24 October 2023

Trading conduct report

Market monitoring weekly report

Trading conduct report

1. Overview for week of 15-21 October

1.1. This week prices were generally above historic average, with most prices between $99-$147/MWh. Thermal generation continues to decrease as demand also decreased in line with warmer weather conditions across the country. Wind was more variable than we have seen in recent weeks with an average of ~440MW. Hydro storage remains above average at 107% of mean as of 22 October.

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.

2.2. Figure 1 shows the wholesale spot prices at Benmore and Ōtāhuhu alongside their historic average and historic 10th-90th percentiles adjusted for inflation. Prices above the historic 90th percentile are highlighted with a vertical black line. Other notable prices that did not exceed the 90th percentile, are marked with black dashed lines.

2.3. Between 15-21 October:

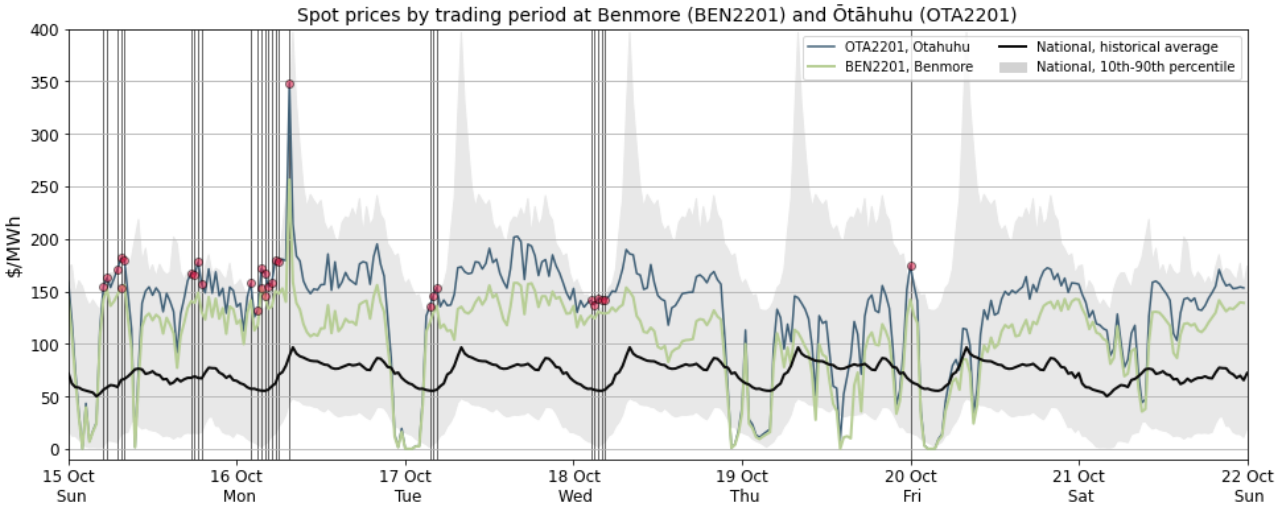
(a) The average wholesale spot price across all nodes was $116/MWh.

(b) 95 percent of prices fell between $1/MWh and $179/MWh.

2.4. Overall, the majority of spot prices sat above the historic average, although a few days of lower overnight prices this week saw the overall average price drop by around $20/MWh. During Sunday morning, wind was lower than forecast by between 65 and 135MW over a few trading periods as well as there being some under forecast demand. This likely contributed to this group of prices sitting above the 90th percentile.

2.5. Similarly on Monday, from around 2.00am to 6.00am the wind generation was between 86 and162MW lower than forecast, likely contributing to these higher overnight prices. There was also one significant price spike this week on Monday morning at 7.30am. The price at Ōtāhuhu was $348/MWh and at Benmore $256/MWh. During this trading period NI demand was close to 50MW under forecast, with SI demand around 70MW under forecast. There was also lower wind than forecast (96MW difference).

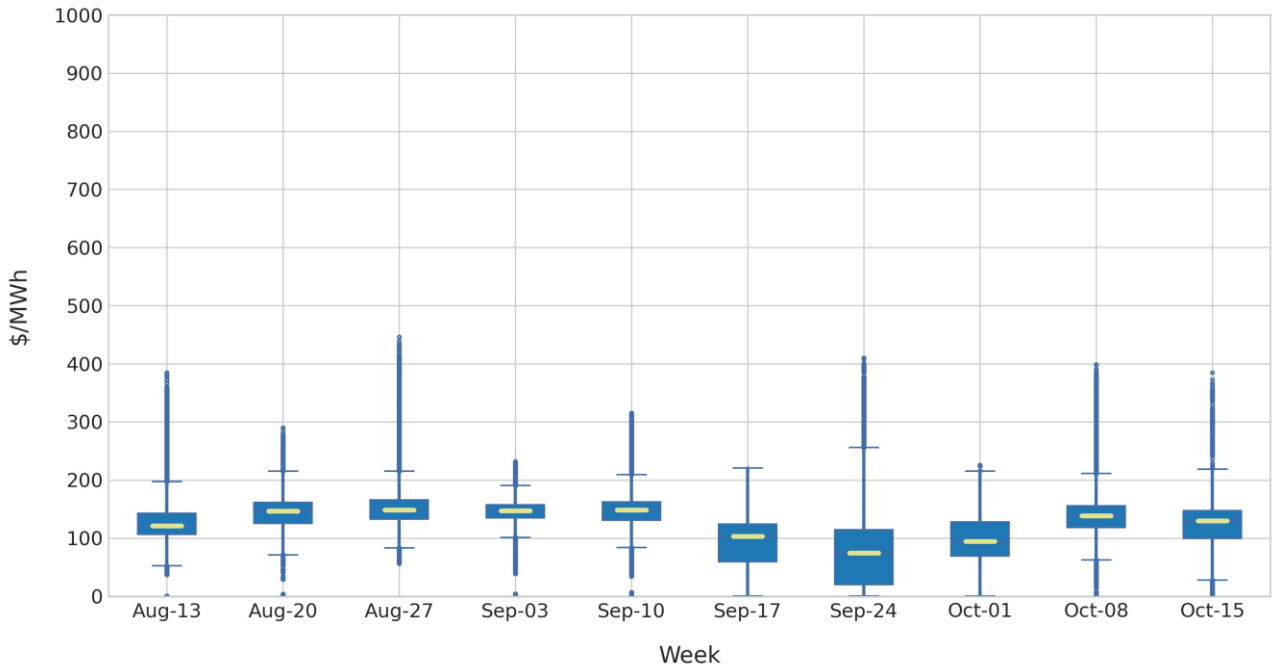
Figure 1: Wholesale spot price between 14 October (Sunday) and 21 October (Saturday)



2.6. Figure 2 shows a box plot with the distribution of spot prices during this week and the previous nine weeks. The yellow 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. The overall distribution of prices was generally small, although there were some prices between $250-$380/MWh, given the spike in prices on Monday morning. However, mostly prices sat within $99/MWh and $147/MWh.

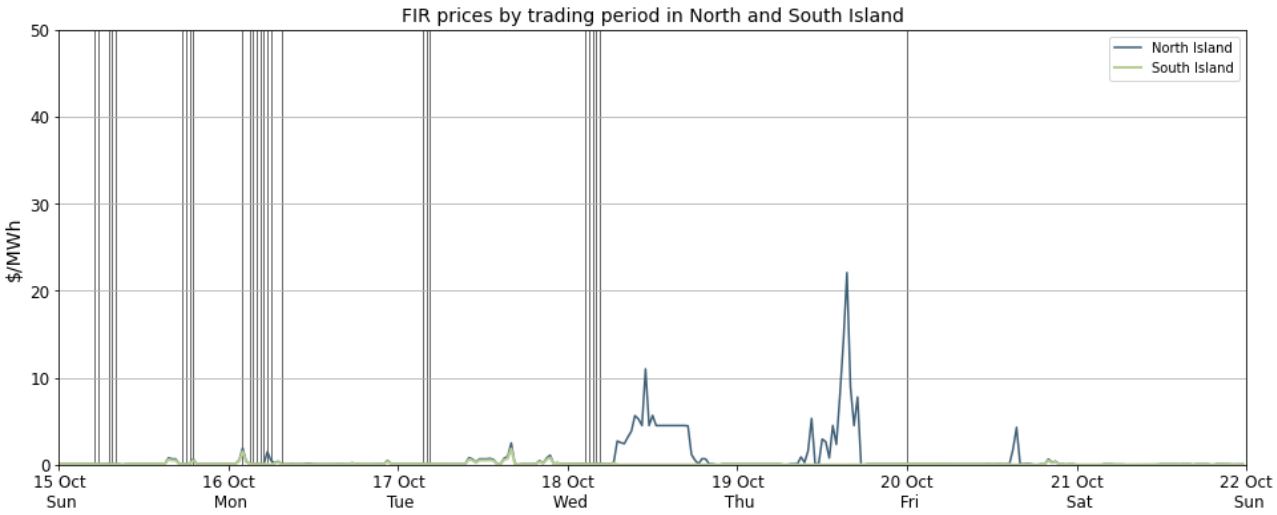
Figure 2: Boxplots showing the distribution of spot prices this week and the previous nine weeks



3. Reserve prices

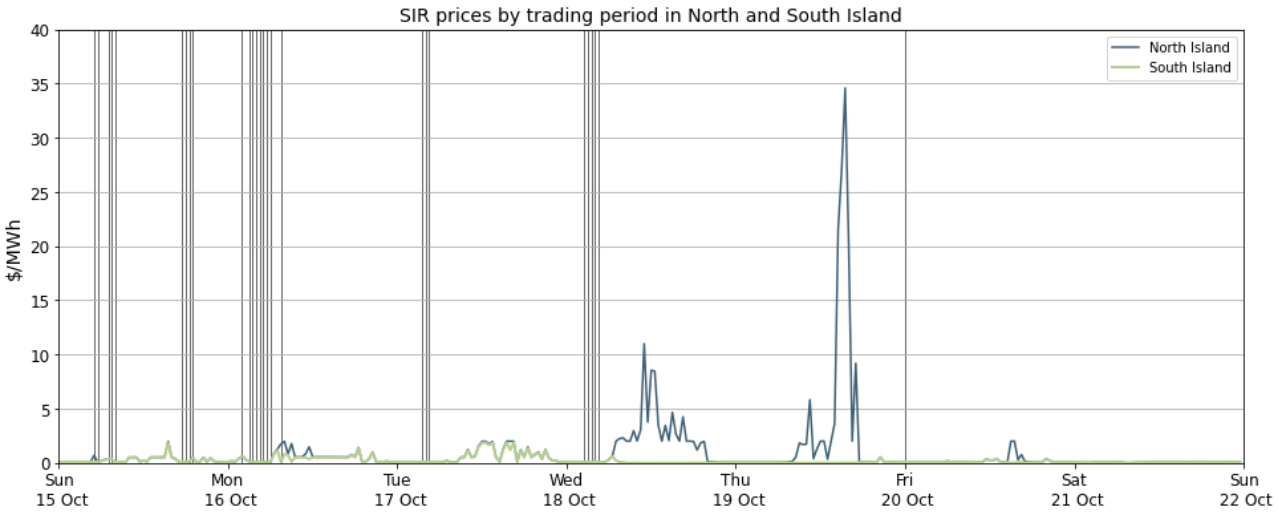
3.1. Fast Instantaneous Reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week FIR prices were mostly below $10/MWh. A binding risk on the HVDC[1] on Thursday caused a small spike in North Island FIR of $22/MWh.

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 $5/MWh. As with the FIR above on Thursday at 3.30pm, North Island SIR spiked to around $34/MWh due to binding on the HVDC.

Figure 4: Sustained Instantaneous Reserve (SIR) prices by trading period and island

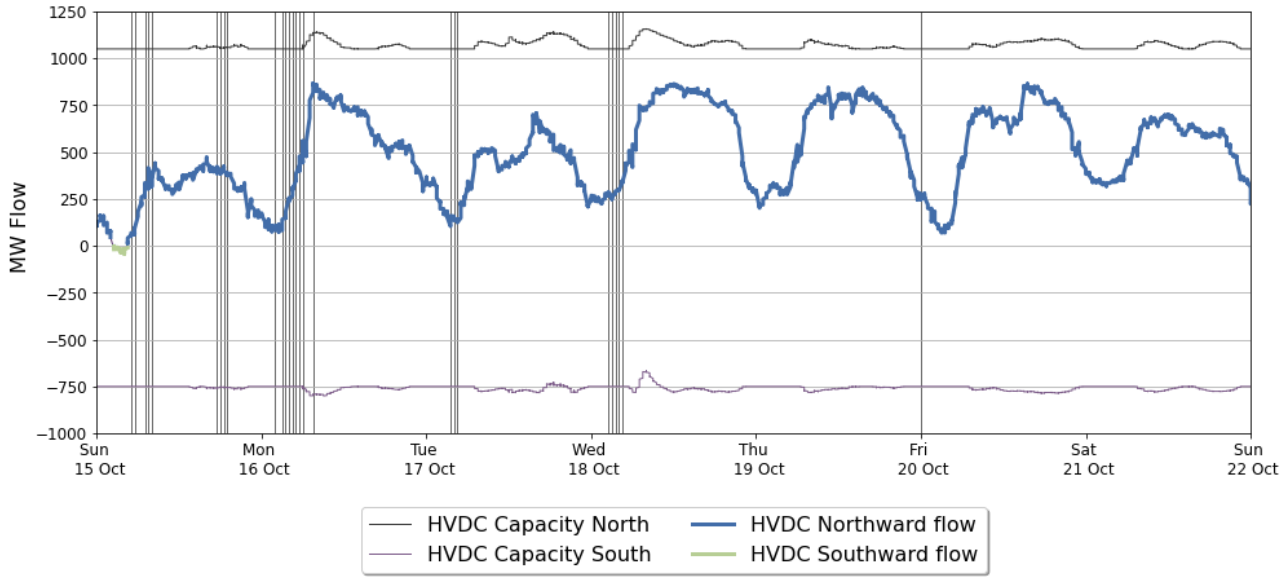


[1] Instantaneous reserve is procured to cover the potential loss of injection from a large generator or one or both poles of the HVDC link, called contingencies or risks. The binding risk is essentially the largest of these—the one that determines the required quantity of instantaneous reserve. Reserve to cover generator risks can be shared between the North and South islands. However, reserve to cover HVDC risks must be located in the receiving island. Because SPD co-optimises energy and reserve, when an HVDC risk binds it can cause both energy and reserve price separation between the islands.

4. HVDC

4.1. Figure 5 shows HVDC flow between 15-21 October. HVDC flows were predominantly northwards apart from a short time early on Sunday morning. Most of the working week saw northwards flow of above 750MW during the day with flow during the price spike on Monday reaching ~867MW.

Figure 5: HVDC flow and capacity



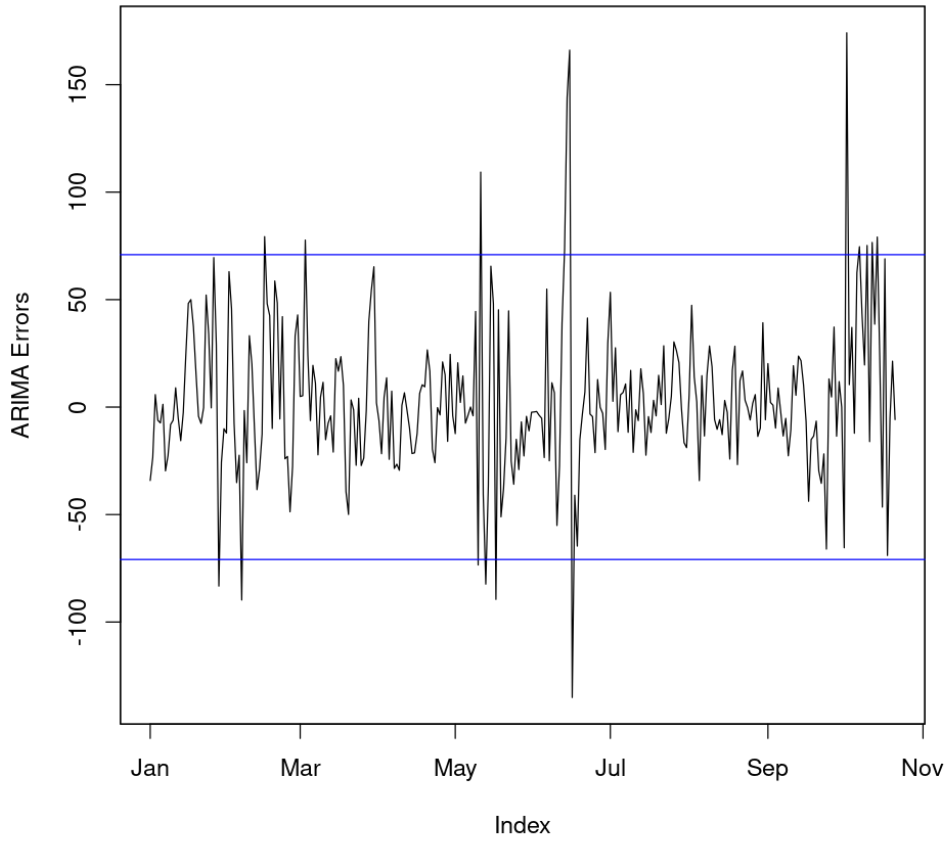
5. Regression residuals

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. Positive residuals indicate that the modelled daily price is lower than actual average daily price and vice versa. When residuals are small this indicates that average daily prices are likely largely aligned with market conditions. These small deviations reflect market variations that may not be controlled for in the regression analysis. This week all prices were within two standard deviations of the data.[2]

[2] Each week this model is rerun with the latest data, including the latest reconciled data, therefore previous residuals can change. Substituting in September's reconciled data has resulted in larger residuals for October, particularly the previous week. In the previous trading conduct report, we had noted a high number of prices above the 90th percentile and flagged 11 October for further analysis.

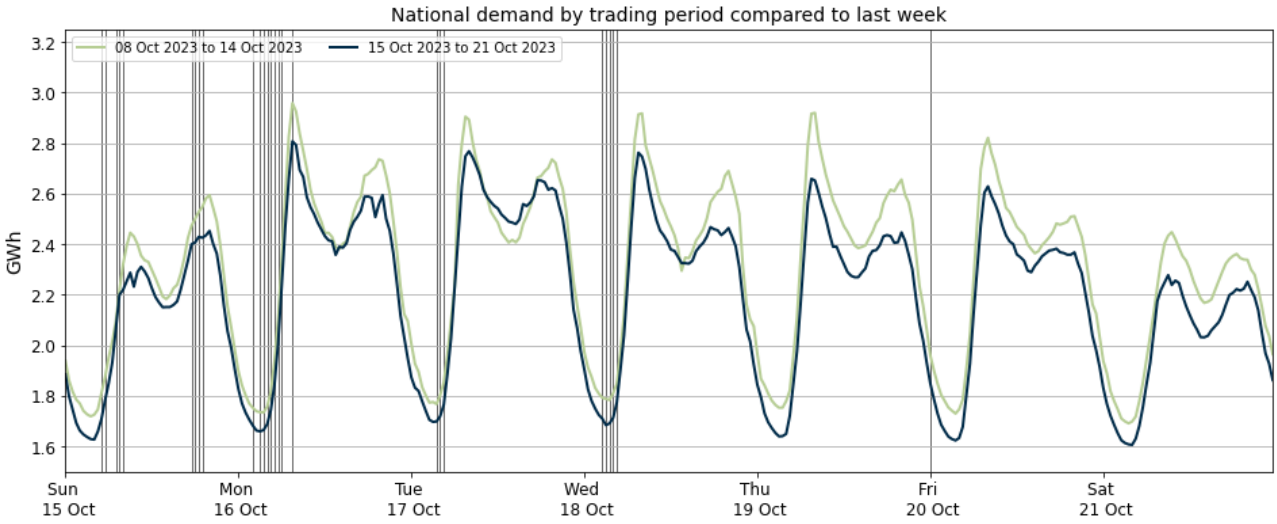
Figure 6: Residual plot of estimated daily average spot prices from 1 January 2023 - 21 October 2023



6. Demand

6.1. Figure 7 shows national demand between 15-21 October, compared to the previous week. Overall, demand was generally lower than the previous week with lower evening peaks as warmer weather occurred last week.

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

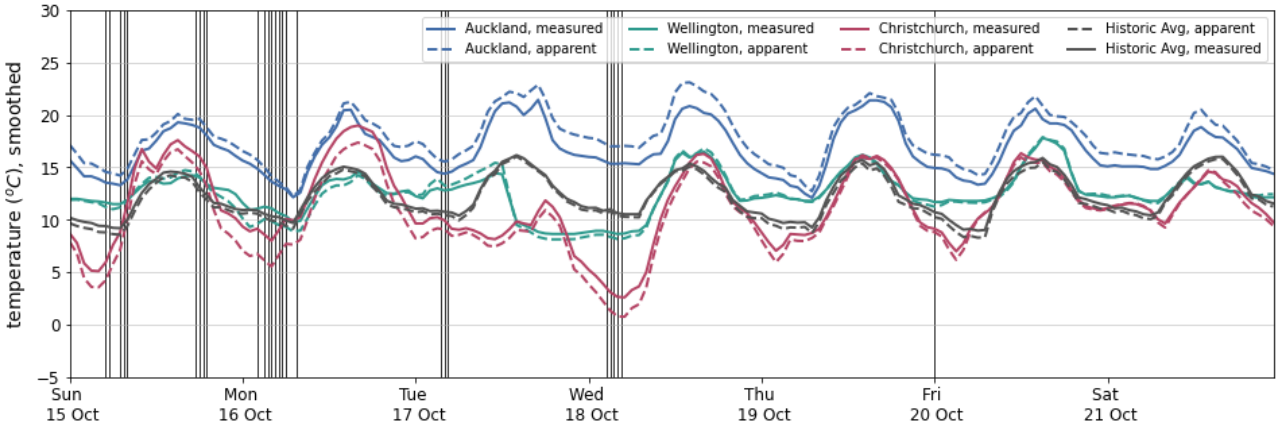


6.2. Figure 8 shows the hourly temperature at main population centres from 15-21 October. The measured temperature is the recorded temperature, while the apparent temperature adjusts

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. Temperatures in Auckland were above average the whole week. Wellington temperatures were mainly on or above average, apart from during Tuesday which saw temperatures drop to single digits. Christchurch saw some variability in temperatures at the beginning of the week, with the latter half seeing most temperatures sit around historic average.

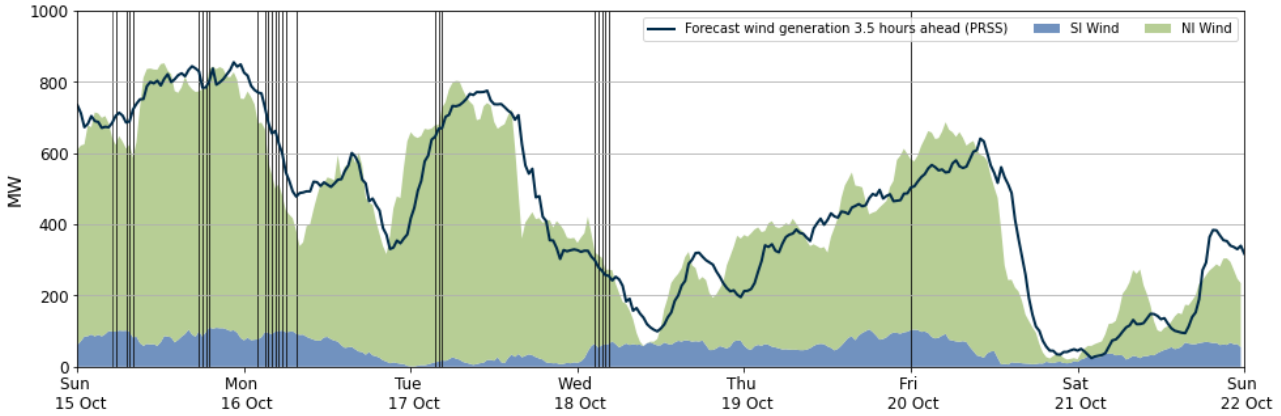
Figure 8: Temperatures across main centres



7. Generation

7.1. Figure 9 shows wind generation, from 15-21 October. Wind generation varied a lot this week with generation ranging between 20MW and 852MW across the week. There were also significant gaps in forecast and actual wind during this week.

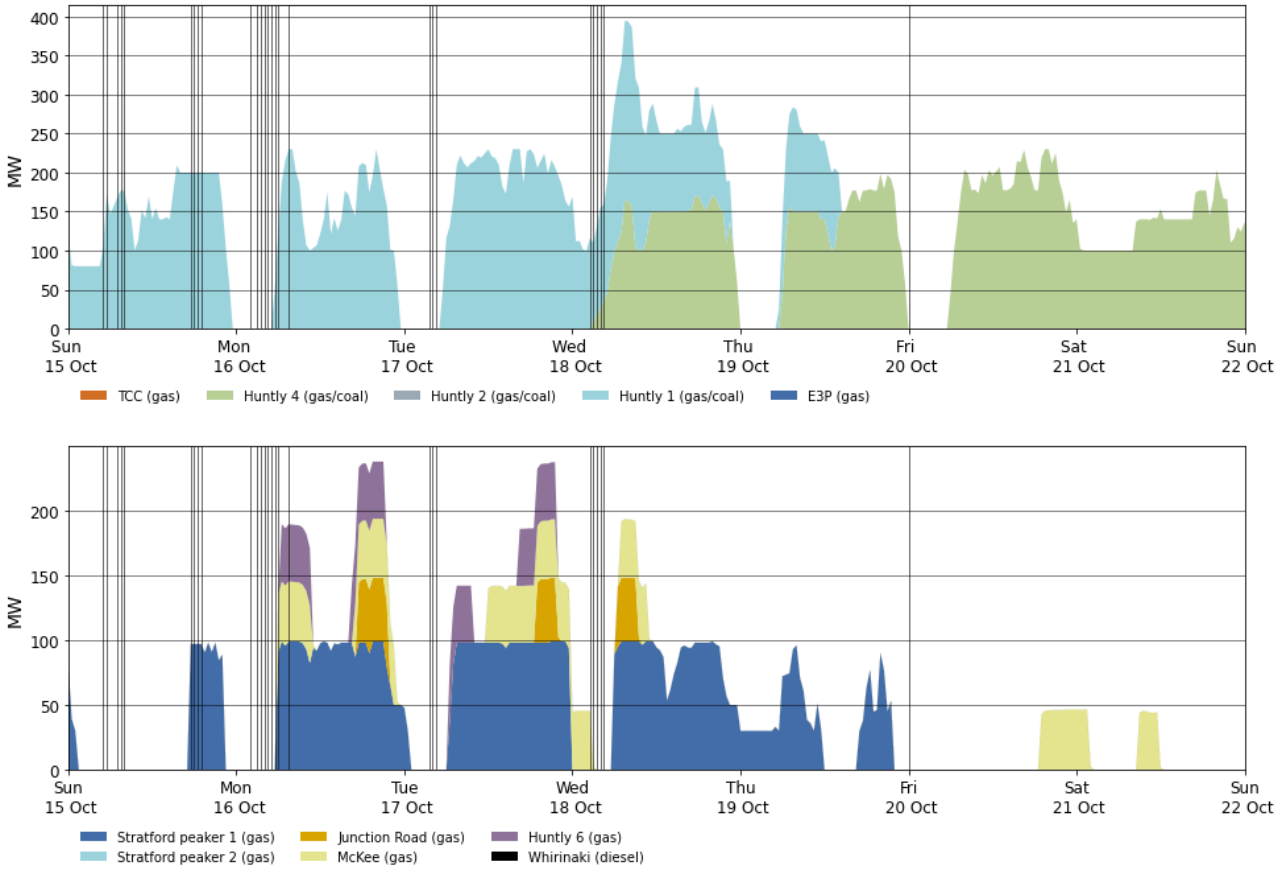
Figure 9: Wind generation and forecast between 15-21 October



7.2. Figure 10 shows the generation of thermal baseload and thermal peaker plants between 15-21 October. Mostly only one Rankine (either Huntly 1 or Huntly 4) ran as baseload, with generation also turning off overnight. Wednesday during the day and Thursday morning were the only times both Huntly 1 and Huntly 4 ran together.

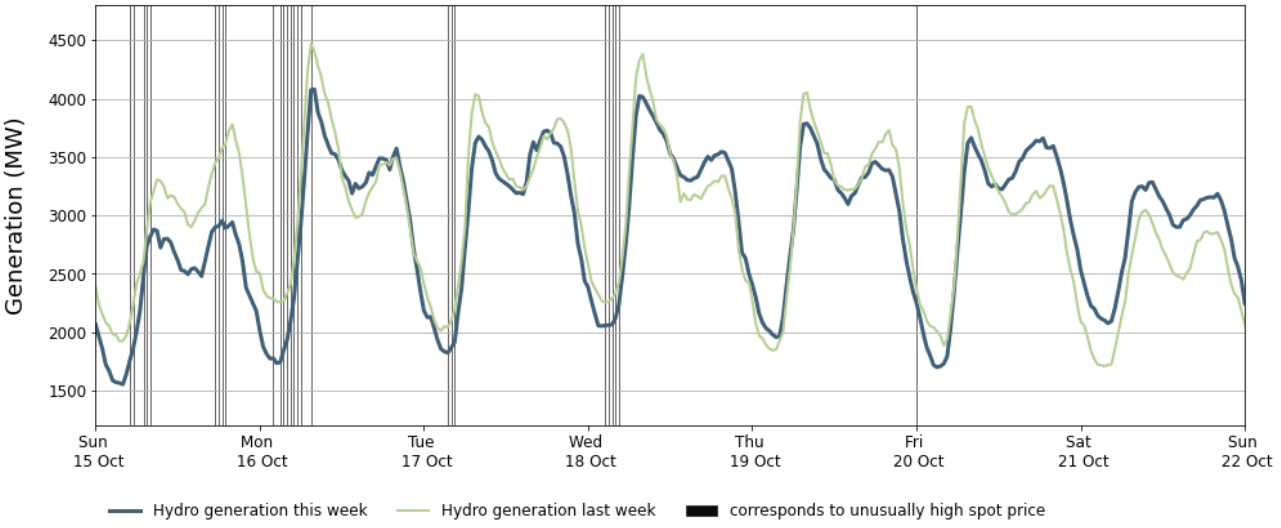
7.3. The beginning of the working week saw most peakers running, with Stratford 1 also running across the shoulder period from Monday to Wednesday. As temperatures increased and demand dropped there was less need for peakers during the second half of the week.

Figure 10: Thermal generation between 15-21 October



7.4. Figure 11 shows hydro generation between 15-21 October. Hydro generation during the morning peaks was lower than the previous week. Friday afternoon and during Saturday hydro generation was higher than the previous week likely due to less thermal running and some lower wind generation.

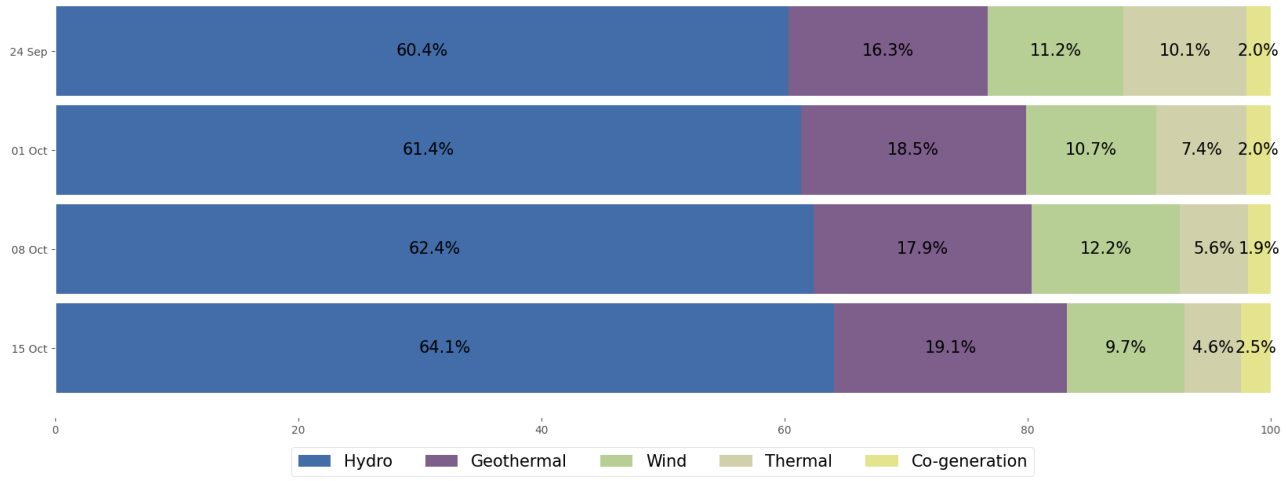
Figure 11: Hydro generation between 15-21 October compared to the previous week



7.5. As a percentage of total generation, between 15-21 October, total weekly hydro generation was 64.1%, geothermal 19.1%, wind 9.7%, thermal 4.6%, and co-generation 2.5%. A small

increase in the proportion of hydro and geothermal generation this week is in line with the drop in wind and thermal generation.

Figure 12: Total generation by type as a percentage each week between 24 September and 21 October 2023



8. Outages

8.1. Figure 13 shows generation capacity on outage. Total capacity on outage between 15-21 October ranged from 1400MW to ~2000MW. Outages have been higher than average for October.

8.2. Notable outages include:

(a) Huntly 5 on outage until 31 January 2024.

(b) Huntly 2 was on outage 19 October.

(c) Stratford 1 was on outage 19 October.

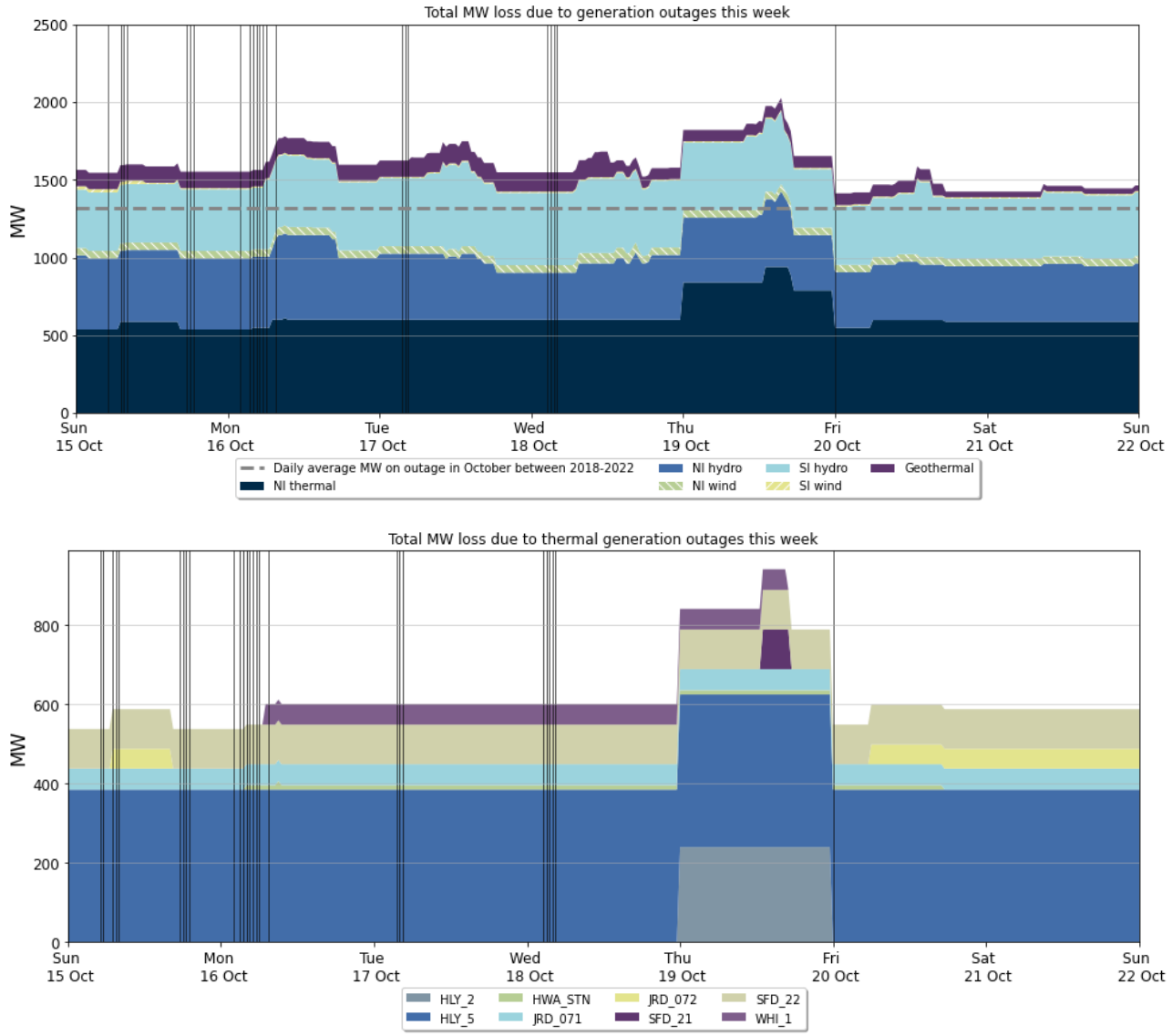
(d) Stratford 2 is on outage until 28 February 2025.

(e) Junction Road units are on outage until 29 October and 12 November.

(f) A Whirinaki unit was out from 16-19 October.

(g) Various North and South Island hydro are on outage.

Figure 13: Total MW loss due to generation outages



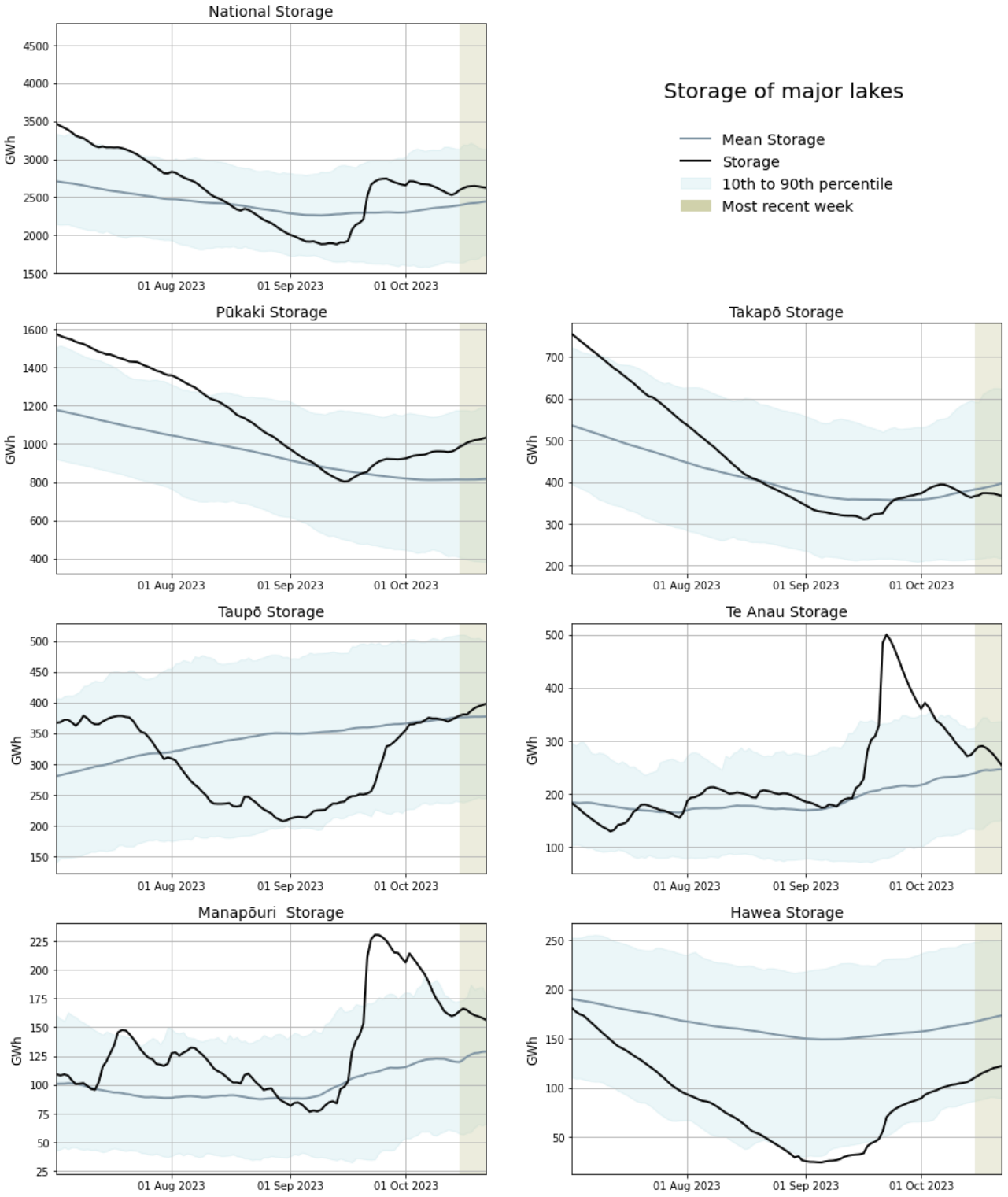
9. Storage/fuel supply

9.1. Figure 14 shows the 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 increased from 2844GWh on 14 October to 2946GWh on 22 October, with controlled storage now at 66.8% nominally full.

9.3. Taupō storage saw a steady increase over the week with storage now above the historic mean and close to 400GWh. Pūkaki storage has also continued to increase. Takapō storage has decreased slightly and is sitting just below its historic average for this time of year. Both Manapōuri and Te Anau storage continued to decrease this week. Manapōuri storage remains above average and Te Anau storage is now around historic average. Although still below its historic average, storage at Hawea has continued to see a steady increase and remains above its historic 10th percentile.

Figure 14: Hydro storage

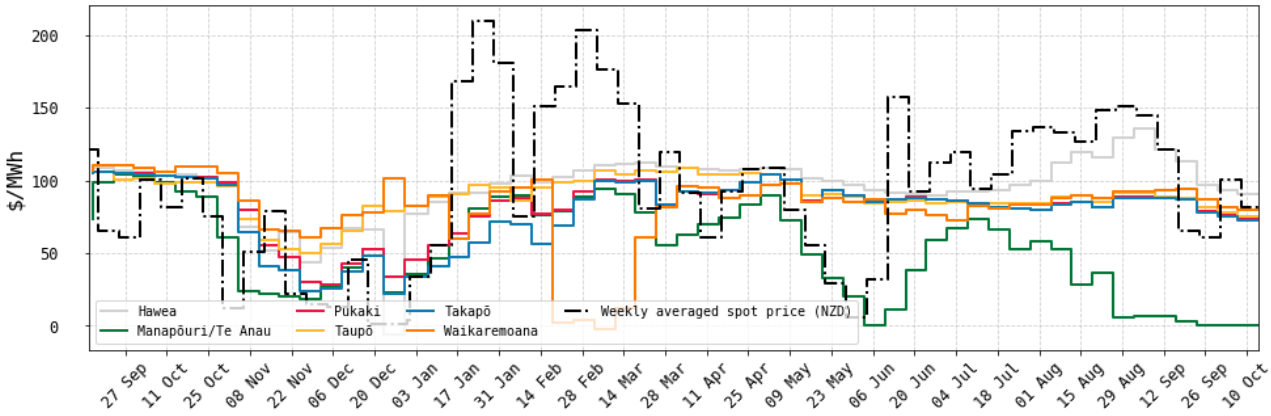


10. JADE water values

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 14 October 2023 obtained from JADE calculated as at the start of the week. 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. Significant inflows over the last couple of weeks have seen water values at Manapōuri and Te Anau of around $0.07/MWh and all other lakes have seen a decrease of around $3/MWh.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 14 October 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 October 2023. The SRMC of diesel plants has been increasing since May, and the SRMC of coal-fuelled plants and gas-fuelled plants has decreased slightly. While an increase in carbon prices has contributed to the increase in the diesel fired plant SRMC, this has been more than offset by a reduction in the underlying fuel prices in the case of gas and coal plant SRMCs.

11.4. The latest SRMC of coal-fuelled Huntly generation is ~$160/MWh.

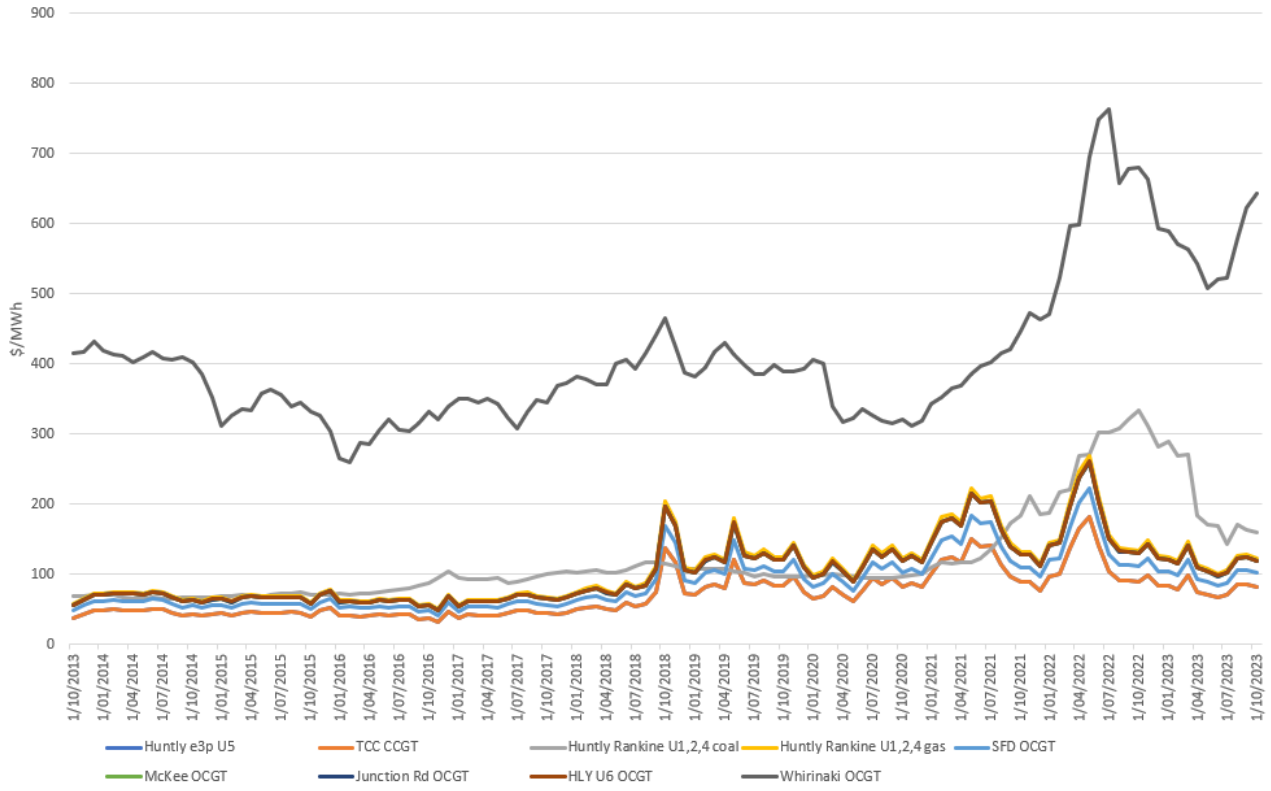
11.5. The SRMC of Whirinaki has increased to ~$643/MWh.

[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.

11.6. The SRMC of gas fuelled thermal plants is currently between $82/MWh and $123/MWh.

11.7. More information on how the SRMC of thermal plants is calculated can be found in Appendix C on the trading conduct webpage. This appendix was recently updated to reflect the changes made to coal price indices by the Indonesian government. These changes have had the effect of decreasing the coal SRMC from April 2023.

Figure 16: Estimated monthly SRMC for thermal fuels

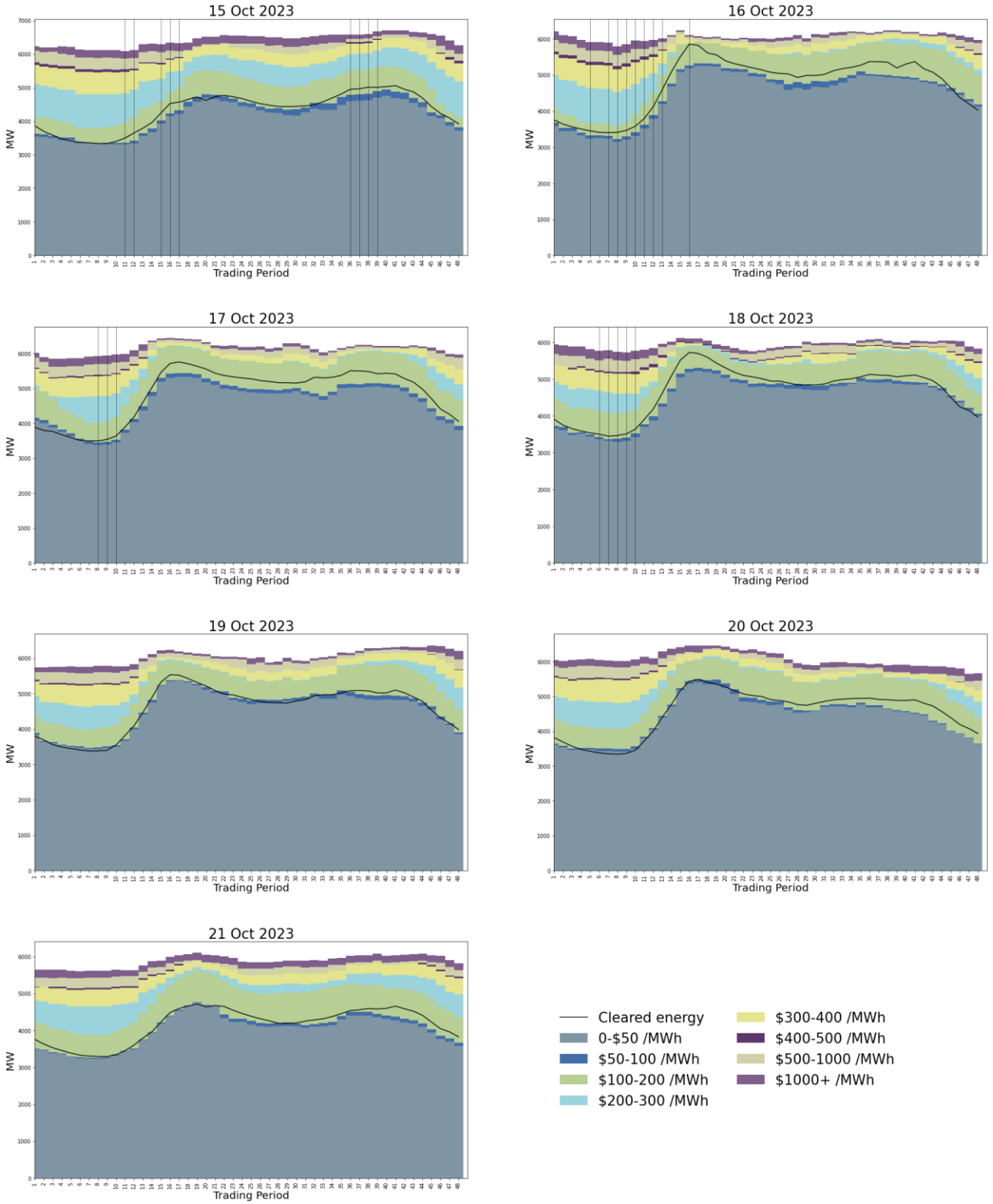


12. Offer behaviour

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. Most offers cleared in the $100-$200/MWh range, with the $50-$100/MWh offers continuing to be very slim.

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.
14/06/2023	15-17	Passed to Compliance	Genesis	Multiple	High energy prices associated with high energy offers.
15/06/2023	15-19	Passed to Compliance	Genesis and Contact	Multiple	High energy prices associated with high energy offers.
22/09/2023-30/09/2023	Several	Further analysis	Contact	Multiple	High hydro offers.
11/10/2023	21	Further Analysis	Genesis	Tokaanu	High prices during off-peak time.