Date: 9 October 2023

Trading conduct report

Market monitoring weekly report

Trading conduct report

1. Overview for week of 1-7 October

1.1. Prices this week were mostly above the historic average during the day, with most prices (middle 50%) between $63/MWh to $118/MWh. Price separation between the islands occurred on Sunday with an HVDC pole on outage until 5.30pm. Higher wind generation during the week and lower demand meant less thermal peakers ran. Multiple prices on Saturday were above the 90th percentile when the prices at Otahuhu were close to $200/MWh. Wind generation during the day had decreased along with thermal baseload generation. This saw hydro generation ramped up as well as three thermal peakers running continuously from the morning peak through the evening.

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 1-7 October:

(a) The average wholesale spot price across all nodes was $90/MWh.

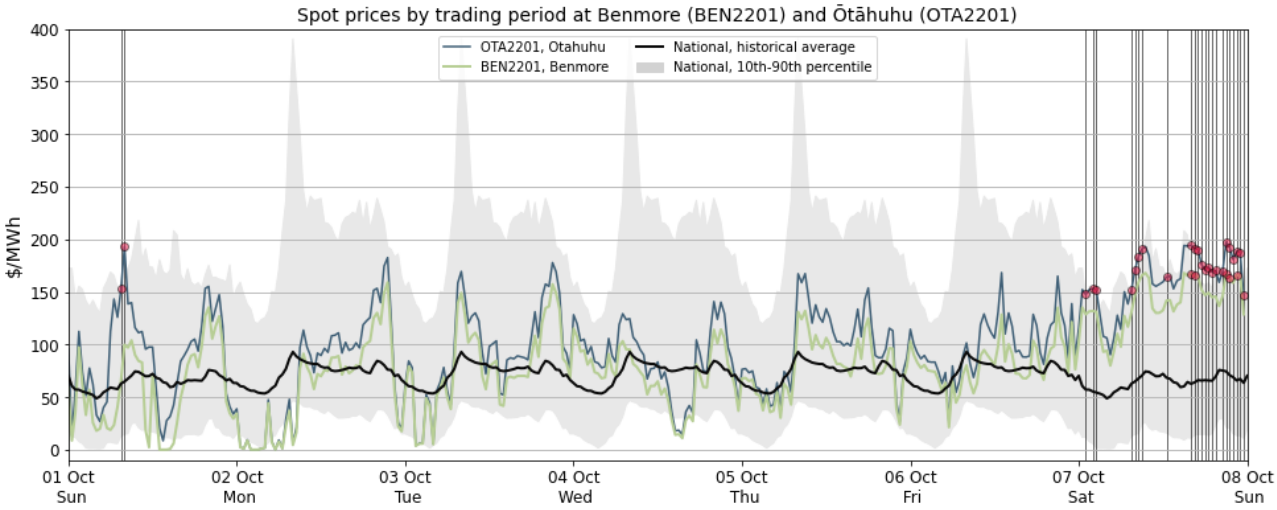
(b) 95 percent of prices fell between ~$2/MWh and $176/MWh.

2.4. Overall, the majority of spot prices were below $150/MWh this week with the average price around $14/MWh higher than the previous week. Hydro storage is back above the historic mean, contributing to lower overnight prices. However, most prices during the day sat above the historic average.

2.5. There was some price separation on Sunday during the HVDC outage. One of the largest price separations was during the Sunday morning peak at 7.30am and 8.00am, when prices at Ōtāhuhu were $153/MWh and $193/MWh respectively. At this same time prices at Benmore were $62/MWh and ~$100/MWh.

2.6. The highest prices this week occurred on Saturday where prices during the day sat mostly above $140/MWh, and at Ōtāhuhu prices reached between $190-$197/MWh for some trading periods. Most of the highlighted prices on Saturday were when Ōtāhuhu breached the historic 90th percentile of prices and although Benmore prices did not go above the 90th percentile, they still remained higher than historic average throughout the day. There was under 400MW of wind generation and only one Rankine running as baseload during this period. Higher prices were likely due to hydro generation ramping up and the three peakers running continuously throughout the day.

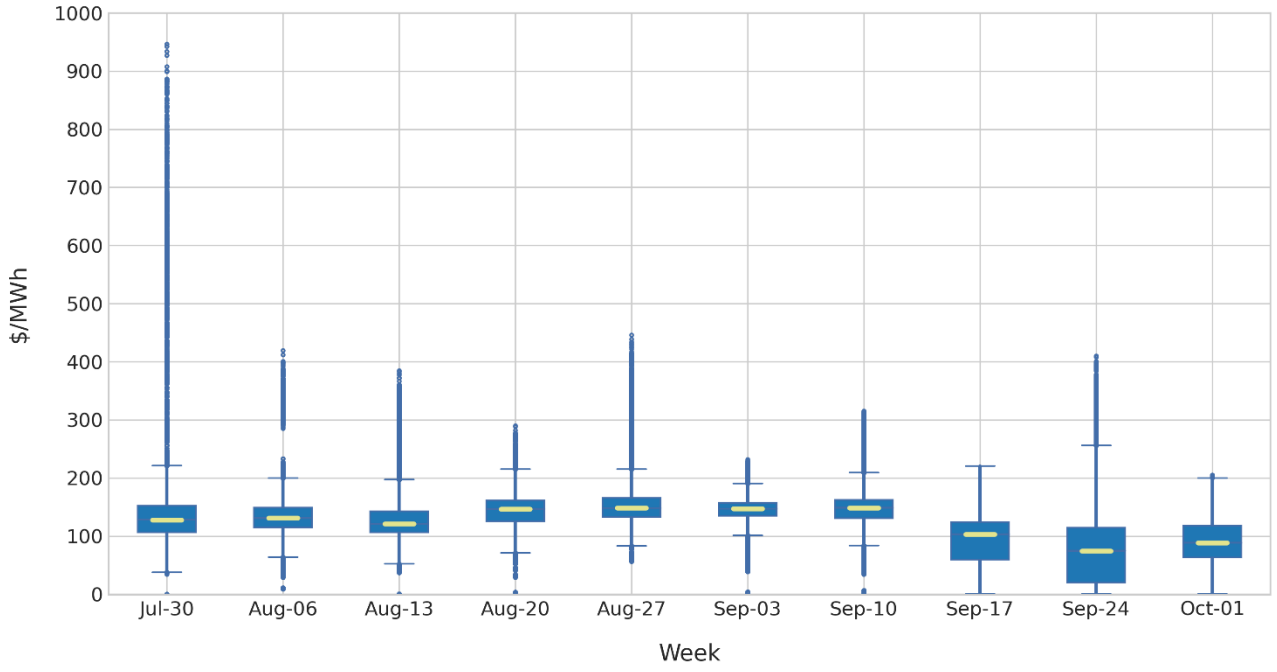
Figure 1: Wholesale spot prices between 1 October (Sunday) and 7 October (Saturday)



2.7. 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.

2.8. The range of prices this week was slightly lower than the previous week with a more even distribution. The middle 50% of prices were between $63/MWh and $118/MWh. This more condensed middle range of prices pushed the average price up compared to the previous week with the median price at $89/MWh.

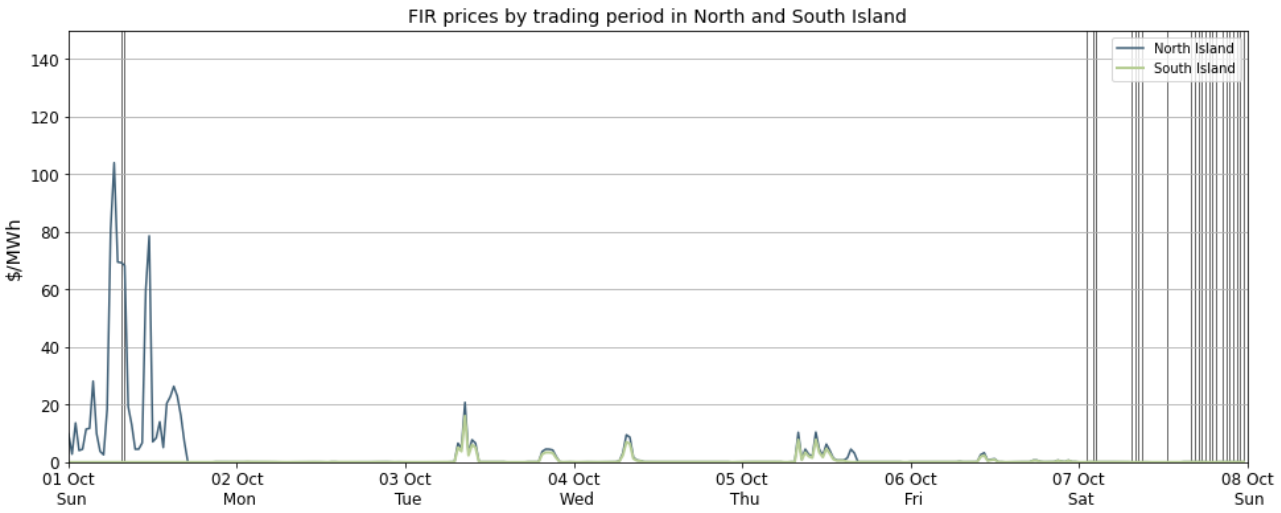
Figure 2: Boxplots showing the distribution of spot prices this week and the previous nine weeks



3. Reserve prices

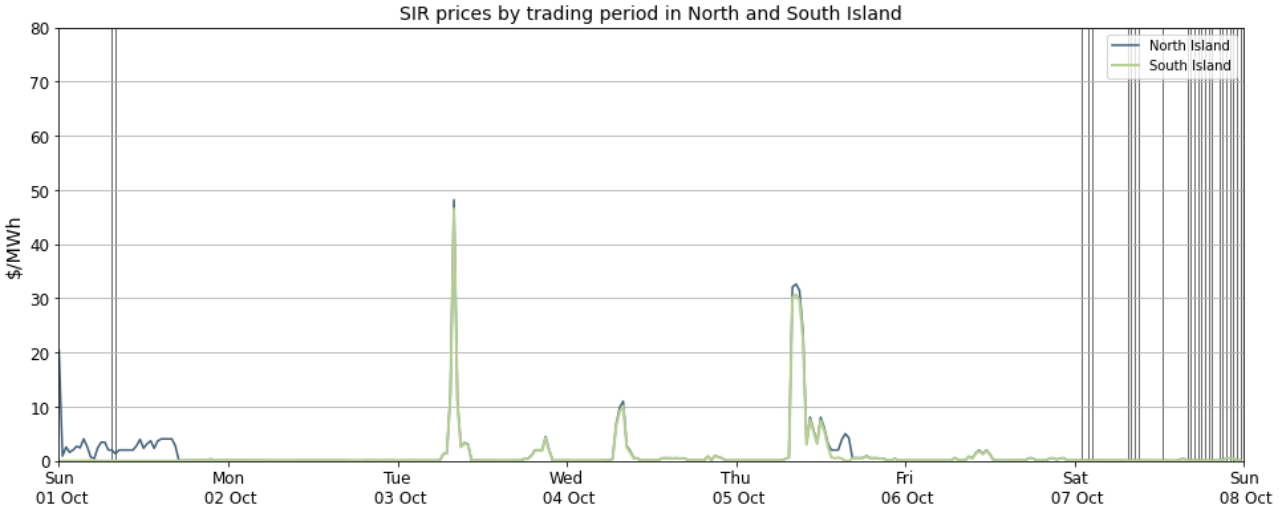
3.1. Fast Instantaneous Reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week FIR prices were mostly below $10/MWh. There were some high North Island FIR prices on Sunday due to the HVDC pole outage which limits reserve sharing between the islands. The highest of the North Island FIR prices occurred between 6.00am and 11.30am with prices ranging from ~$60-$104/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 mainly below $10/MWh with higher prices sometimes occurring during the morning peak. On Tuesday at 8.00am both North and South Island SIR prices spiked with a North Island price of $48/MWh and a South Island price of ~$47/MWh. There were also SIR spikes on Thursday morning between 8.00am and 9.00am, where prices in both Island were around $30-$33/MWh.

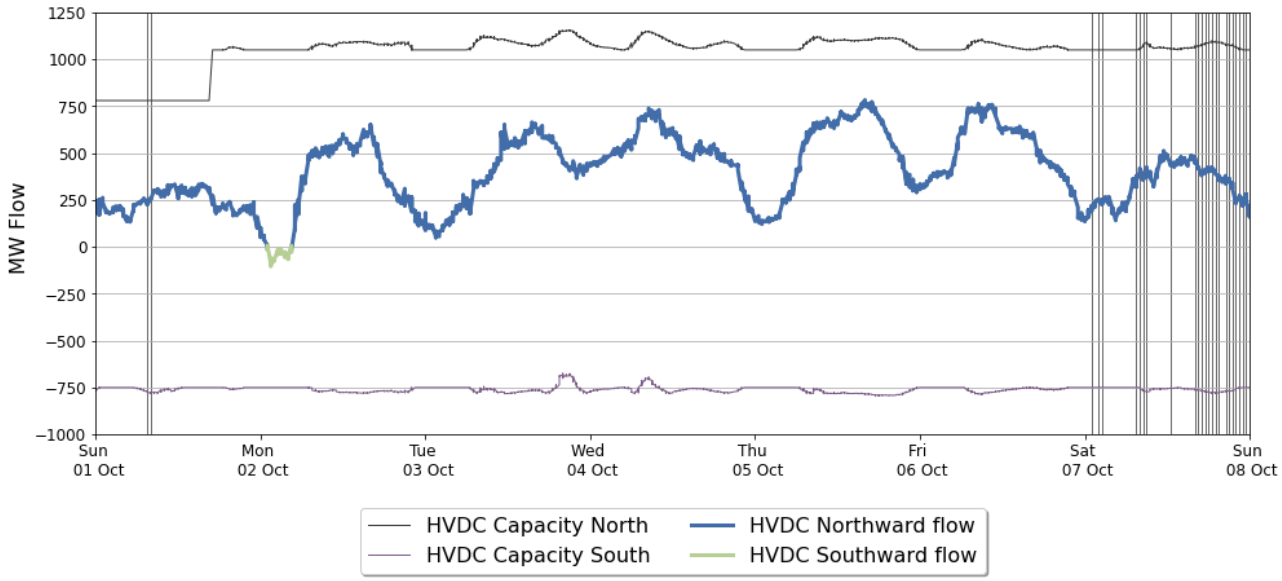
Figure 4: Sustained Instantaneous Reserve (SIR) prices by trading period and island



4. HVDC

4.1. Figure 5 shows HVDC flow between 1-7 October. HVDC flows were predominantly northwards this week with only a short time overnight on Sunday into Monday with some southwards flow of around 100MW. Maximum northwards flow was generally below 750MW, although reached around 780MW on Thursday afternoon.

Figure 5: HVDC flow and capacity



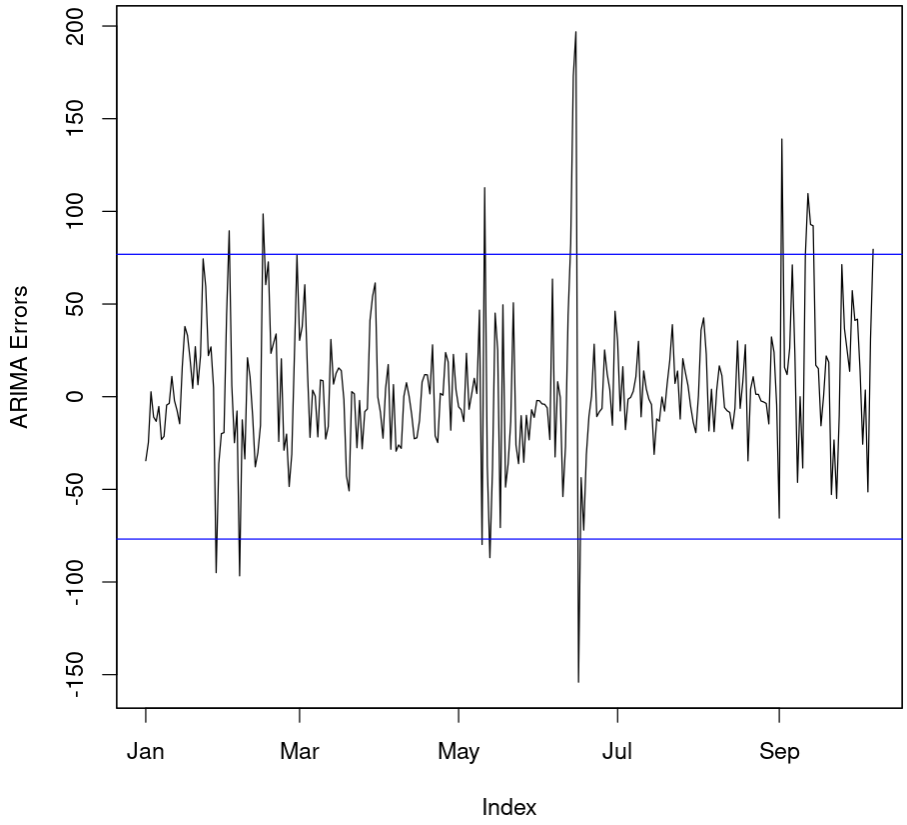
5. Regression residuals

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.

5.3. This week there was one residual above two standard deviations on Saturday indicating prices were higher than the model expected. TCC turned off on Friday night resulting in higher than average prices throughout Saturday. However, the model would have assumed TCC was still generating and therefore expected lower prices.

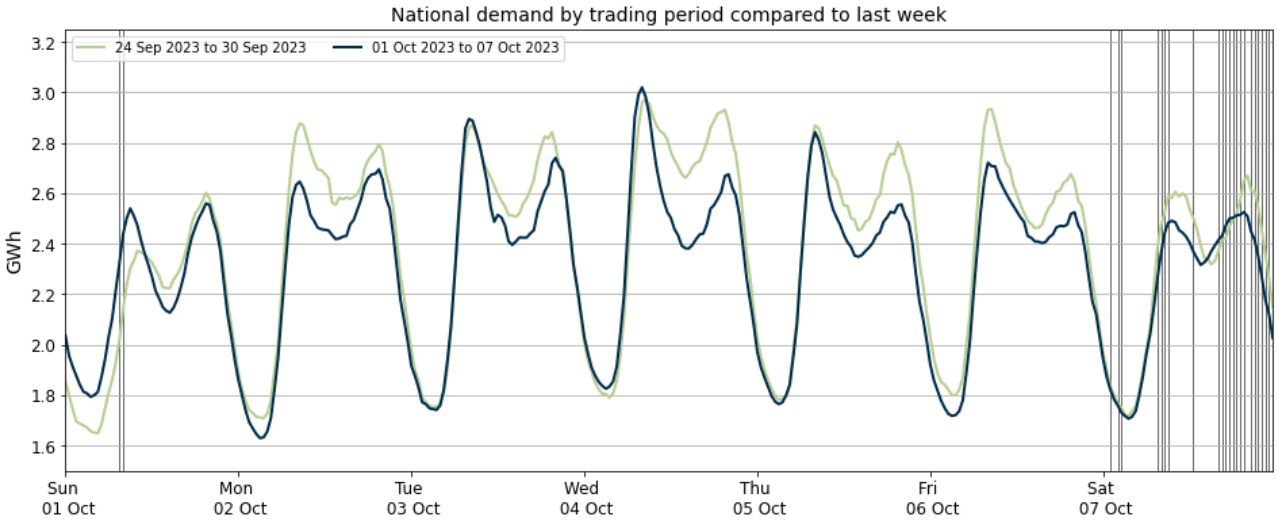
Figure 6: Residual plot of estimated daily average spot prices from 1 January 2023 - 7 October 2023



6. Demand

6.1. Figure 7 shows national demand between 1-7 October, compared to the previous week. Demand was mostly lower this week than the previous week. From Tuesday to Friday there is a noticeable drop in the evening peak demand as we see cold spring mornings with milder evening temperatures. There were still instances of cool mornings with maximum demand on Wednesday reaching 3.02GWh, slightly higher than last week.

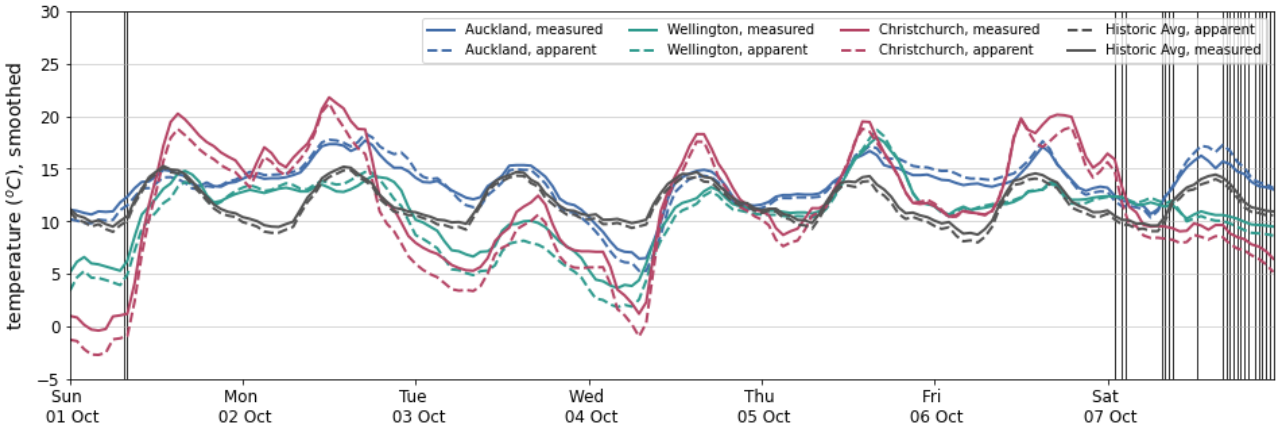
Figure 7: National demand by trading period compared to the previous week



6.2. Figure 8 shows the hourly temperature at main population centres from 1-7 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. Auckland temperatures were mainly on or above average except for a dip into single digits on Wednesday morning where temperatures across the country were also low. Wellington and Christchurch saw more variable temperatures throughout the week. Apparent temperatures in Wellington ranged between 2°C and 19°C and apparent temperatures in Christchurch ranged between -3°C and 21°C.

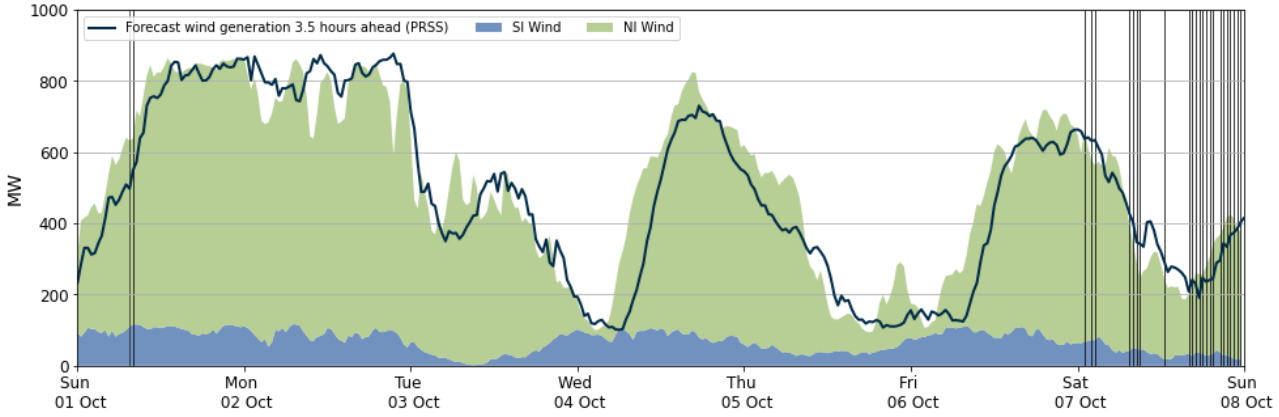
Figure 8: Temperatures across main centres



7. Generation

7.1. Figure 9 shows wind generation, from 1-7 October. Wind generation ranged between ~94MW to ~870MW across the week. While there were some periods of low generation, the overall average wind generation across the week was 511MW. On Saturday, wind generation dropped below forecast levels, contributing to elevated prices.

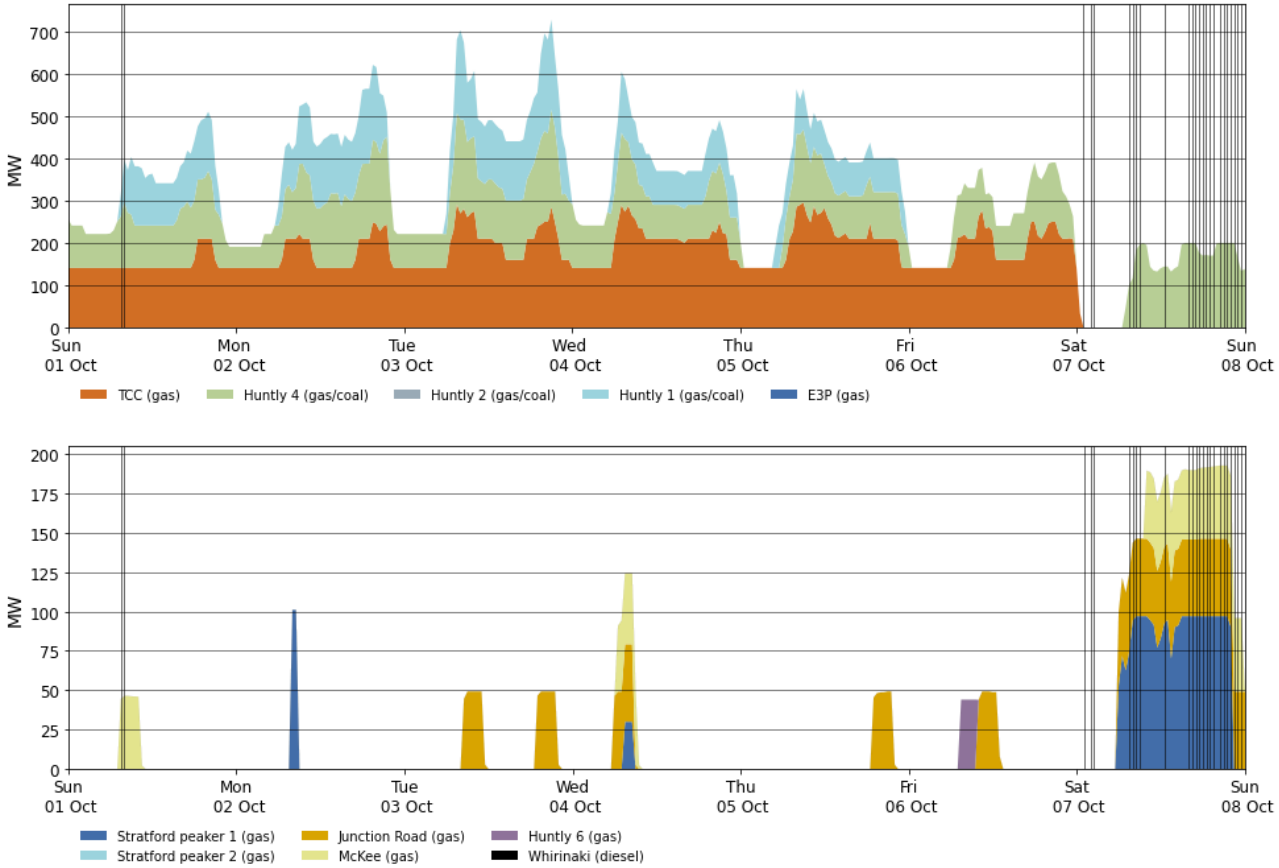
Figure 9: Wind generation and forecast between 1-7 October



7.2. Figure 10 shows the generation of thermal baseload and thermal peaker plants between 1-7 October. TCC and Huntly 4 ran most of the week as baseload with support from Huntly 1 during the day from Sunday to Thursday. TCC ramped down generation overnight on Friday 6th October and only Huntly 4 ran as baseload on Saturday.

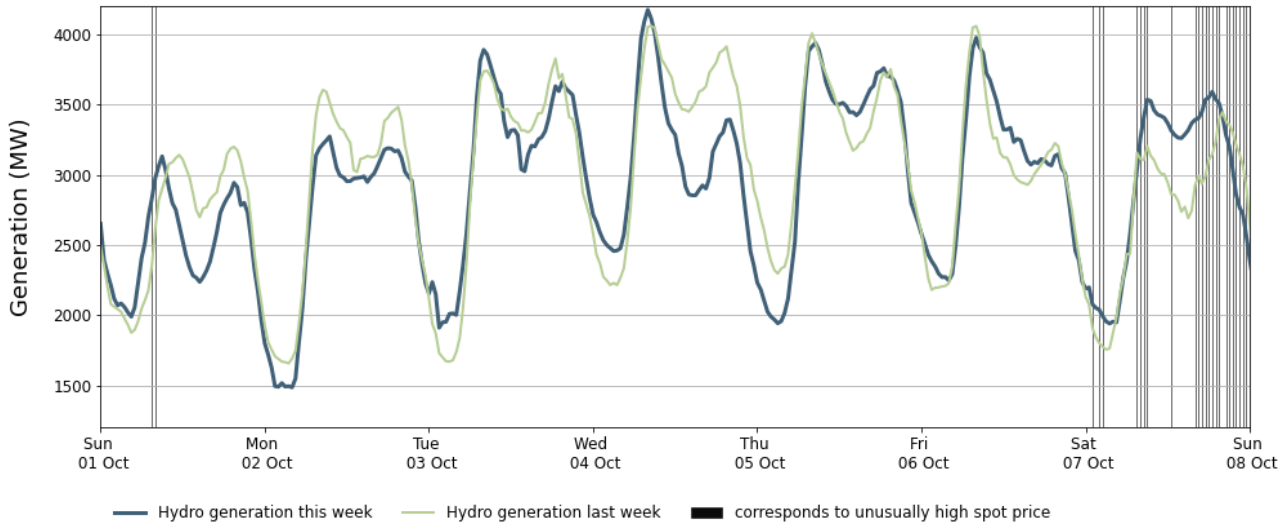
7.3. Peaking generation only ran briefly for morning peaks from Sunday to Friday with lower demand overall and periods of high wind generation across the week. However, with only one Rankine running and a decrease in wind during the day on Saturday Stratford 1, Junction Road and McKee all ran continuously from the morning peak through to late evening.

Figure 10: Thermal generation between 1-7 October



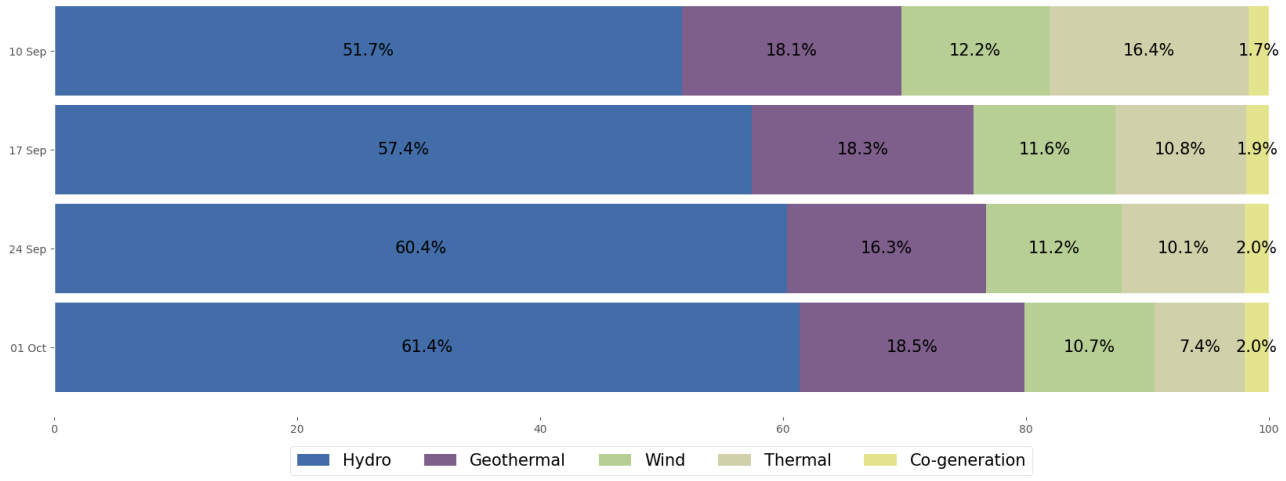
7.4. Figure 11 shows hydro generation between 1-7 October. Overall, there was a similar percentage of generation from hydro to the previous week with this week's generation profile following the demand for the week. There was higher hydro generation on Saturday than the previous week likely due to the lower baseload generation as demand was generally lower than the previous Saturday.

Figure 11: Hydro generation between 1-7 October compared to the previous week



7.5. As a percentage of total generation, between 1-7 October, total weekly hydro generation was 61.4%, geothermal 18.5%, wind 10.7%, thermal 7.4%, and co-generation 2%. With lower demand and some high generation from wind there was a decrease in the percentage of generation from thermal this week.

Figure 12: Total generation by type as a percentage each week between 10 September and 7 October 2023



8. Outages

8.1. Figure 13 shows generation capacity on outage. Total capacity on outage between 1-7 October ranged between ~1400MW and 2100MW, above the long-term average.

8.2. Notable outages include:

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

(b) Huntly 1 was on outage on 6 October.

(c) Stratford 1 was on outage until 2 October 2023.

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

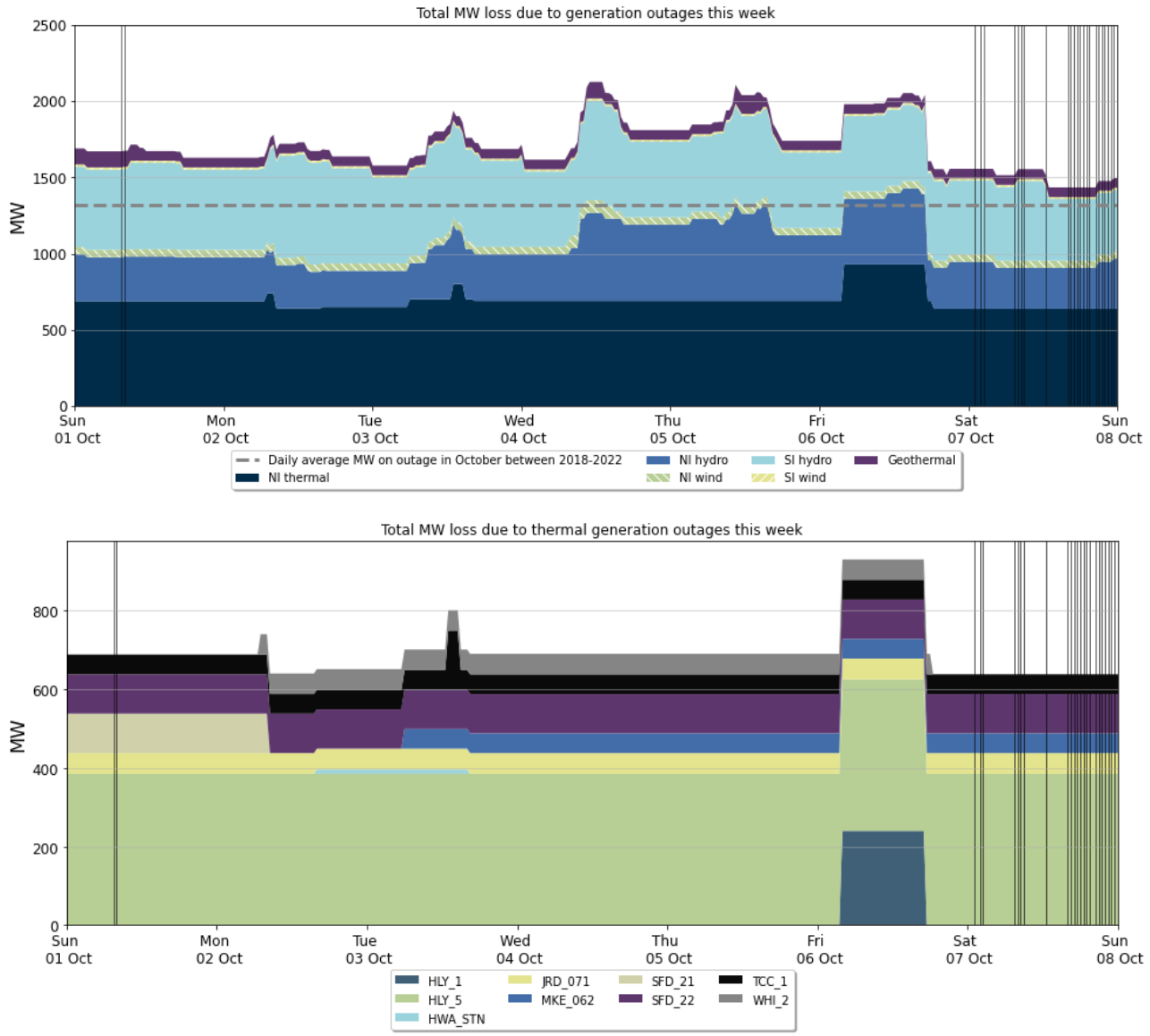
(e) Junction Road is on outage (50MW) from 29 September to 31 October.

(f) McKee is on outage (50MW) from 3 October to 13 October.

(g) A Whirinaki unit was on outage from 2-6 October.

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

Figure 13: Total MW loss due to generation outages



9. Storage/fuel supply

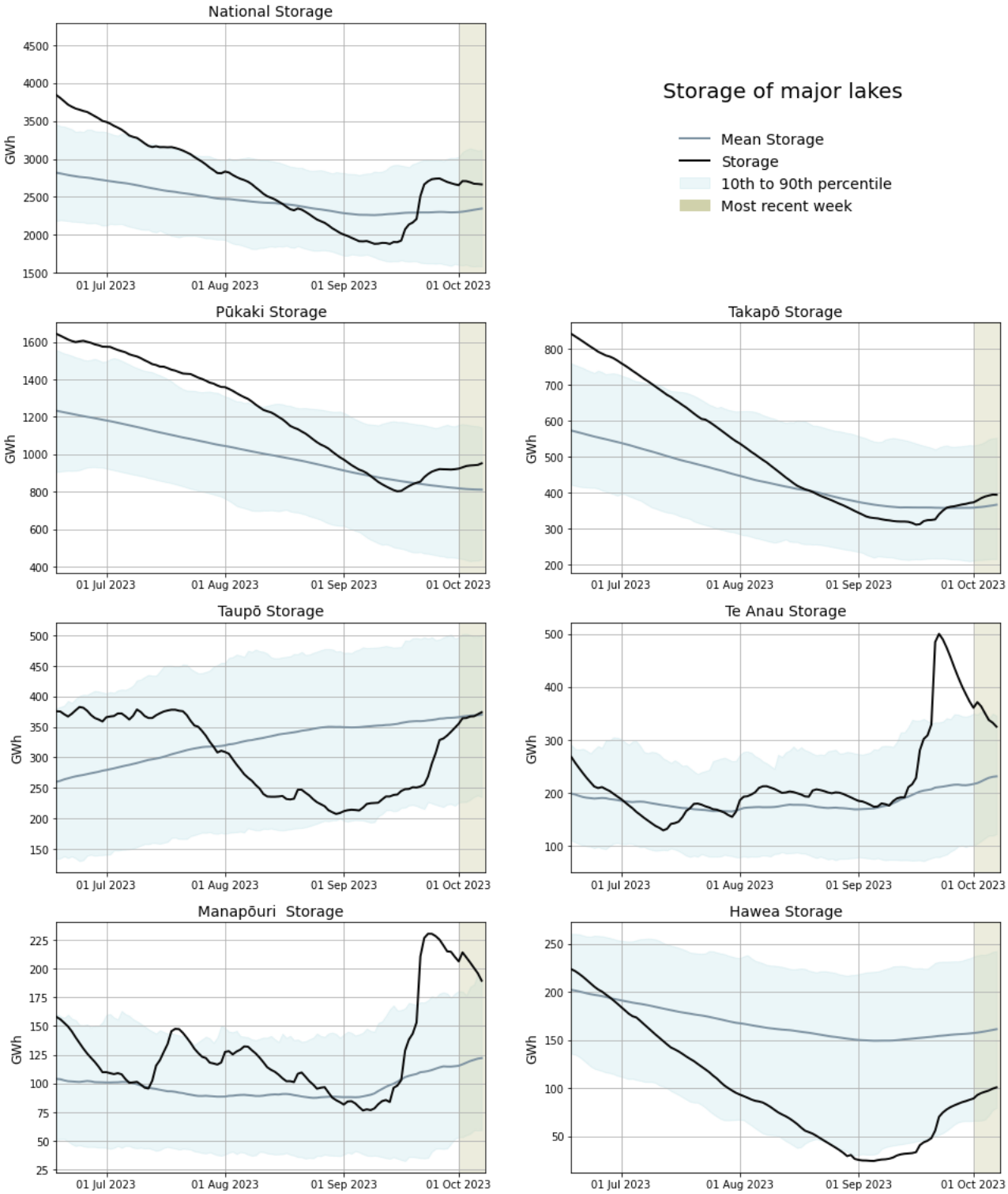
9.1. Figure 14 shows the total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

9.2. National hydro storage levels increased slightly over the week to 2949GWh. Controlled storage is currently 66.8% of nominally full and 110% of historic mean.

9.3. Most lakes continued to see an increase in storage this week with Taupō now back up to its historic mean. Pūkaki and Takapō have remained above their historic mean this week with some small increases to storage. Hawea has seen a steady increase to storage this week and is still above its historic 10th percentile. Manapōuri and Te Anau have both dipped to

just below their 90th percentile. However, both remain just above their high operating range with some spilling still occurring.

Figure 14: Hydro storage

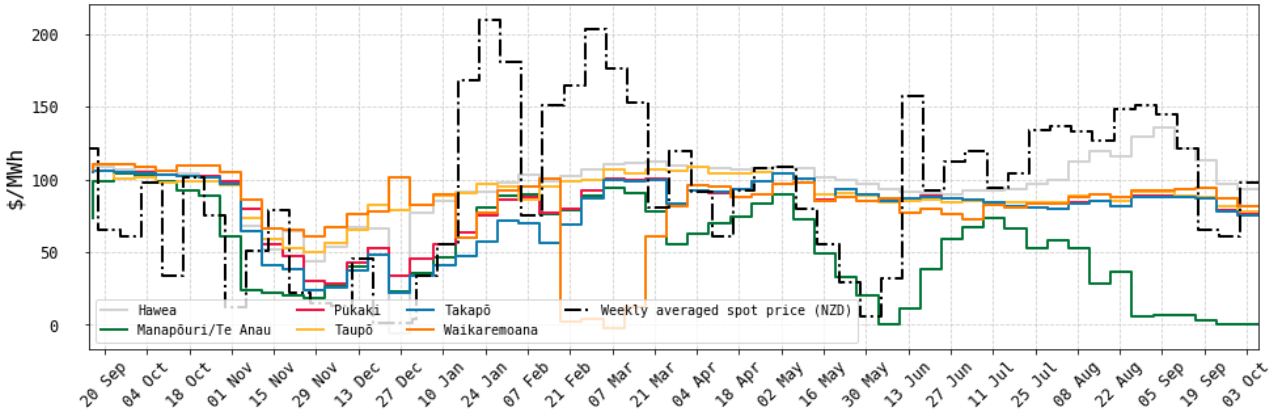


10. JADE water values

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 7 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. With continued high lake levels Manapōuri and Te Anau water values remain close to ~$0/MWh. All other lakes saw a decrease in water values of between $3-$6/MWh as most storage lakes continued to see inflows over this last week.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 7 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 September 2023. The SRMC of diesel plants has been increasing since May, and the SRMC of coal-fuelled plants has started to increase again, with gas-fuelled plants continuing to decrease slightly. An increase in carbon prices has contributed to the increase in the diesel and coal fired plant SRMCs, while a reduction in gas prices has curtailed this increase in gas plant SRMCs.

[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.

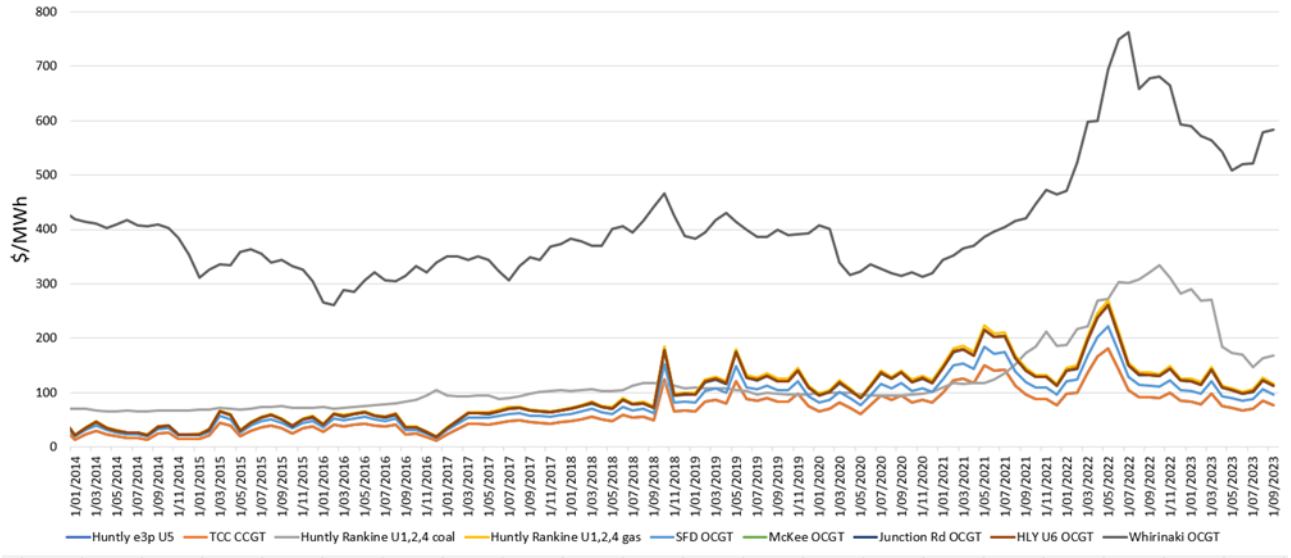
11.4. The latest SRMC of coal-fuelled Huntly generation is ~$168/MWh. With two or three Rankines often running simultaneously this winter Genesis has been using more coal recently.

11.5. The SRMC of Whirinaki has increased to ~$583/MWh.

11.6. The SRMC of gas fuelled thermal plants is currently between $78/MWh and $116/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



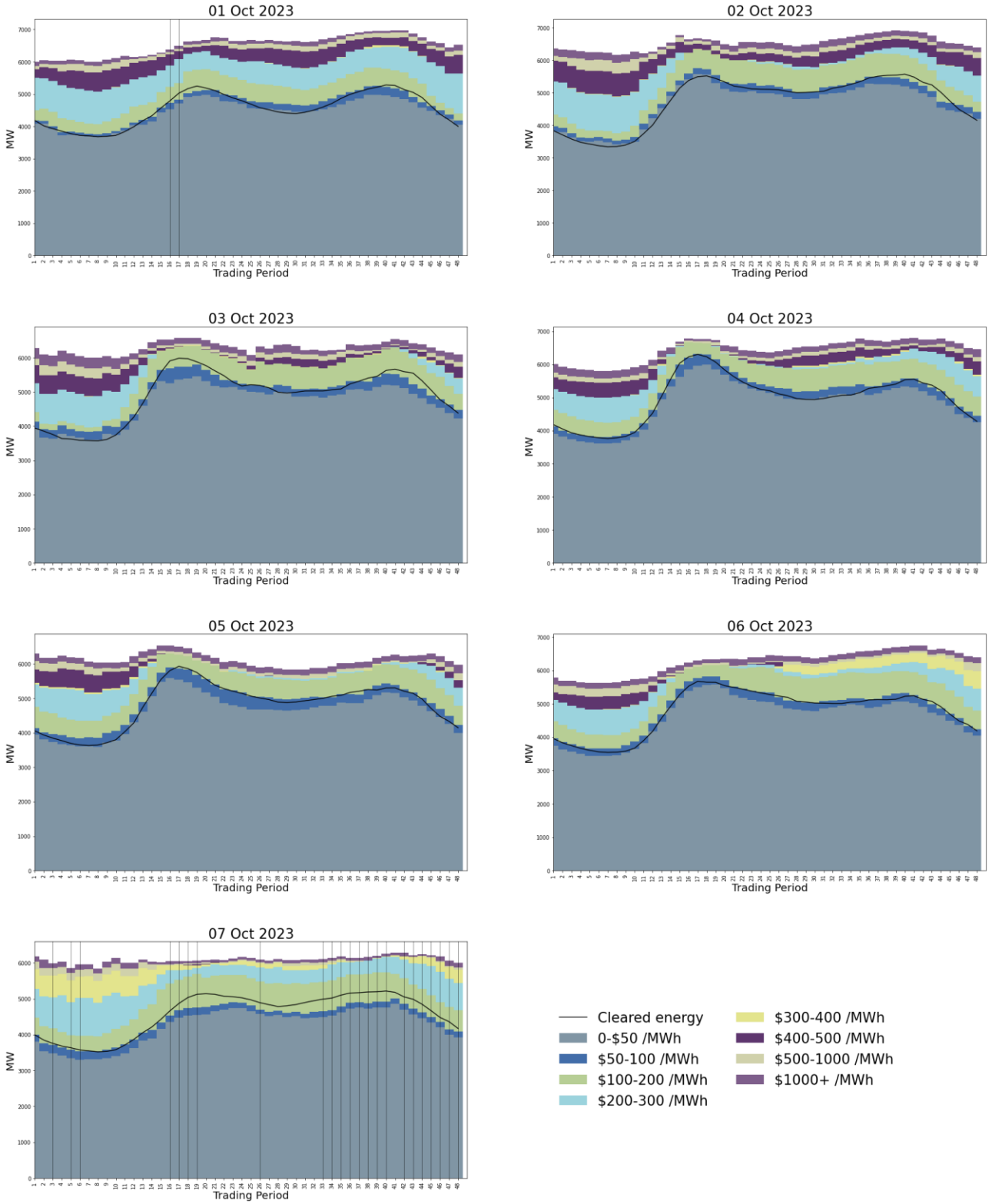
12. Offer behaviour

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. In the early part of the week a lot of offers cleared in the $50-$100/MWh range, with overnight prices clearing in the $0-$50/MWh range.

12.3. Towards the end of the week more offers were clearing in the $100-$200/MWh range, in particular on Saturday when there were 3 peakers running during the day.

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.
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.
22/09/2023-30/09/2023	Several	Further analysis	Contact	Multiple	High hydro offers.