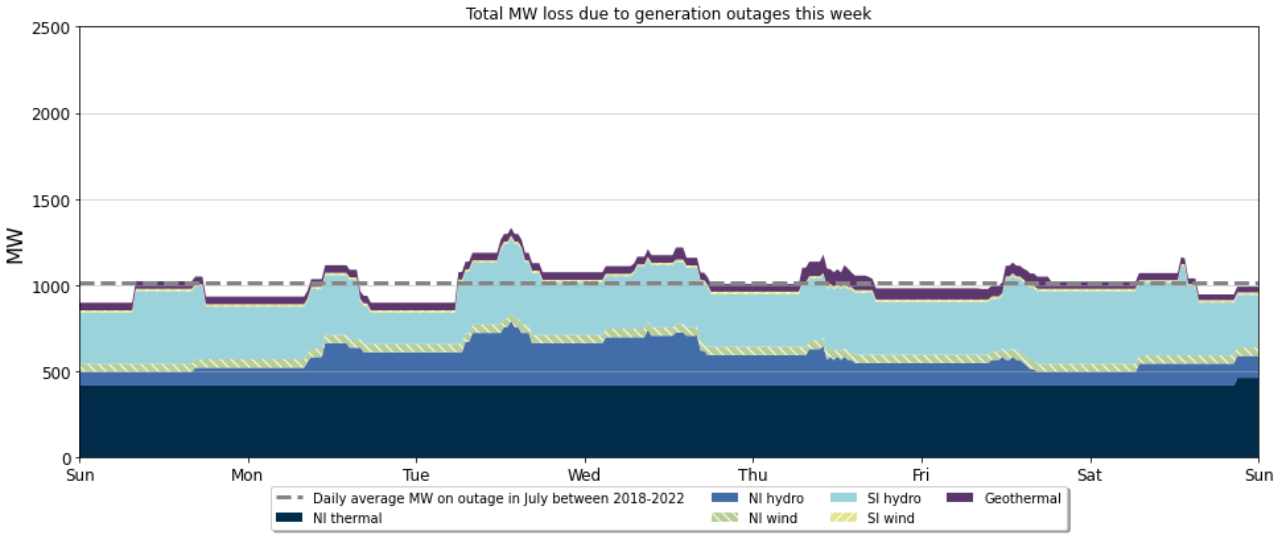
(a) Huntly 5 extended outage from until 31 July to 31 August.

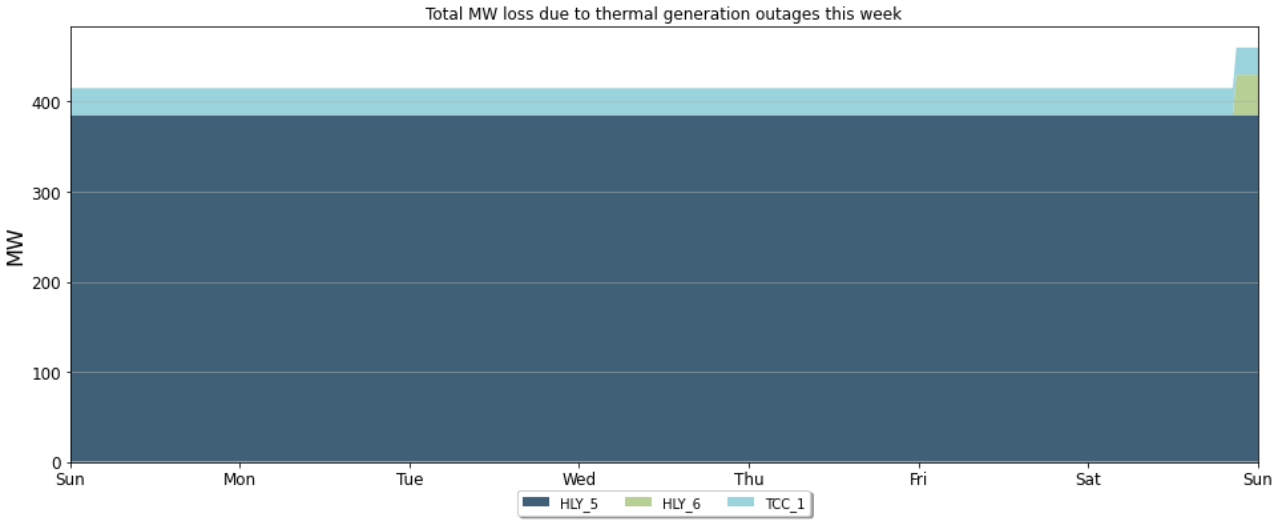
(b) Huntly 6 was on outage from 22 to 23 July.

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

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

Figure 9: Total MW loss due to generation outages.



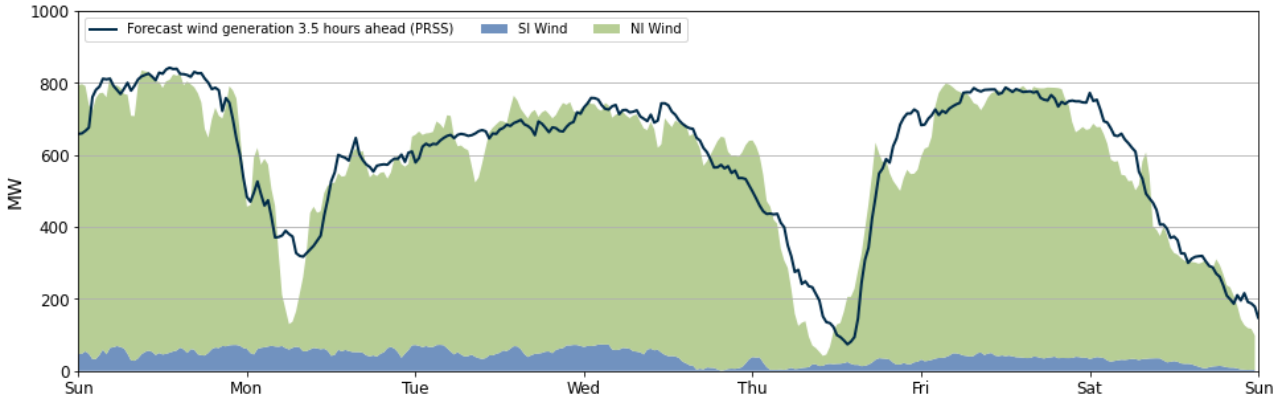


8. Generation

8.1. Figure 10 shows wind generation, from 16 – 22 July, ranged from 40 - 830 MW across the week. At the start of the week, started off strong, reaching around 800 MW. However, there was a sharp decrease in wind generation on Monday morning, dropping to approximately 120 MW, significantly lower than the initial forecast.

8.2. From Monday, wind generation gradually increased, stabilizing at around 700 MW until it experienced a notable drop on Thursday, falling below 100 MW and deviating from the predicted levels. However, on Thursday, wind generation rebounded, reaching up to 600 MW. On Friday, wind generation remained high but then steadily declined to around 100 MW by Saturday. On Saturday, there were periods when the wind dropped, coinciding with spot prices sitting above the historic average.

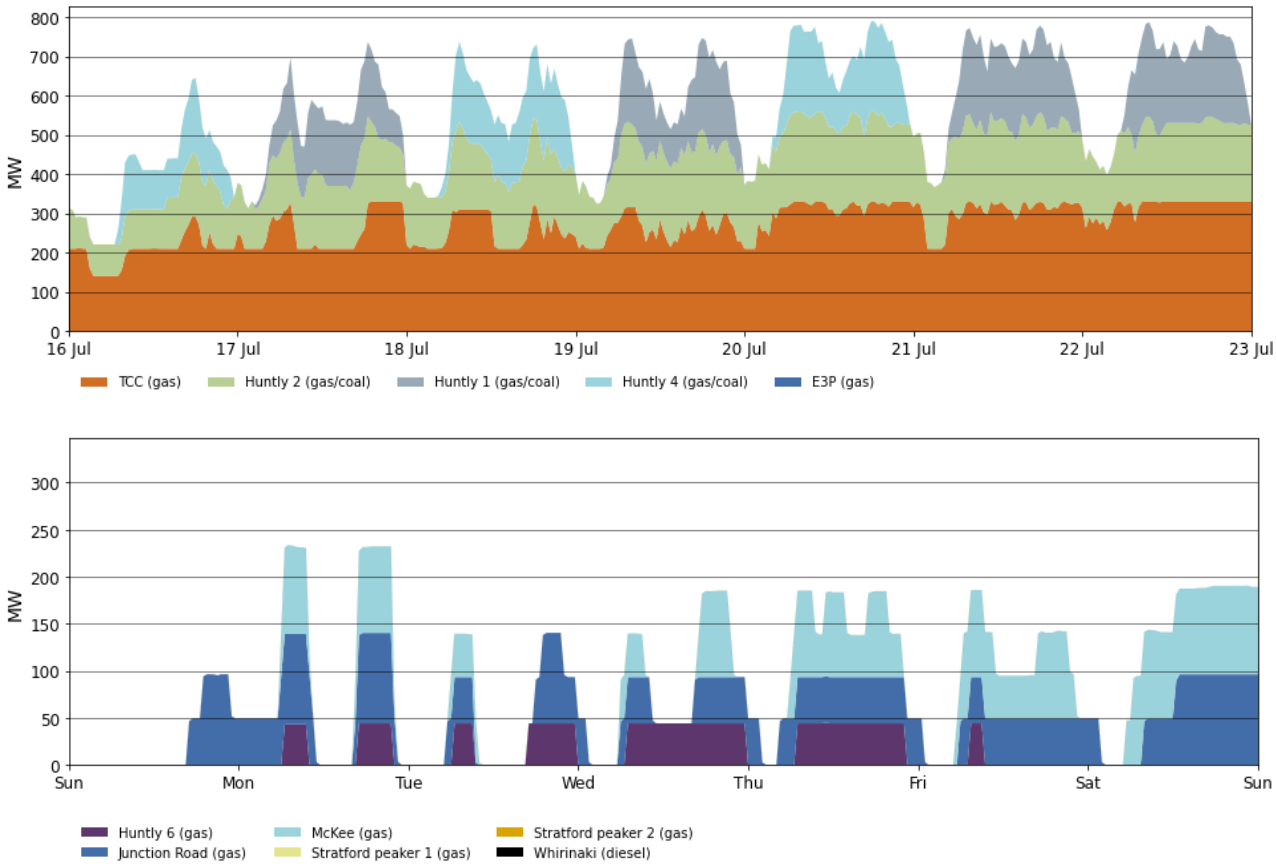
Figure 10: Wind Generation and forecast.



8.3. Figure 11 shows the generation of thermal baseload and thermal peaker plants between 16 – 22 July. Like the previous weeks, as E3P (Huntly 5) is on outage, Huntly was cycling the three Rankine units on and off to support baseload requirements. TCC and Huntly 2 ran continuously as baseload throughout the week. Huntly 1 ran on Monday, Wednesday, Friday and Saturday while Huntly 4 alternatively ran on Sunday, Tuesday and Thursday.

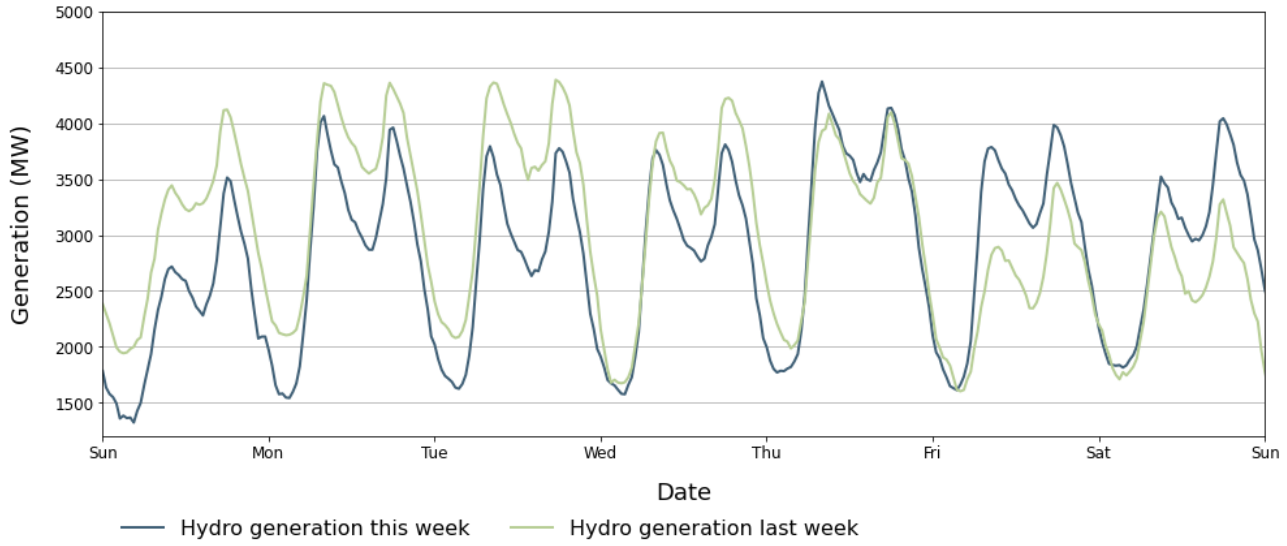
8.4. Due to relatively high wind generation, there was a reduced need for thermal peakers. Junction Road and McKee ran during peak demand periods, and shoulder periods in the latter half of the week. Huntly 6 ran during the peak demand periods on working days and during the shoulder periods on Wednesday and Thursday.

Figure 11: Thermal Generation.



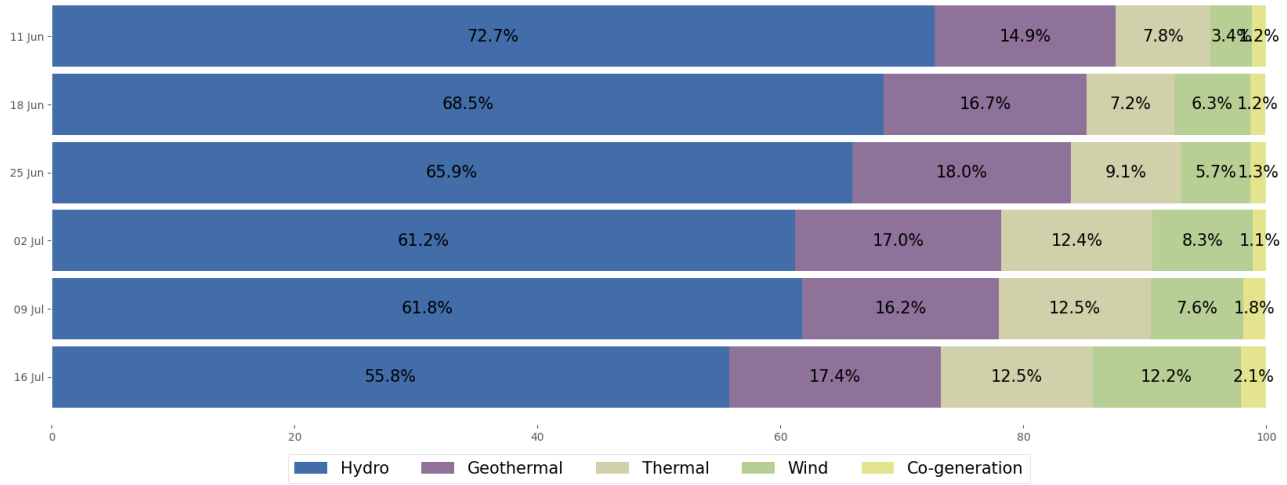
8.5. Figure 12 shows hydro generation between 16 – 22 July. Hydro generation from Sunday to Wednesday was lower than the previous week. However, on Thursday, there was a notable increase in morning peak generation, while the generation levels remained similar for the rest of the day. On Friday and Saturday, there was a significant increase in hydro generation. Last week, on Friday, the generation was lower due to it being a public holiday. On Saturday, demand was high, and wind generation was low, which further contributed to the increased hydro generation during that day.

Figure 12: Hydro generation between 16 – 22 July compared to the previous week.



8.6. As a percentage of total generation, between 16 – 22 July, total weekly hydro generation was 55.8 percent, geothermal 17.4 percent, thermal 12.5 percent, wind 12.2 percent, and co-generation 2.1 percent. Overall wind generation was higher this week. A notable increase in thermal generation from previous few weeks can be due to relatively lower hydro generation.

Figure 13: Total generation as a percentage each week between 11 June and 22 July 2023.



9. Storage/Fuel Supply

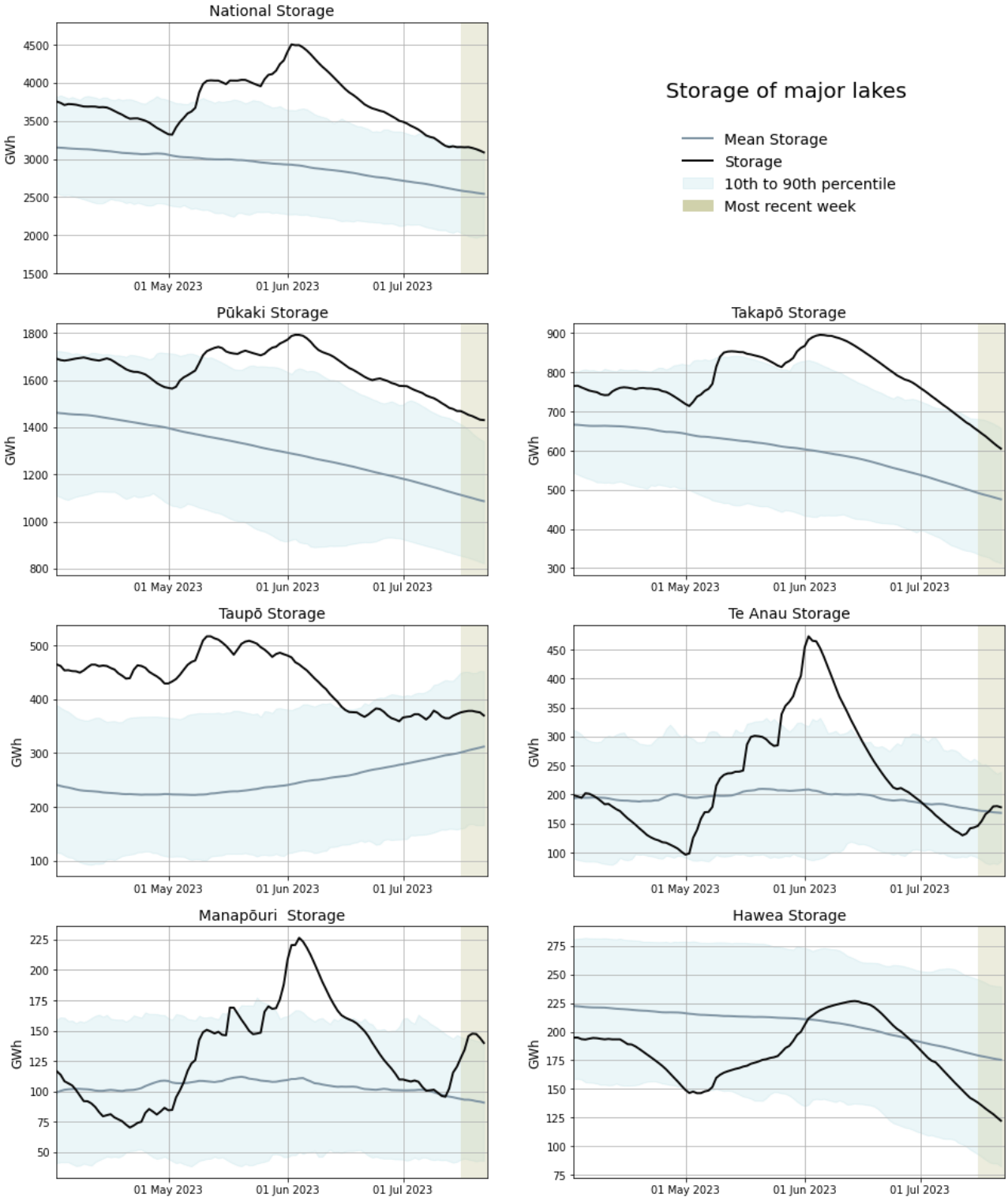
9.1. Figure 14 shows total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

9.2. National hydro storage levels have decreased this week to 76 percent of nominal full as of 22 July. However national controlled storage is still high at 118.6 percent of the historic mean for this time of year.

9.3. During this week, most lake levels experienced a decline. Lake Pūkaki is slightly above its historic 90th percentile and Takapō just under its historic 90th percentile. Storage at lakes Te Anau and Manapōuri increased at the start of the week and then decreased, Te Anau is slightly above its historical average, while Manapōuri is touching its respective 90th percentile. The storage level at Taupō is below its historical 90th percentile but above its

historic mean. Hawea storage decreased and is currently below its historic mean for this time of year.

Figure 14: Hydro Storage.

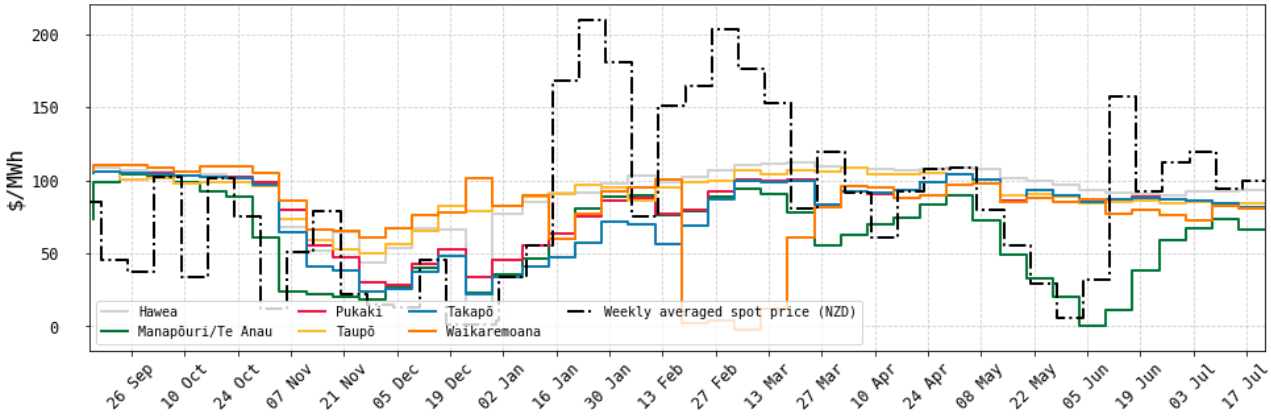


10. JADE Water Values

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 22 July 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. Recently the water values in most of the lakes remained relatively steady. Water values at Te Anau and Manapōuri have been increasing in recent weeks as storage decreased, with a small decrease in the water value in the last week as storage increased again.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 22 July 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 July 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 July, Indonesian coal was at around ~$456/tonne (NZD) putting the latest SRMC of coal-fuelled Huntly generation at ~$247/MWh.

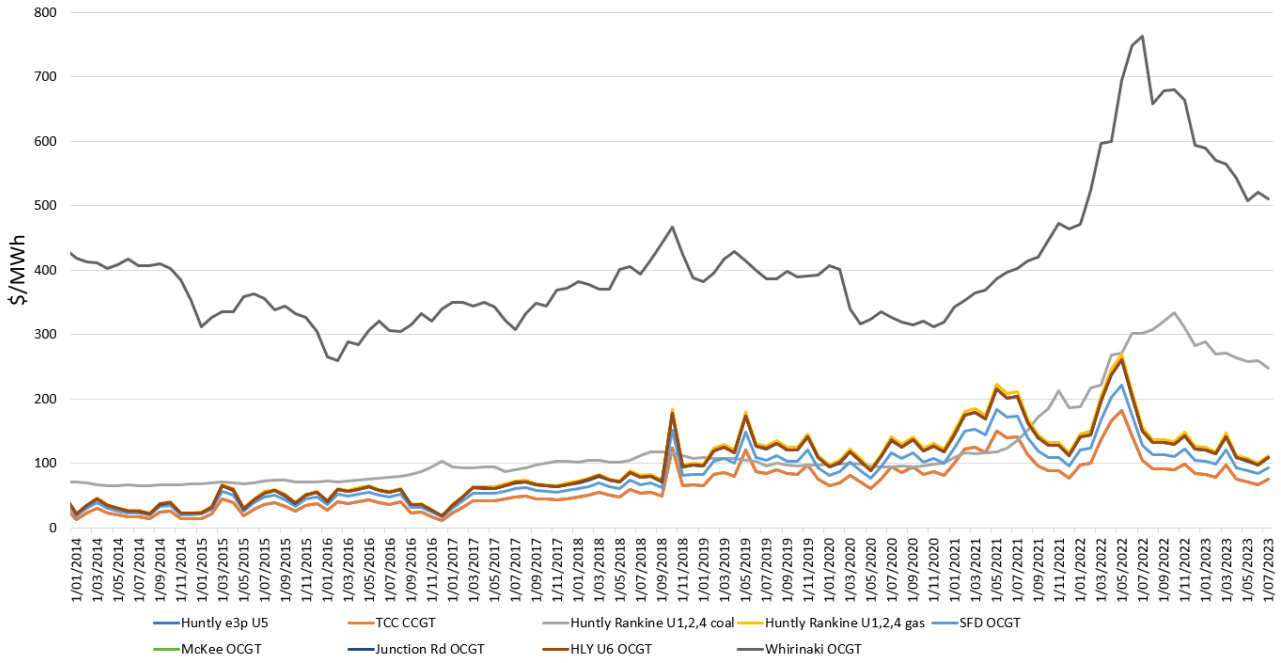
11.5. The SRMC of Whirinaki has decreased to ~$511/MWh.

11.6. The SRMC of gas fuelled thermal plants increased slightly and is between $75/MWh and $113/MWh, likely due to an increase in thermal generation.

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

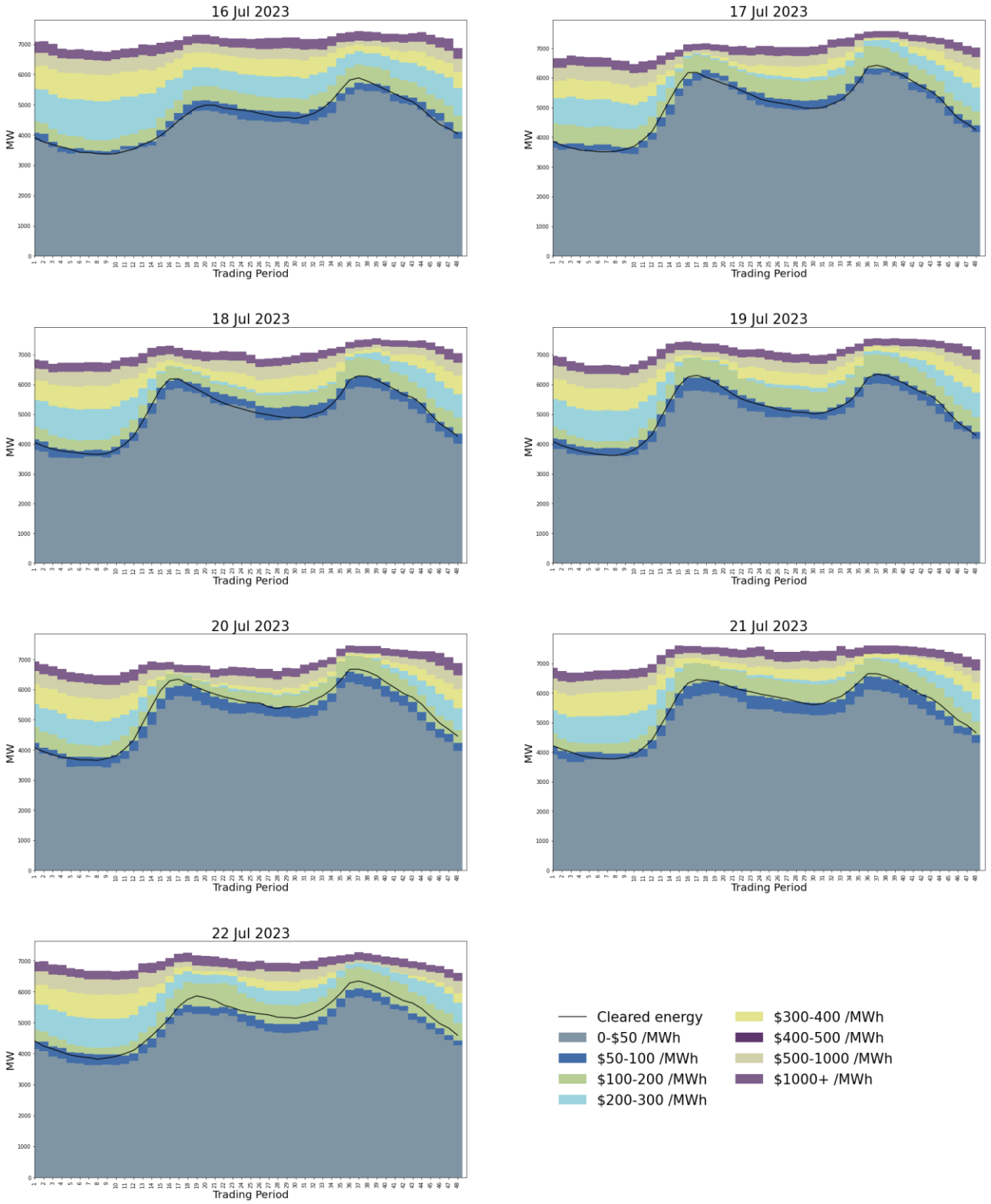
12.1. Figure 17 shows this week's national daily offer stacks. The black line shows cleared energy, indicating the range of the average final price.

12.2. Throughout the week, most generation cleared in the price range of $0-$100/MWh or in the $100-$200/MWh price range, especially in the evening peak $100 to $200/MWh band.

12.3. The rise in generation within the relatively higher price bands might be due to the decline in hydro storage, which was compensated by increased thermal generation. However, the presence of wind generation played a crucial role in providing support and keeping the prices within the lower bands.

12.4. From Thursday, there was an increase in generation offered into the market within the $100-$200/MWh price range. On Saturday, there was an increase in the volume of generation cleared within the $50-$200/MWh range, primarily due to low wind generation.

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.

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.
18/05/2023	Several	Further Analysis	Contact	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.