20 December 2022

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 11-17 December

1.1. Most wholesale spot prices between 11-17 December appear to be consistent with market conditions. Some trading periods are undergoing further analysis.

1.2. Note that the next trading conduct report will be published in early January covering the period from 18 December to 7 January.

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 considering 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 exceeds its historical 90th percentiles.

2.2. Between 11-17 December:

(a) The average wholesale spot price across all nodes was $40.70/MWh.

(b) 95 per cent of prices fell between $0.01/MWh and $247/MWh.

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

2.4. Average spot prices increased this week, with volatile prices during the day and instances of prices above the 90^{th} percentile on Tuesday, Wednesday and Friday. There were also less price separation this week. Price spikes above the 90^{th} historic percentile occurred on:

(i) Tuesday, December 13, at 3:00 pm, trading period 31, with a $434/MWh price at Ōtāhuhu and $341/MWh price at Benmore.

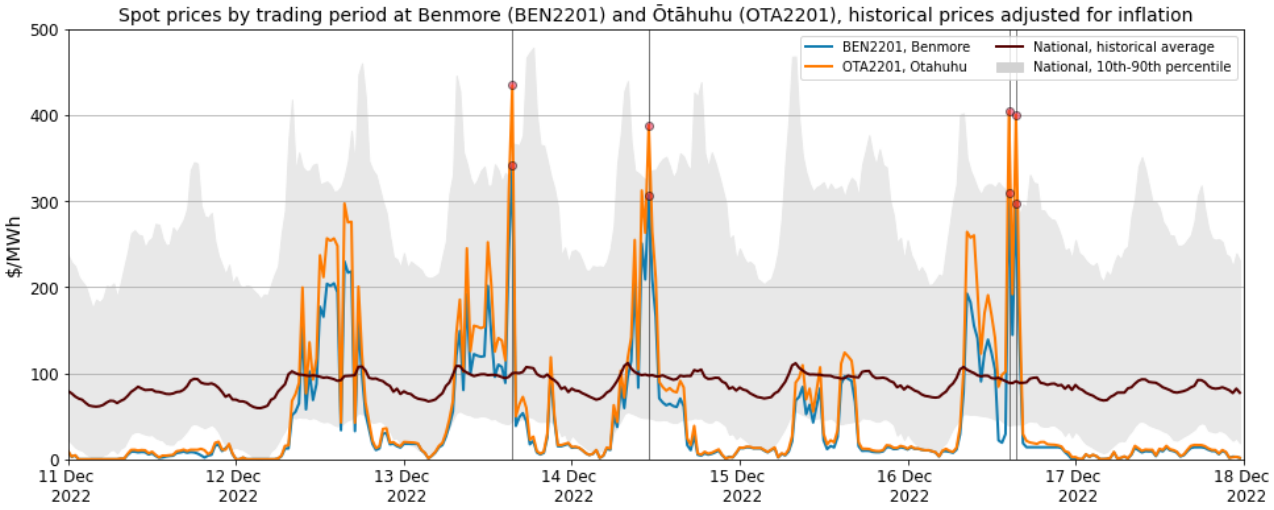
(ii) Wednesday, December 14, at 11:00am, trading period 23, with a $388/MWh price at Ōtāhuhu and $306/MWh price at Benmore.

(iii) Friday, 16 December, at 2:30 pm, trading period 30, with a $404/MWh price at Ōtāhuhu and $308/MWh price at Benmore.

(iv) Friday, 16 December, at 3:30 pm, trading period 32, with a $399/MWh price at Ōtāhuhu and $297/MWh price at Benmore.

2.5. The instances of high spot prices, both during peak and offpeak, on Monday, Tuesday, Wednesday and Friday were due to low wind generation, which increased the need for thermal generation – both baseload and peaker - coupled with high temperatures and high North Island demand. There were also some high South Island hydro offers, which we are investigating.

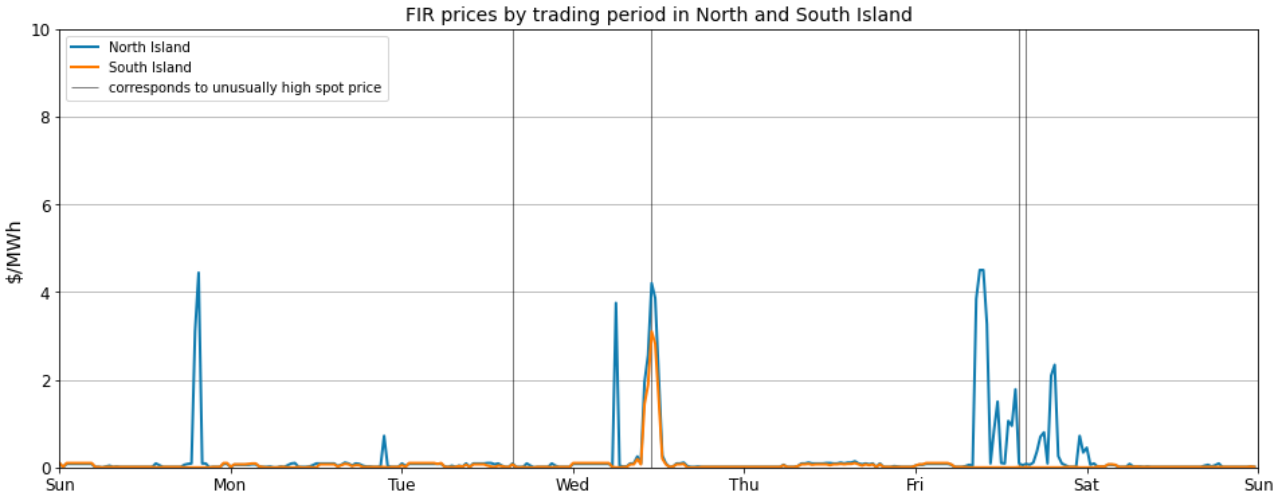
Figure 1: Wholesale Spot Prices



3. Reserve Prices

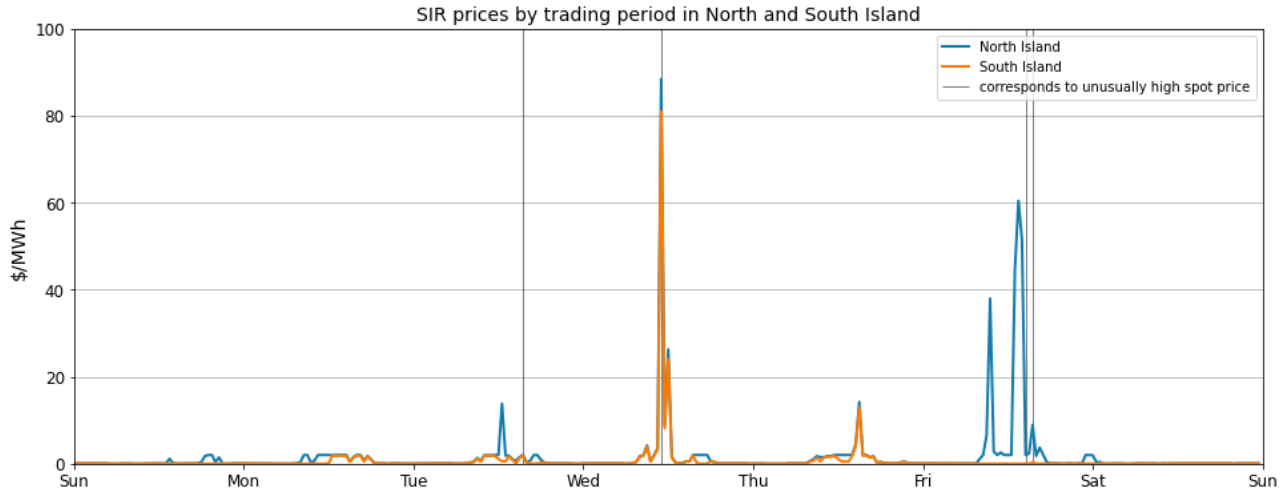
3.1. Fast instantaneous reserve (FIR) prices for the North and South Island are shown below in Figure 2. All trading periods this week had FIR prices below $5/MWh.

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserve (SIR) prices for the North and South Island are shown below in Figure 3. Most SIR prices this week were below $5/MWh. However, North and South Island SIR prices spiked on Wednesday, with this co-occurring with the spot market price spike. SIR prices in both Islands over $80/MWh. SIR price spikes occurred in the North Island on Friday, however, none of these coincided with the price spikes.

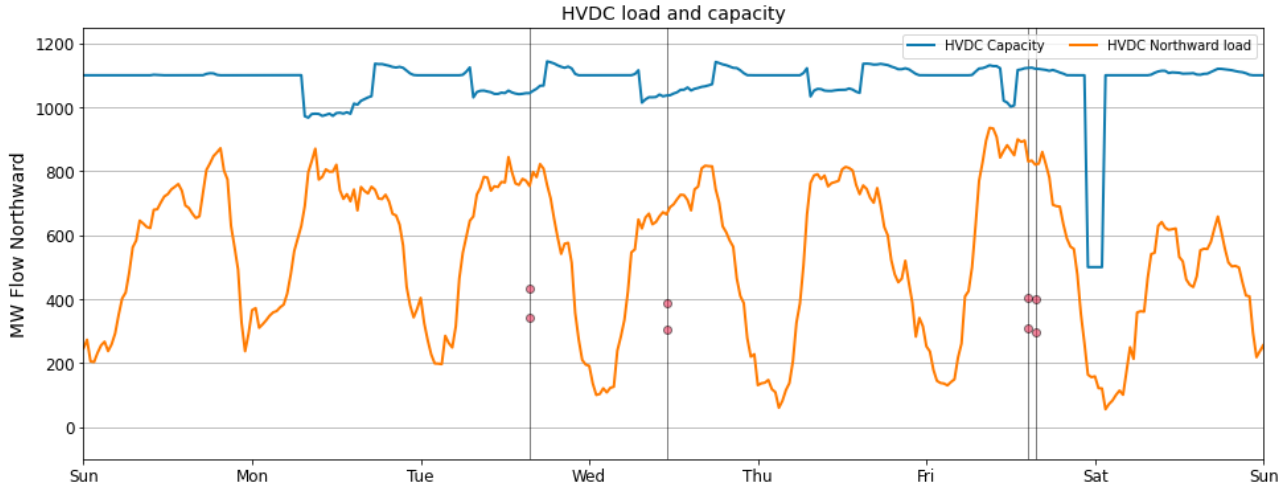
Figure 3: SIR prices by trading period and Island



4. HVDC

4.1. Figure 4 shows northward HVDC flow between 11-17 December. Northward HVDC flow daytime flow was mostly between 600-800 MW, a reduction from the flows seen in November. Northward flow was highest on Friday.

Figure 4: HVDC northward flow and capacity



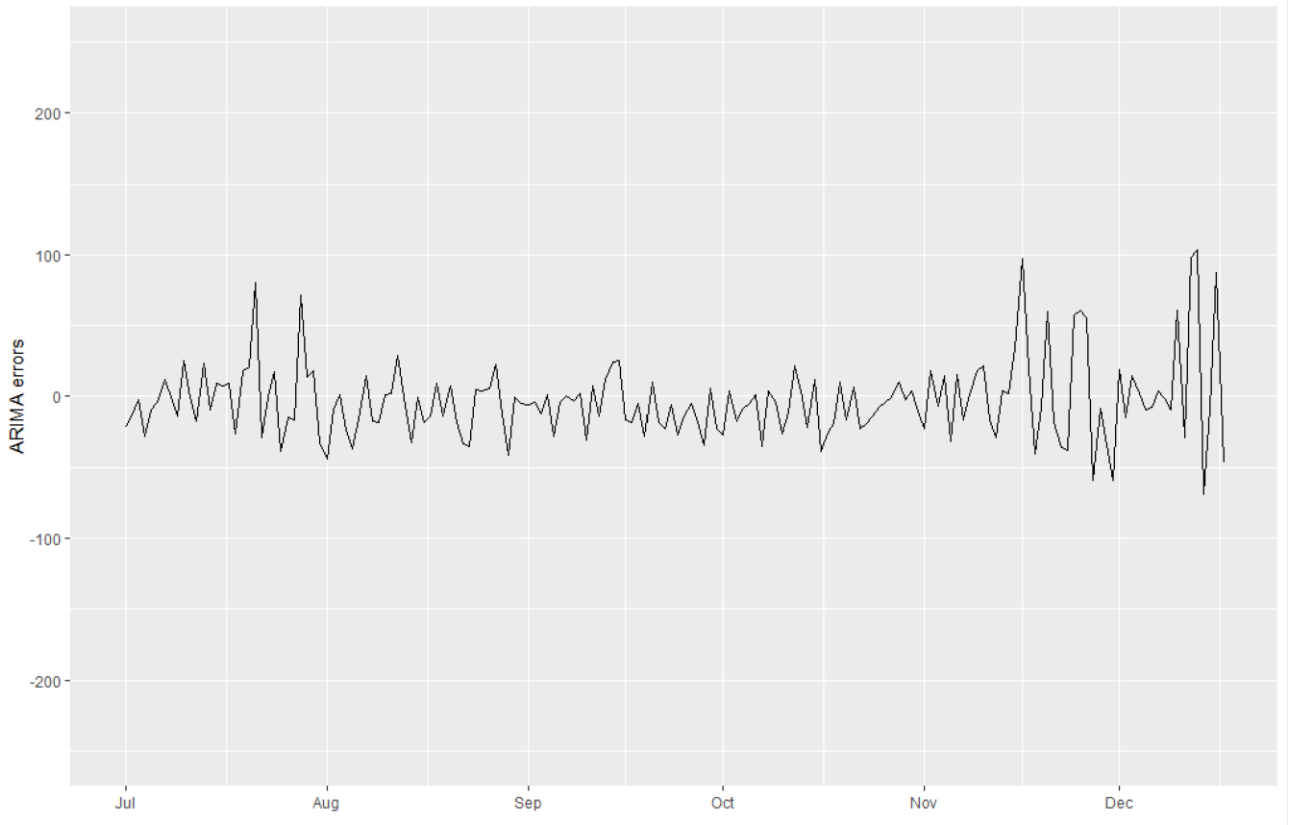
5. Regression Residuals

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[1] on the trading conduct webpage.

5.2. Figure 5 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Residuals for 11-17 December were large on most days. The residuals for Monday, Tuesday and Friday show the model underestimated the price, while the residual for Wednesday and Saturday shows the model overestimated the price. The monitoring team will continue analysing the high residuals this week.

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

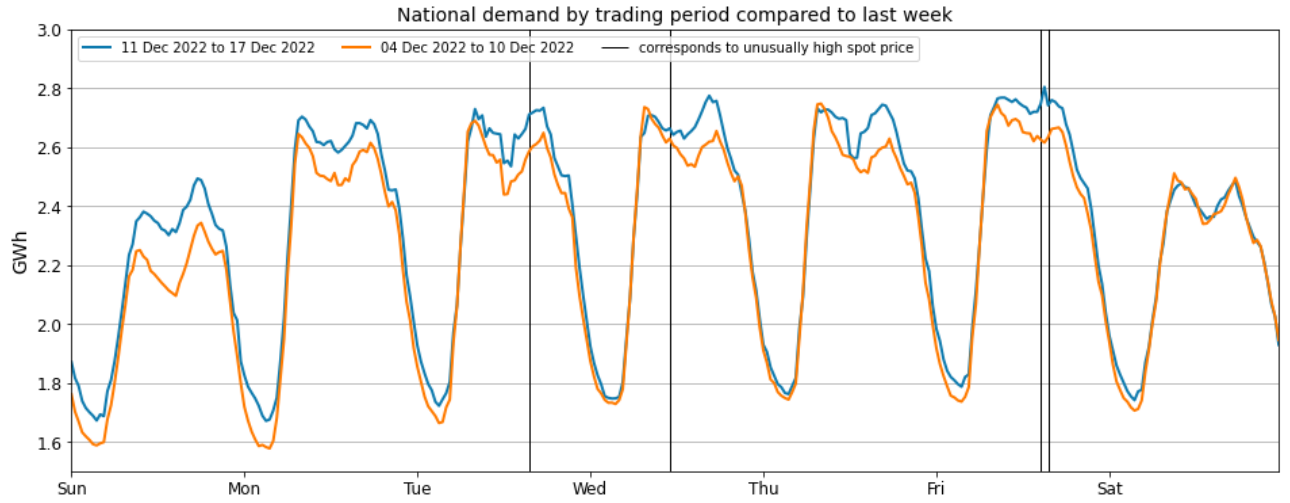
Figure 5: Residual plot of estimated daily average spot prices from 1 July – 17 December 2022



6. Demand

Figure 6 shows this week's national grid demand compared to the previous week. Demand between 11-17 December was greater than the previous week, due to warmer weather, especially in Auckland, which generally increases demand due to load from air conditioning. Load was particularly high on Friday- with the two Friday price spikes sandwiching the highest demand of the week.

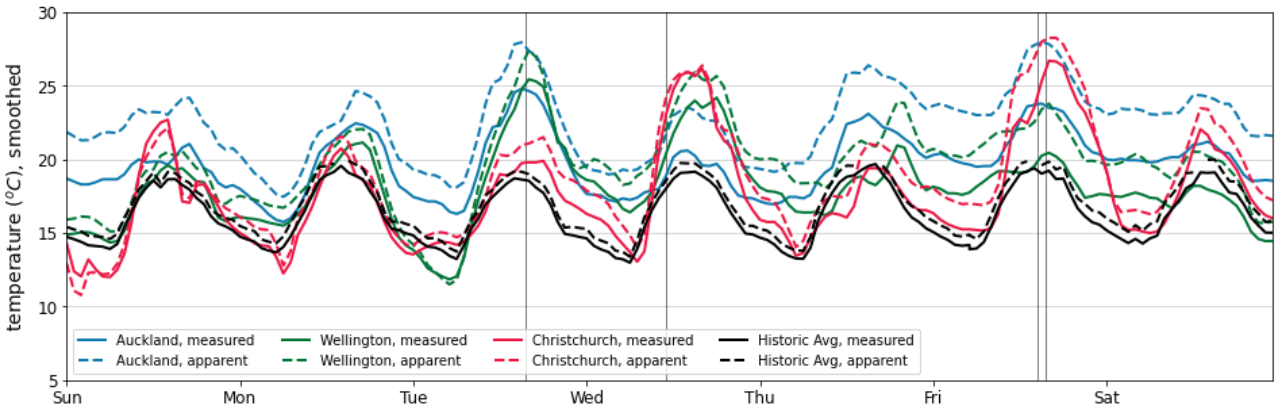
Figure 6: National demand by trading period compared to the previous week



6.1. Figure 7 shows hourly temperature at 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.

6.2. Temperatures were mostly above the historic average in Auckland, Wellington and Christchurch this week – with the apparent temperature almost reaching over 25 degrees multiple times during the week. These high temperatures likely contributed to higher prices due to increased load from air conditioning and irrigation.

Figure 7: Temperatures across main centres



7. Outages

7.1.

7.2.

7.3. Figure 8 shows generation capacity on outage. Total capacity on outage ranged between ~850 – 1,600MW over the week. Outages stepped up from ~850 MW on Monday to over 1,400MW during times on Monday. Outages remained between 1,300 and 1,600 MW until Friday, were reductions in hydro, geothermal and North Island wind outages brought total outages again below 1,000 MW.

7.4. The pink dashed line in

7.5.

7.6. Figure 8 shows that outages are usually around 1500 MW on average at this time of the year. The high capacity on outage this year is consistent with normal outage activity for this time of year. Monthly average outages per year for 2018 to 2021 are shown in Figure 9.

7.7. Outages of note include:

- Huntly 5 had an outage on Tuesday.
- Huntly 4 remained on outage.
- Huntly 6 had outages on Wednesday and Thursday.
- The roughly 100 MW of geothermal outages ended on Friday.
- Over 100 MW of North Island wind was on outage between Wednesday and Friday.

Figure 8: Total MW loss due to generation outages

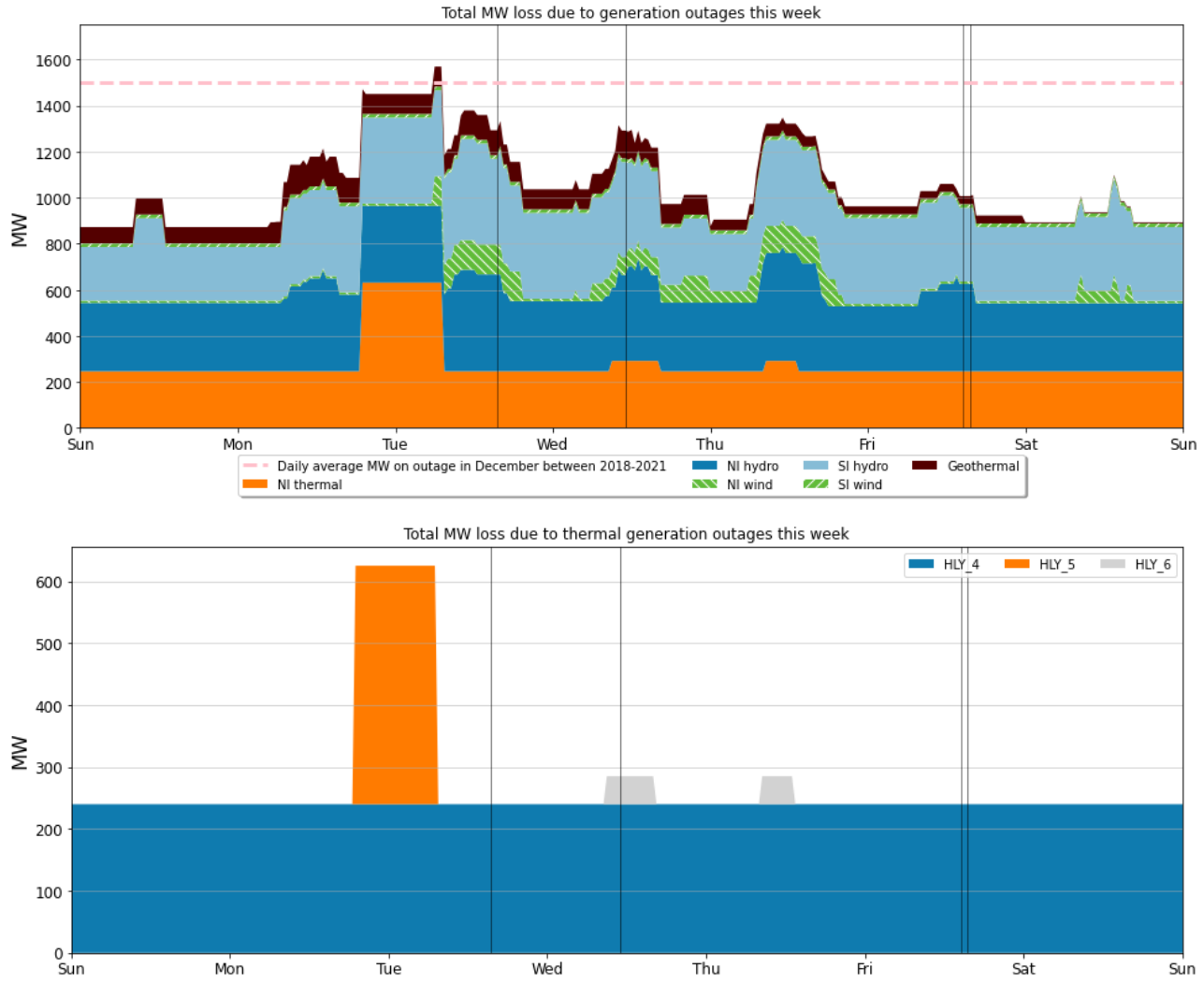
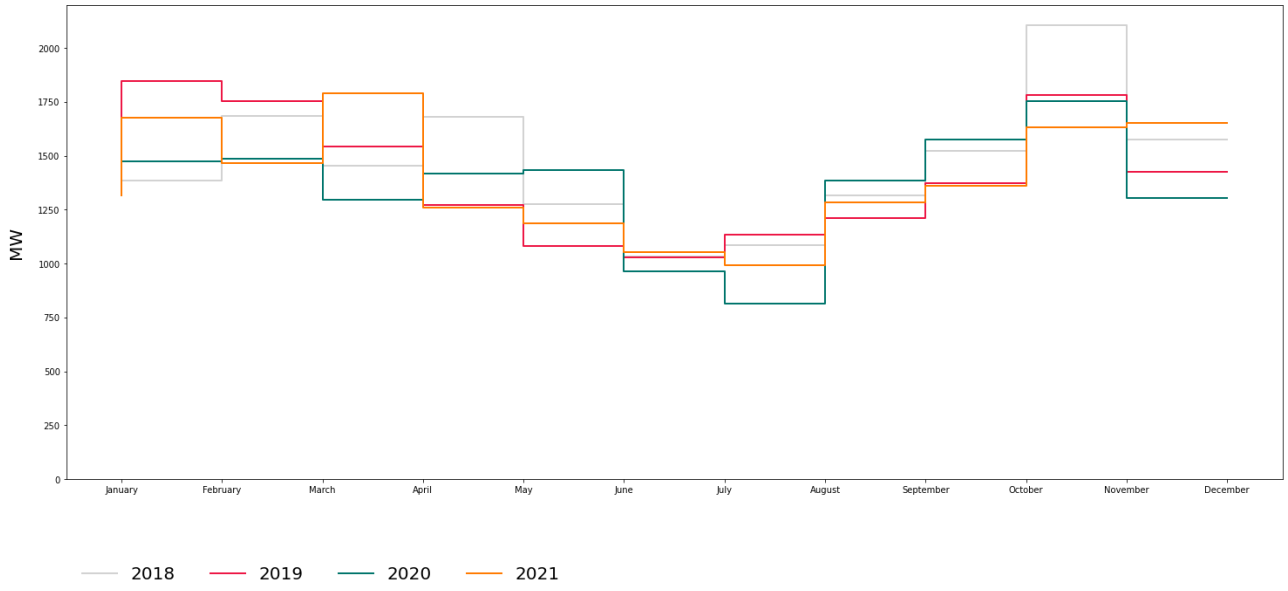


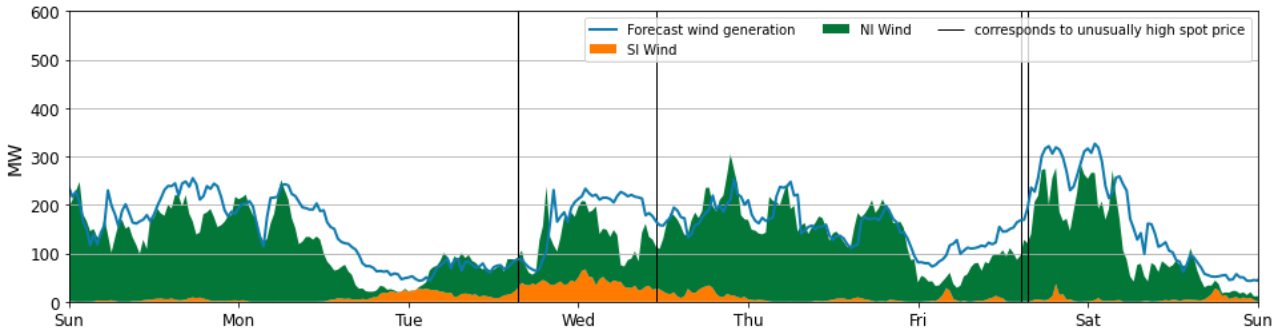
Figure 9: Monthly average MW losses due to generation outages, by year 2018-2021



8. Generation

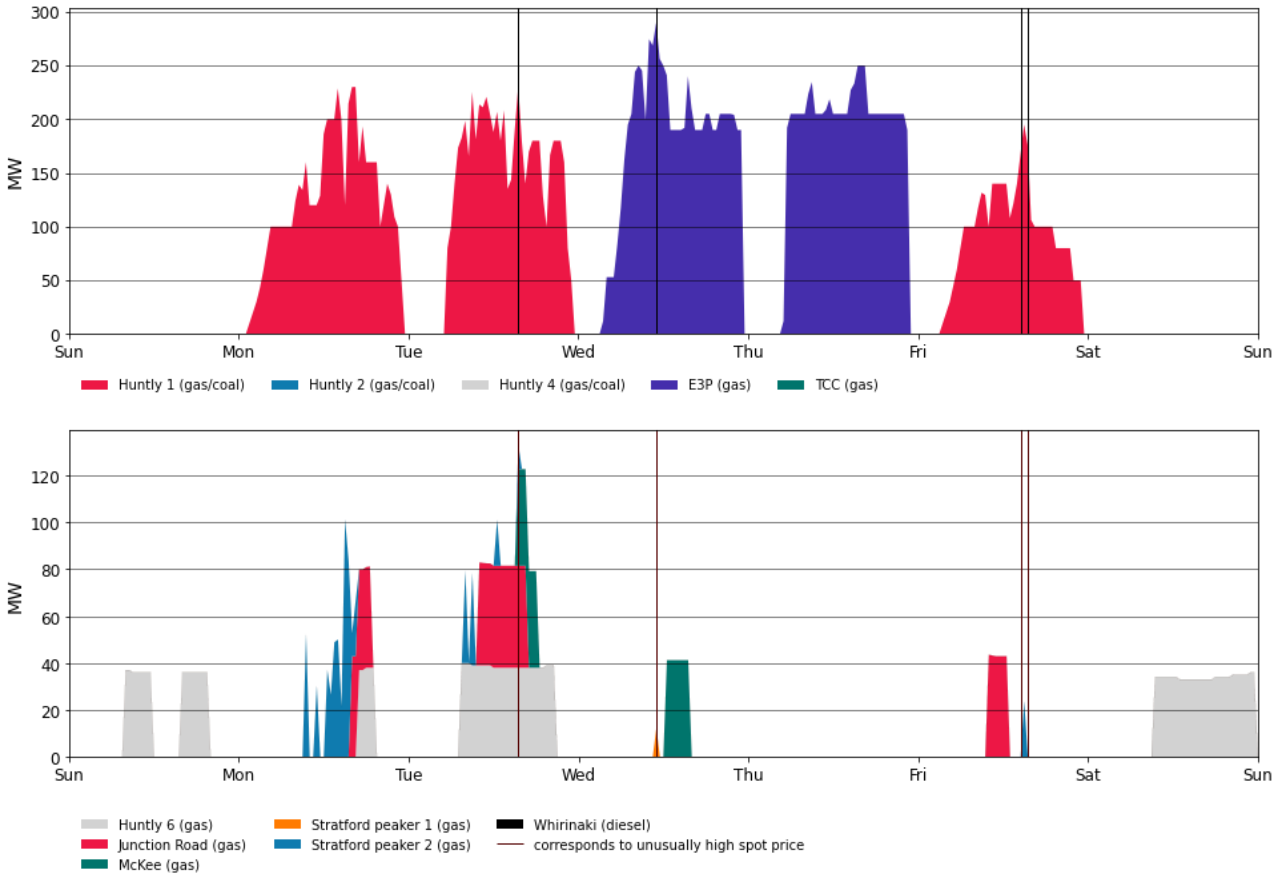
8.1. This week, wind generation varied between 20 and 300 MW, a reduction on that seen in previous weeks, as seen in Figure 10. Wind generation was mostly between 100 - 250 MW between Sunday and Monday evening, before it lulled on Monday night. It then increased, slightly, to between 100-300 MW between Tuesday and Saturday. Wind generation was around 100 MW during the Tuesday, Wednesday and Friday price spikes. Also, price spikes on Wednesday and Friday occurred during times when wind generation differed from forecast by ~50MW.

Figure 10: Wind Generation and forecast



8.2. Figure 10 shows generation of thermal baseload and thermal peaker plants between 11-17 December. Huntly 1 ran during the day as baseload, between Monday and Tuesday. Huntly 5 ran on Wednesday and Thursday, with its output peaking during the Wednesday price spike. Huntly 1 ran again on Friday.

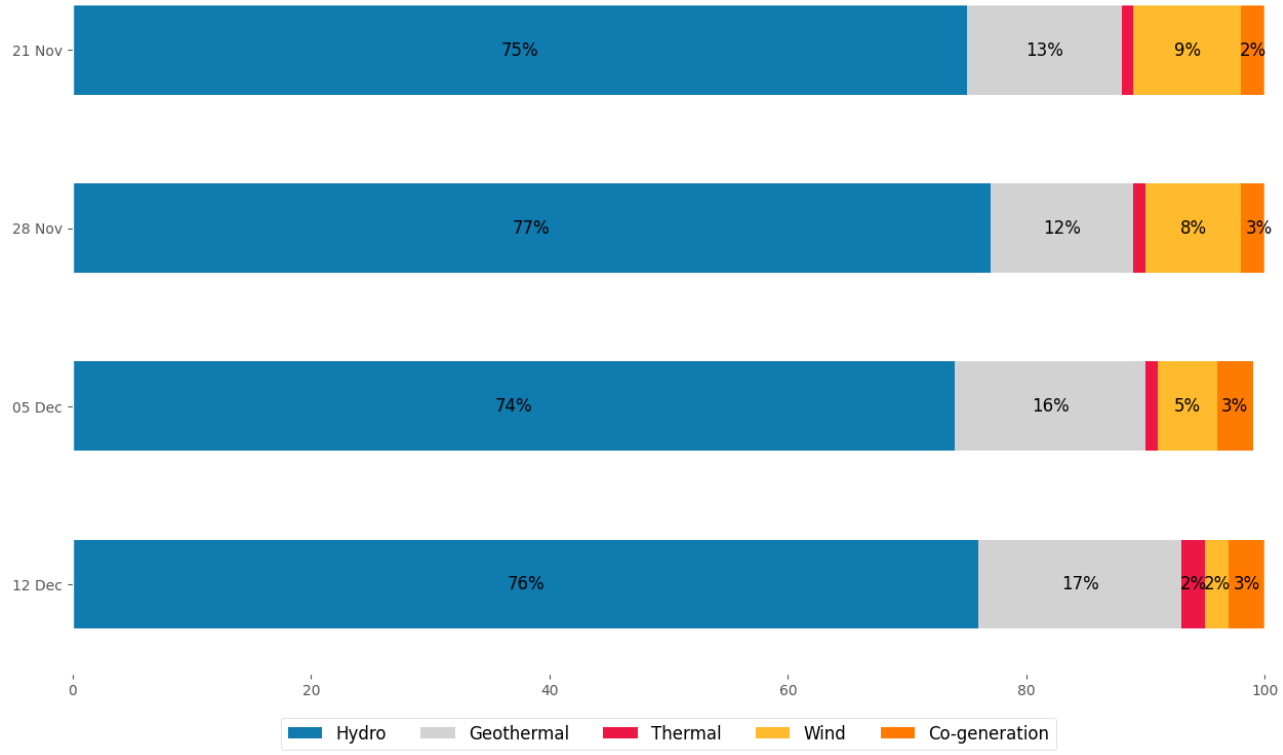
Figure 11: Thermal Generation



8.3. Huntly 6 ran during peak times on Sunday, and during the Monday evening peak. It also ran during the day on Tuesday and Saturday to cover baseload. Mckee ran during the day on Tuesday and Wednesday. Stratford peaker two ran, with fluctating output, on Monday. It was also disptached a few times on Tuesday, and once on Friday. Stratford peaker one ran during the Wednesday price spike.

8.4. As a percentage of total generation, between 11-17 December, hydro totalled 76.3 percent, geothermal 16.5 percent, thermal 2.2 percent, wind 2.4 percent and co-generation 2.6 percent.

Figure 12: Total generation as a percentage each week between 21 November and 18 December



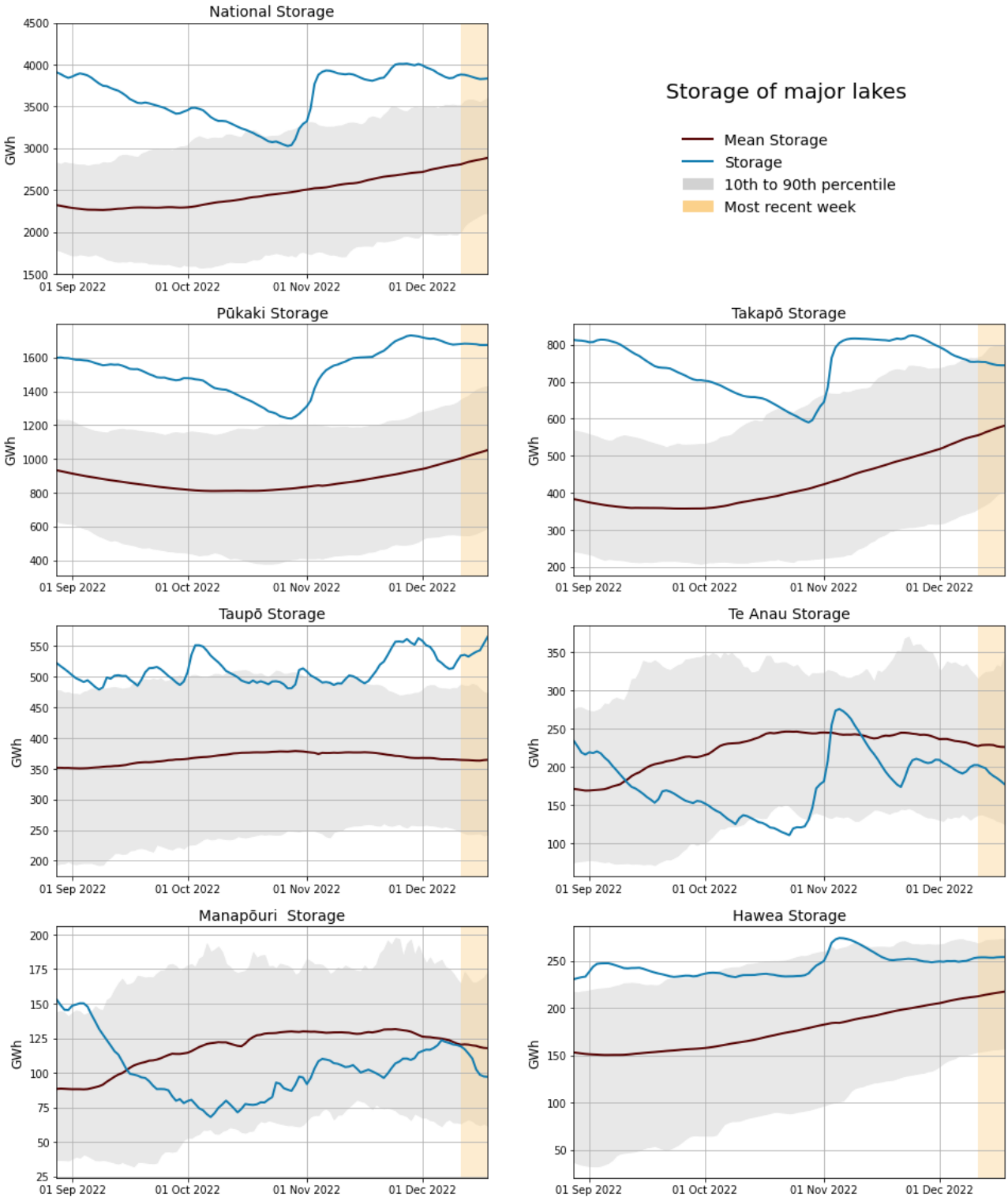
9. Storage/Fuel Supply

9.1. Figure 12 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 decreased slightly this week, but is still around 93.5 per cent of nominal full.

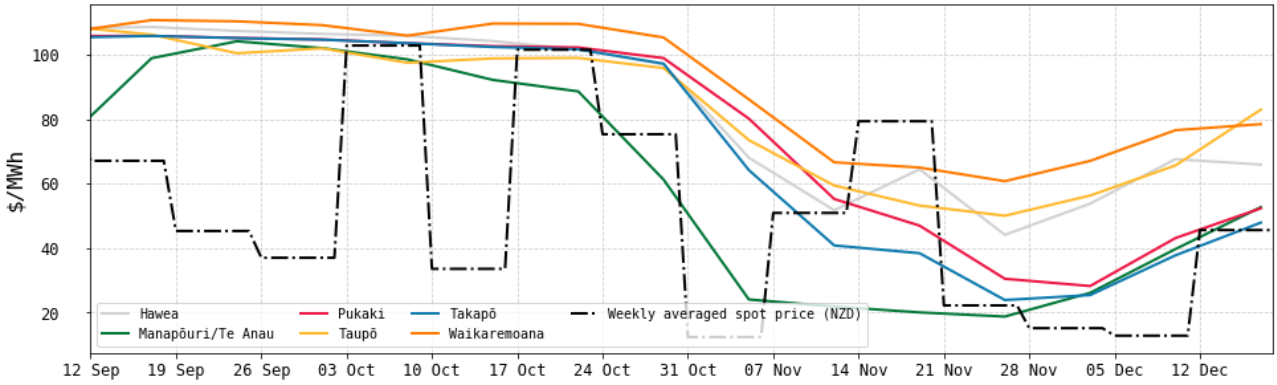
9.3. Lakes Taupō and Pūkaki remained well above their 90th percentiles this week, with Lake Taupō experiecing an increase in storage . Lake Hawea and Takapō are now below thier 90th percentiles. Storage at Lake Te Anau and Manapōuri decrease last week, but both lakes below their respective historic means.

Figure 13: Hydro Storage



10. JADE Water Values

Figure 14: JADE water values across various reservoirs between 9 September and 18 December 2022



10.1. The JADE[2] 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. **Error! Reference source not found.** shows the national water values between 9 September and 18 December 2022 using values obtained from JADE. These values are used to estimate marginal water value at the actual storage level. More details on how water values are calculated can be found in Appendix B[3] on the trading conduct webpage.

10.2. Recently water values have been falling, reaching a low in mid to late November, when national storage was high. Over the last couple of weeks, the water values at most reservoirs have increased, with a small decrease at Hawea.

11. Price 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 15 shows an estimate of thermal SRMCs as a monthly average up to 1 December 2022. The SRMC of gas fuelled plants has remained relatively flat, the SRMC of diesel has continued to fall from its June peak, and the SRMC of coal has also fallen.

11.4. In early December Indonesian coal was around ~$480/tonne putting the latest SRMC of coal fuelled Huntly generation at ~$300/MWh. The SRMC of Whirinaki has fallen to ~$600/MWh. Both are likely reactions to a slight easing of international demand and prices.

11.5. The SRMC of gas run thermal plants decreased to between $90/MWh and $135/MWh, likely due to the increase in gas fuel availability in December, as Kupe returned from outage in late November.

11.6. More information on how the SRMC of thermal plants is calculated can be found in Appendix C[4] on the trading conduct webpage.

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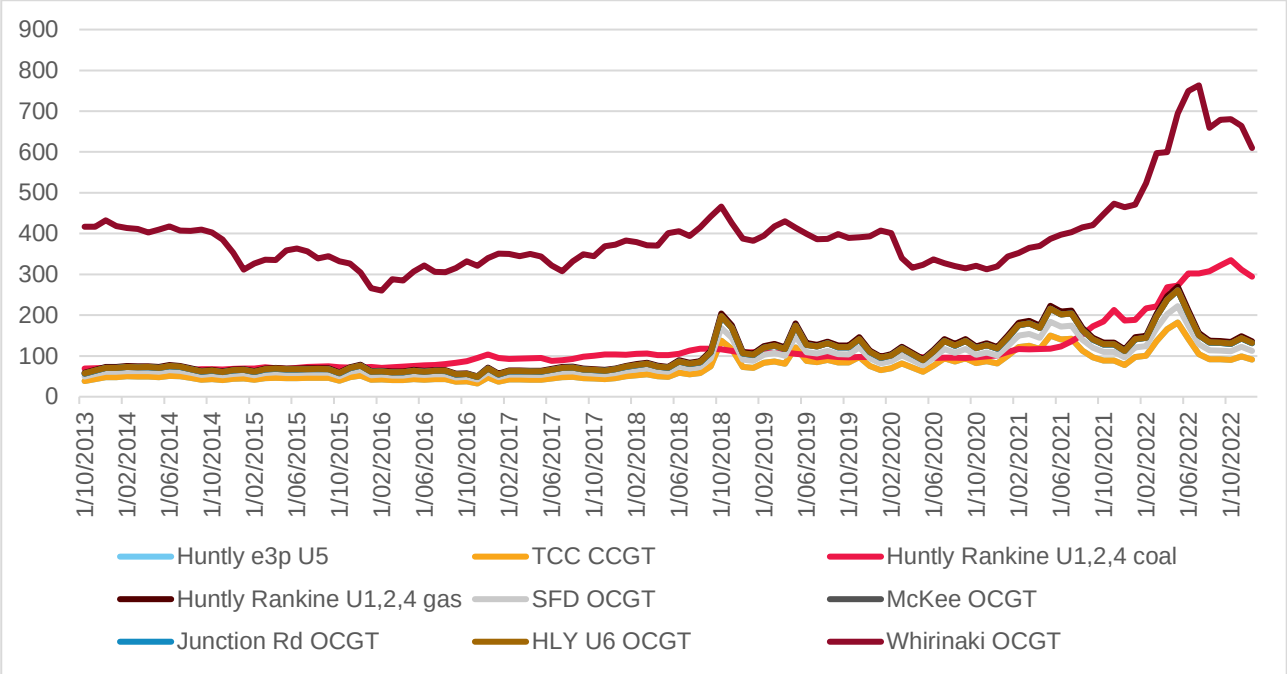
[2] JADE (Just Another DOASA Environment) is an implementation of the Stochastic Dual Dynamic Programming (SDDP) algorithm of Pereira and Pinto. JADE was developed by researchers at the Electric Power Optimisation Centre (EPOC) for the New Zealand electricity market.

[3] https://www.ea.govt.nz/assets/dms-assets/29/Appendix-B-JADE-water-value-model.pdf

[4] https://www.ea.govt.nz/assets/dms-assets/30/Appendix-C-Calculating-thermal-SRMCs.pdf

Figure 15: Estimated monthly SRMC for thermal fuels



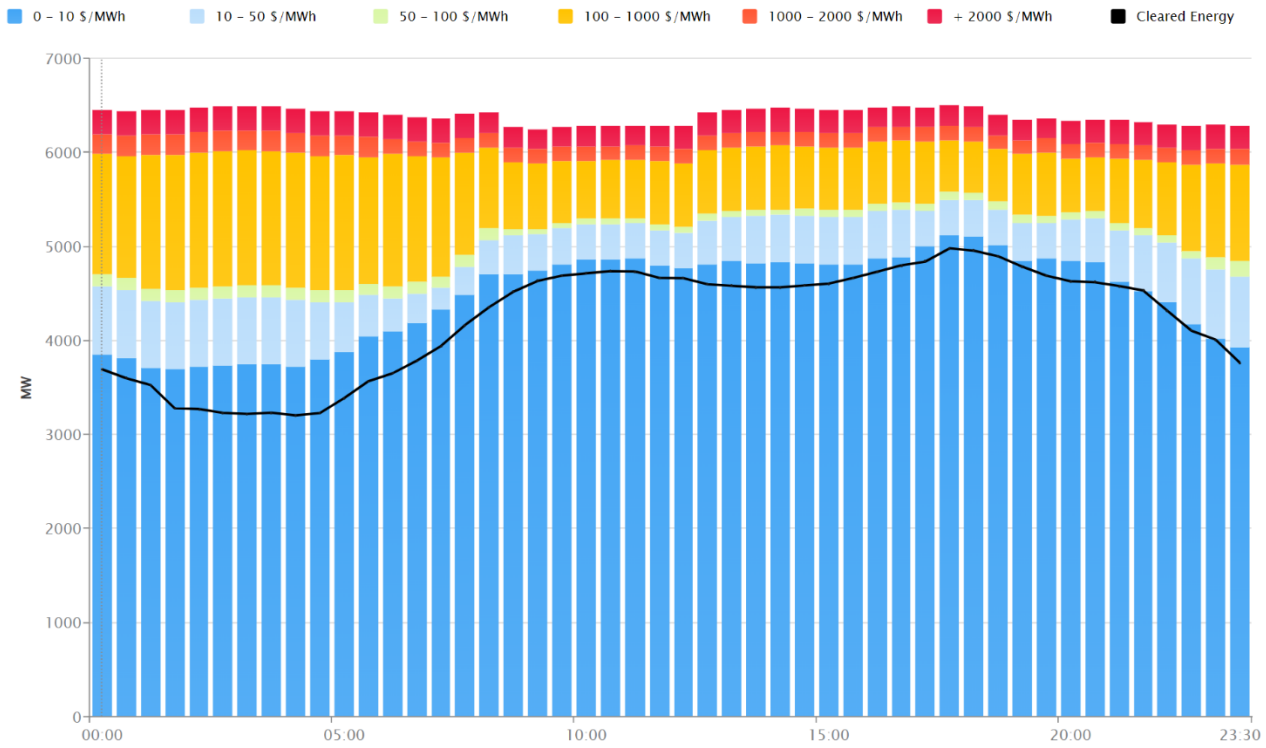
12. Offer Behaviour

12.1. Figure 15 shows this week's national daily offer stacks from WITS[5]. The black line shows cleared energy, indicating the range of the average final price. The majority of energy, between Monday and Friday, was cleared in the $10-50/MWh - with jumps into the $50-100/MWh $100-1000/MWh bands during the price spikes. These jumps in clearing price reflects the tighter supply of energy during the times of low wind generation and high demand.

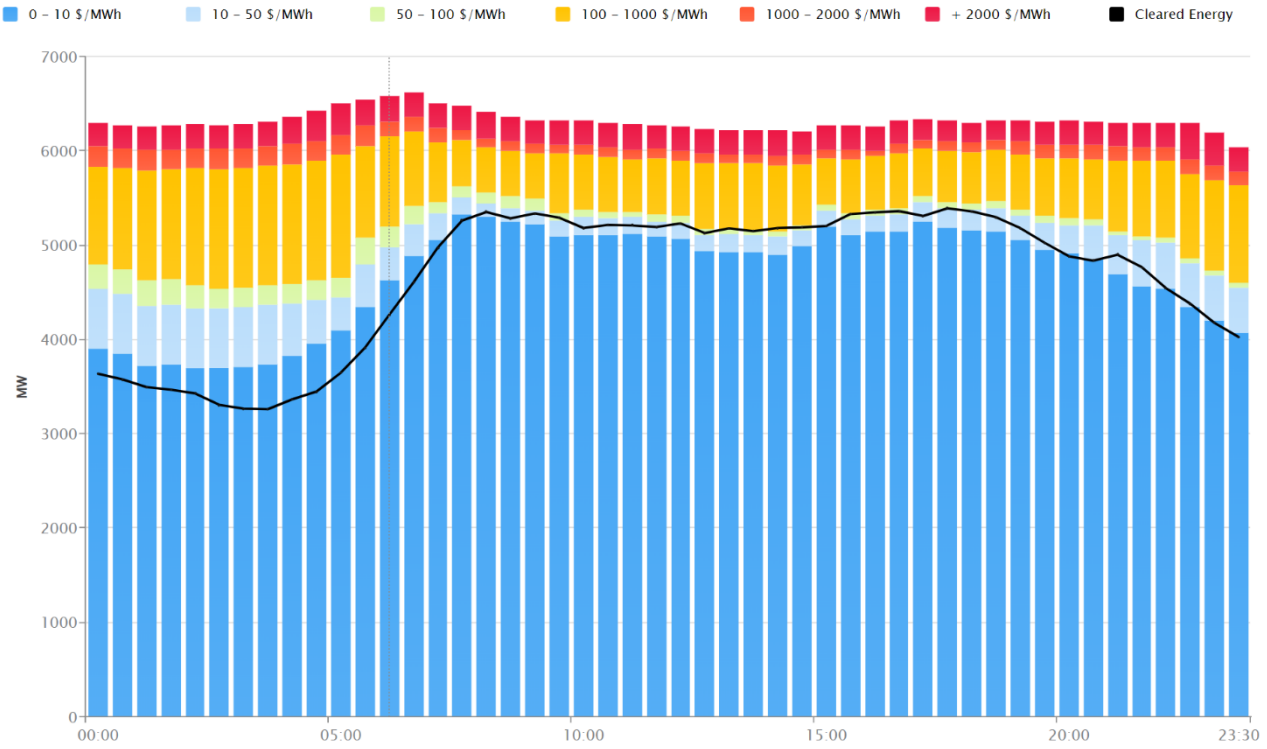
[5] Cleared Energy Stack | WITS (electricityinfo.co.nz)

Figure 16: Daily offer stack from WITS

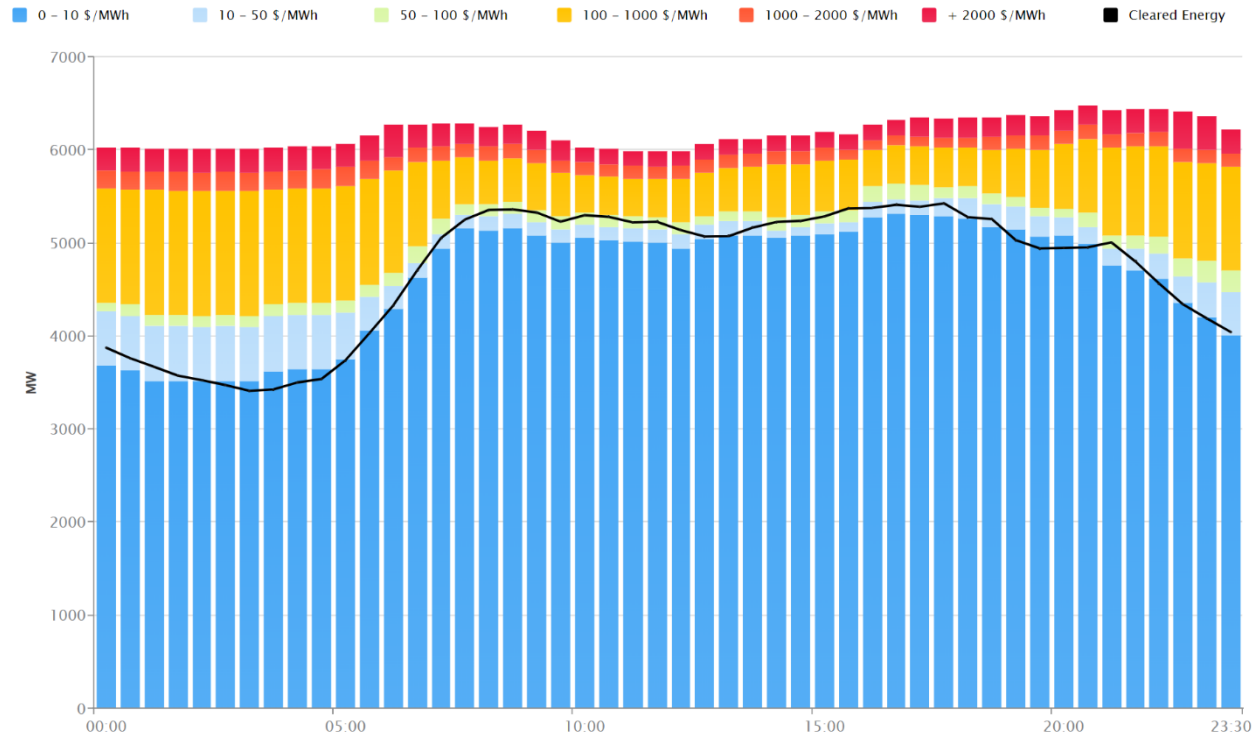
Sunday 11 December



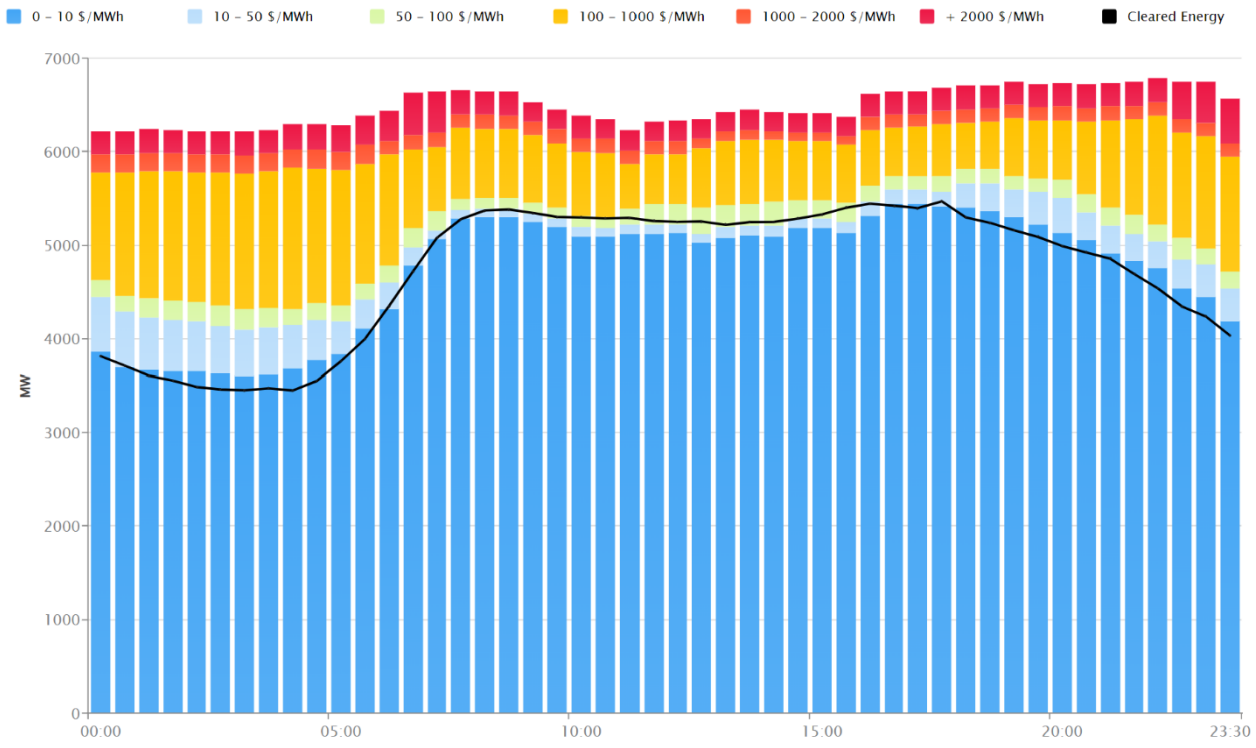
Monday 12 December



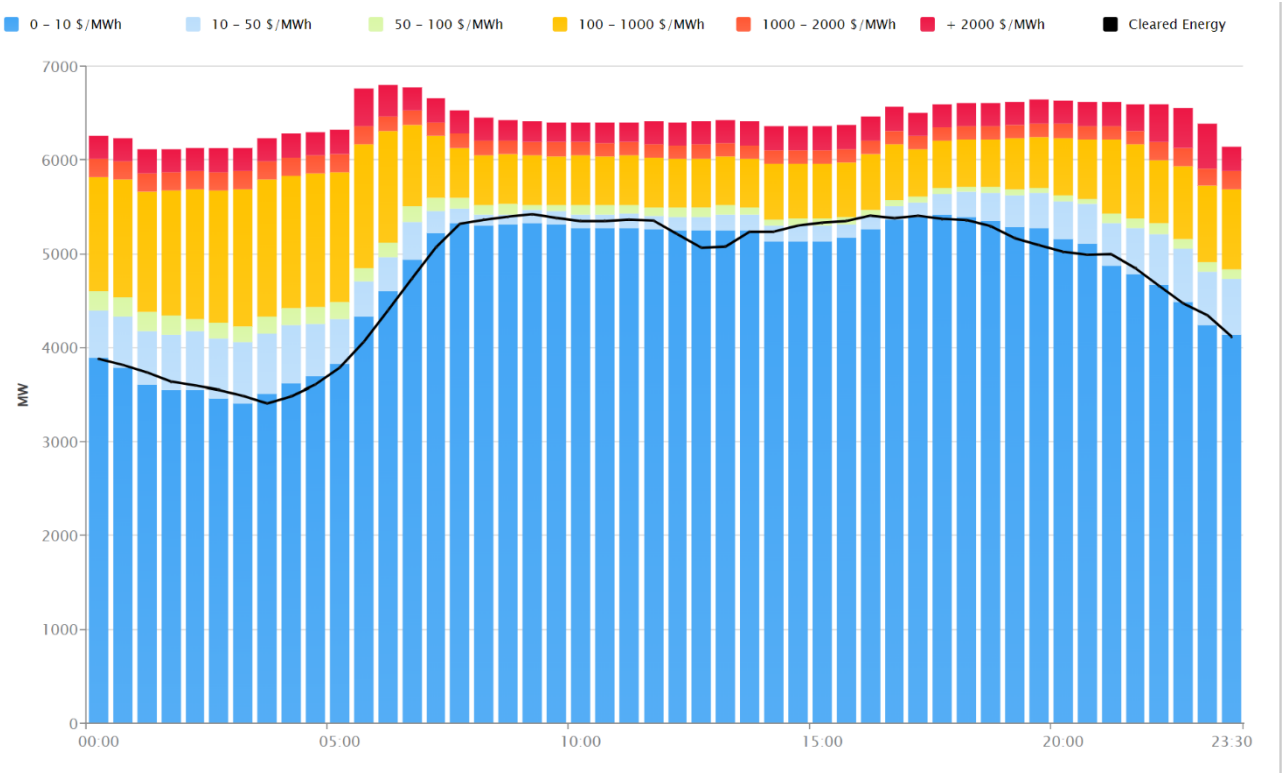
Tuesday 13 December



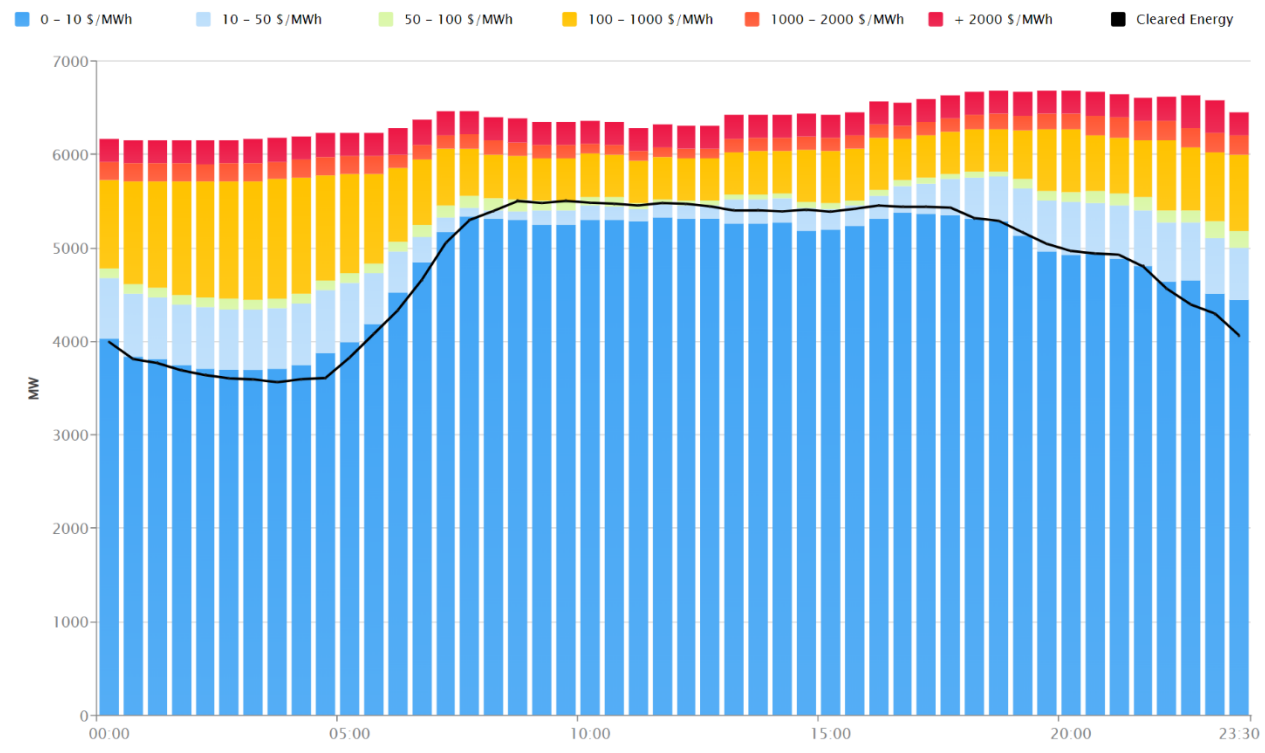
Wednesday 14 December



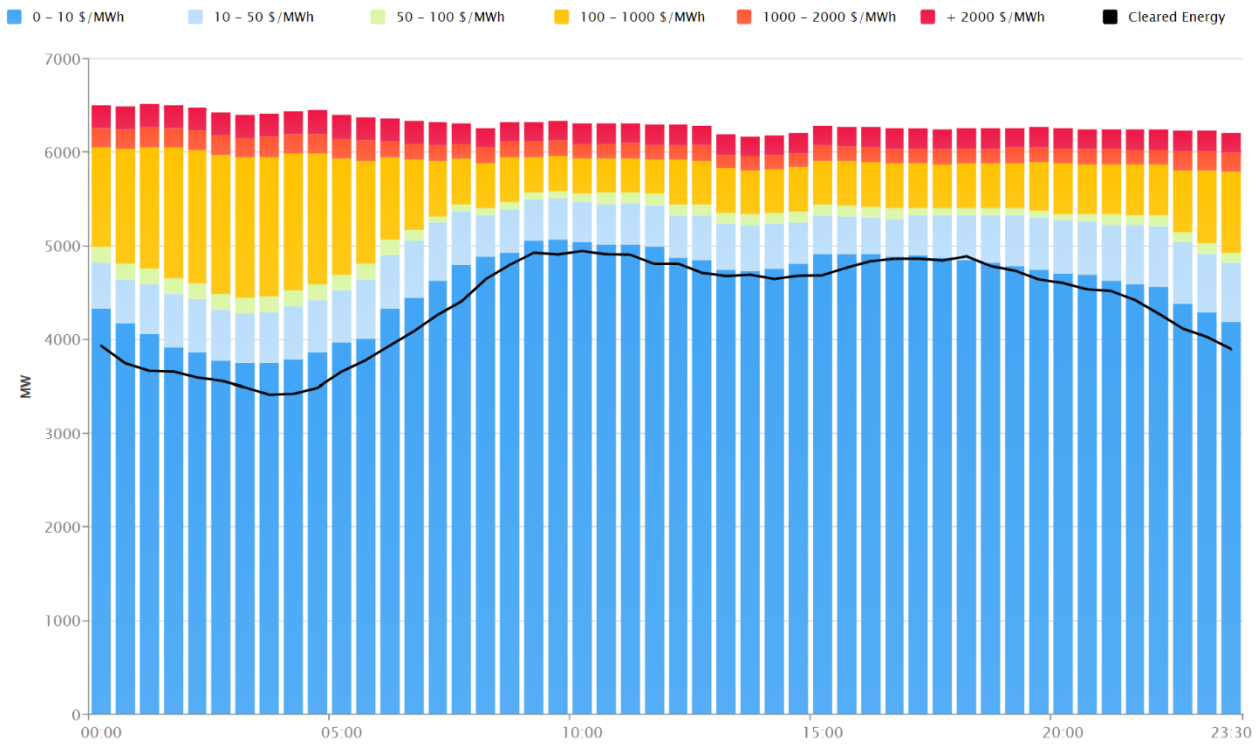
Thursday 15 December



Friday 16 December



Saturday 17 December



13. Ongoing Work in Trading Conduct

13.1. This week, most prices appeared to be consistent with supply and demand conditions, however a few trading periods are undergoing further analysis.

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
19/02/2022-24/02/2022	Several	Compliance enquiries in progress	After reviewing information received from Genesis regarding offers from Tekapo B while Lake Tekapo was spilling, this case has been passed to compliance to assess if the offers were compliant with trading conduct rules.
07/10/2022	15-16	Further analysis	The Monitoring team is making enquires with Genesis regarding offers changes to final tranche prices at Huntly 5 for trading period 15-16.
15/11/2022 – 24/11/2022	Several	Further analysis	The Authority will continue analysis into the high energy prices.
13/12/2022-16/12/2022	Several	Further analysis	The Authority will continue analysis into the high energy prices.