27 July 2022

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 17 to 23 July

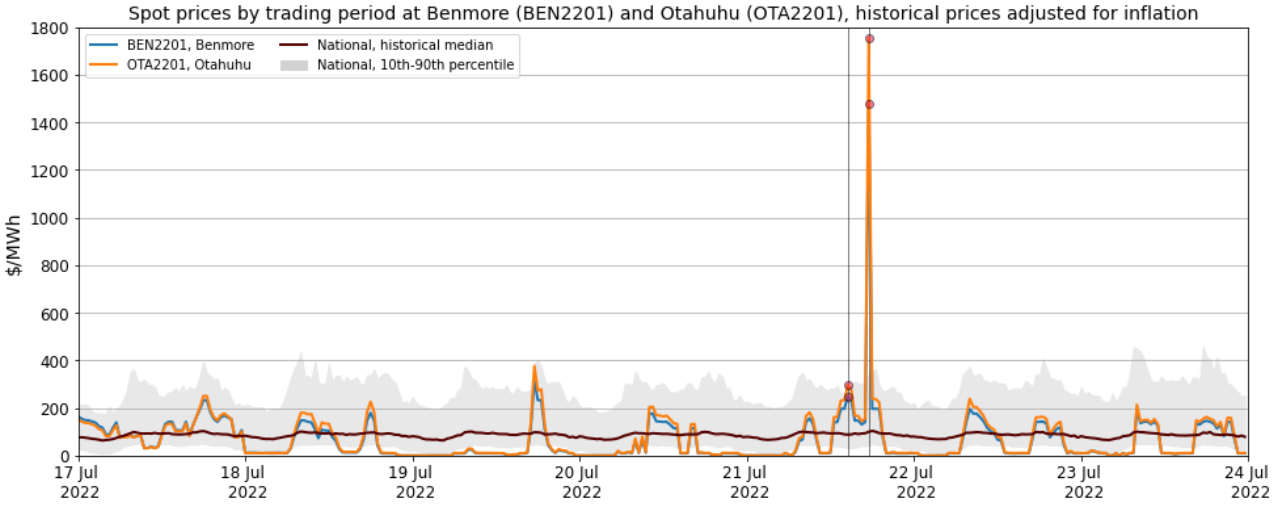
1.1. Overall wholesale spot prices appear to align with market conditions this week.

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 Benmore and/or Otahuhu nodes exceed their historical 90th percentiles. These historically high-priced trading periods are marked out by vertical lines in the majority of figures in this report.

2.2. Figure 1 shows spot prices between 17 and 23 July at Benmore and Otahuhu alongside their historic median and historic 10th-90th percentiles adjusted for inflation. Over the week Otahuhu and Benmore spot prices fluctuated around their historic median with prices reaching as low as $0.01/MWh and rising as high as $1,752.61/MWh. Prices rose above their historical 90th percentiles on two occasions on the evening of 21 July.

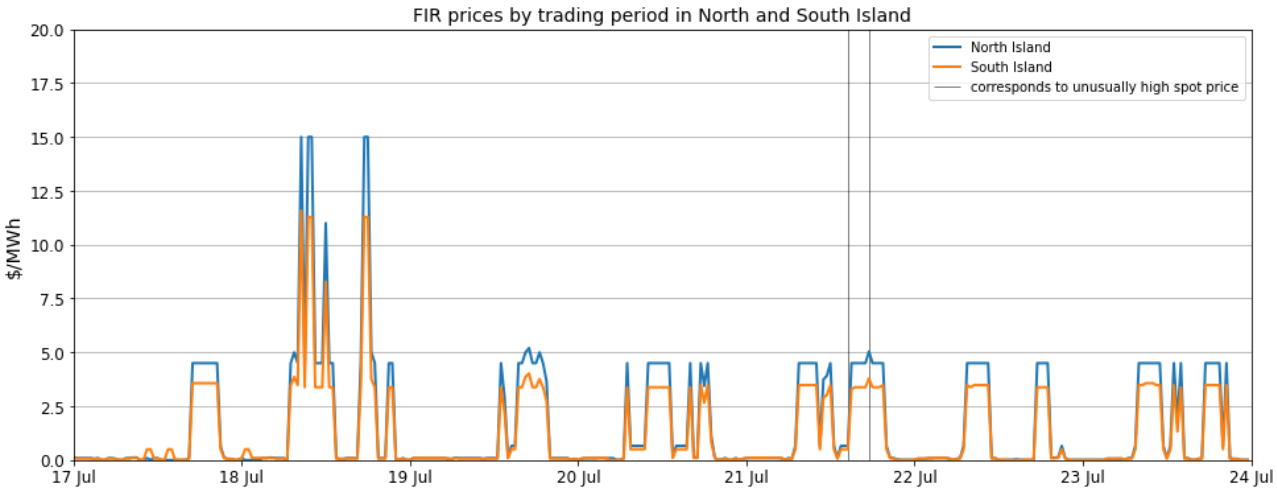
Figure 1: Wholesale Spot Prices



3. Reserve Prices

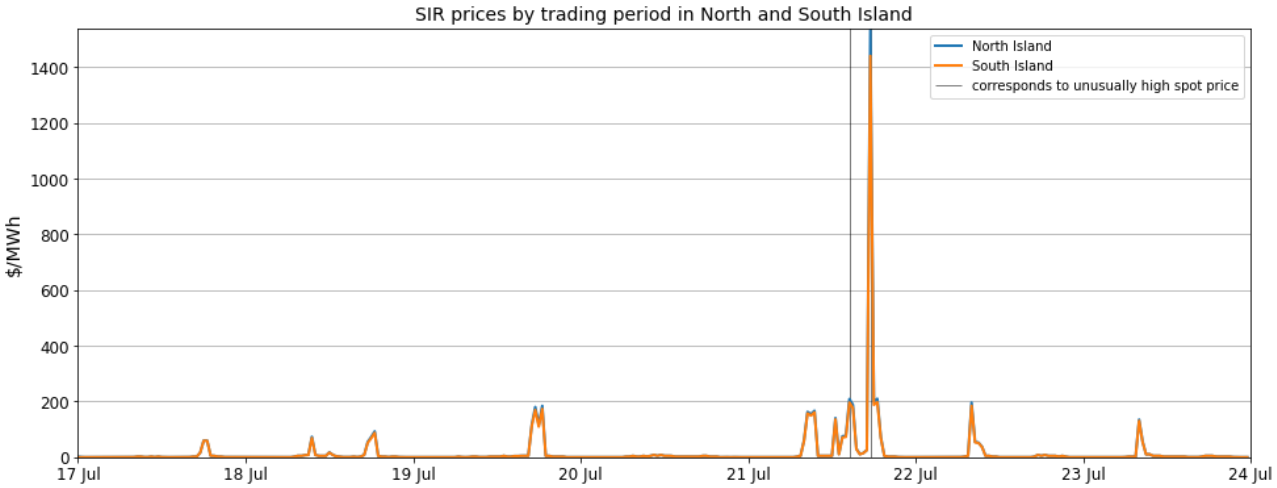
3.1. Fast instantaneous reserves (FIR) prices for the North and South Island are shown below in Figure 2. FIR prices fell within historical bounds this week at below $15/MWh.

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices for the North and South Island are shown below in Figure 3. SIR prices also fell mainly within historical bounds this week with the exception of some price spikes which reached over $1,400/MWh. The price spikes were likely due to reserves being dispatched instead of higher priced energy offers in an effort to reduce the overall spot price.

Figure 3: SIR prices by trading period and Island



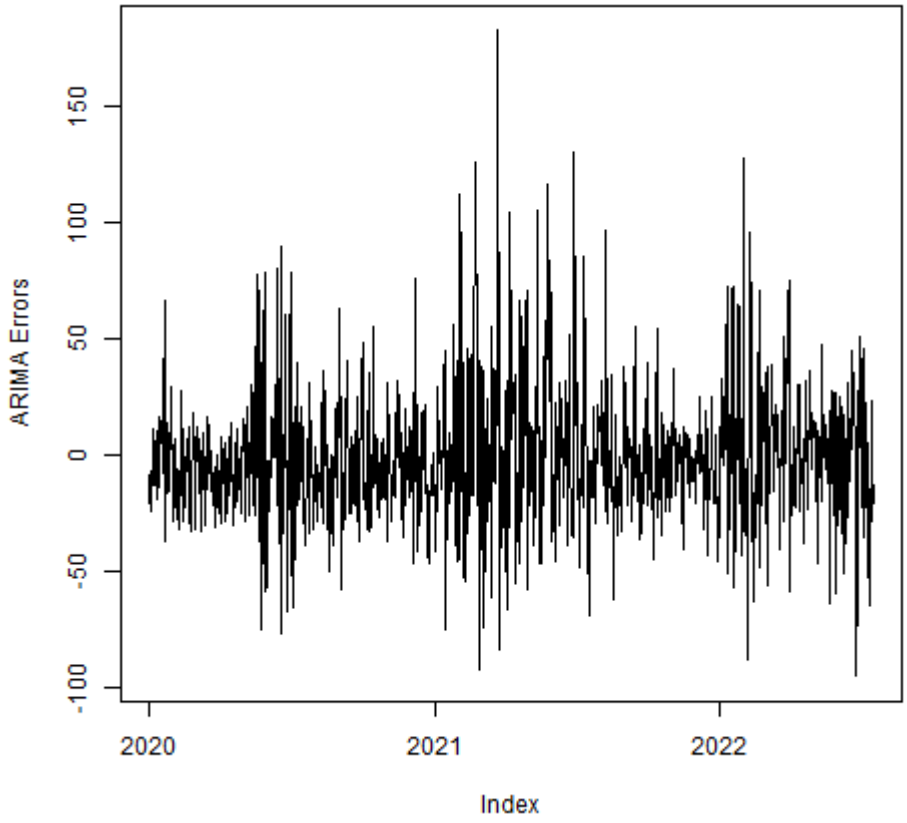
4. Regression Residuals

4.1. 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.

4.2. Figure 4 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Daily residuals this week suggest that prices appear to be largely aligned with market conditions.

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

Figure 4: Residual plot of estimated daily average spot price



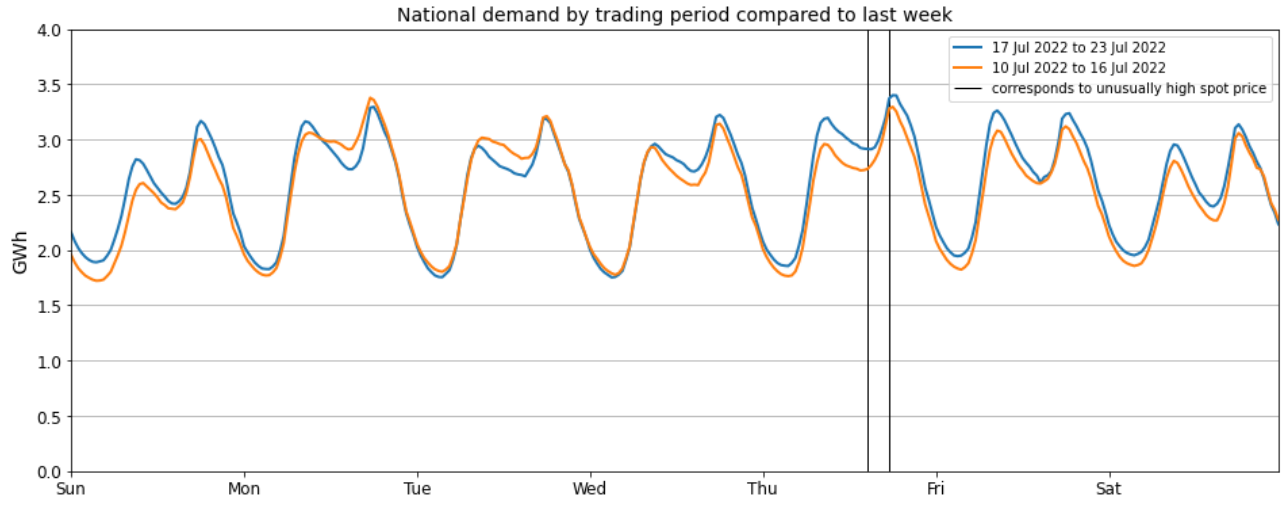
5. Demand

5.1. Figure 5 shows this week's national grid demand against national grid demand from the previous week.

5.2. Average daily demand between 17 and 23 July was similar to average daily demand between 10 and 16 July, with the exception of daily demand on Thursday 21 and Friday 22 July which was noticeably higher. The increase in demand on 21 and 22 was likely linked to extreme weather conditions around the nation on those days with severe weather historically associated with increased electricity consumption.

5.3. Prices which exceeded their historical 90th percentile this week fell on periods of higher than usual demand meaning high demand was a likely contributor towards spot prices peaks this week.

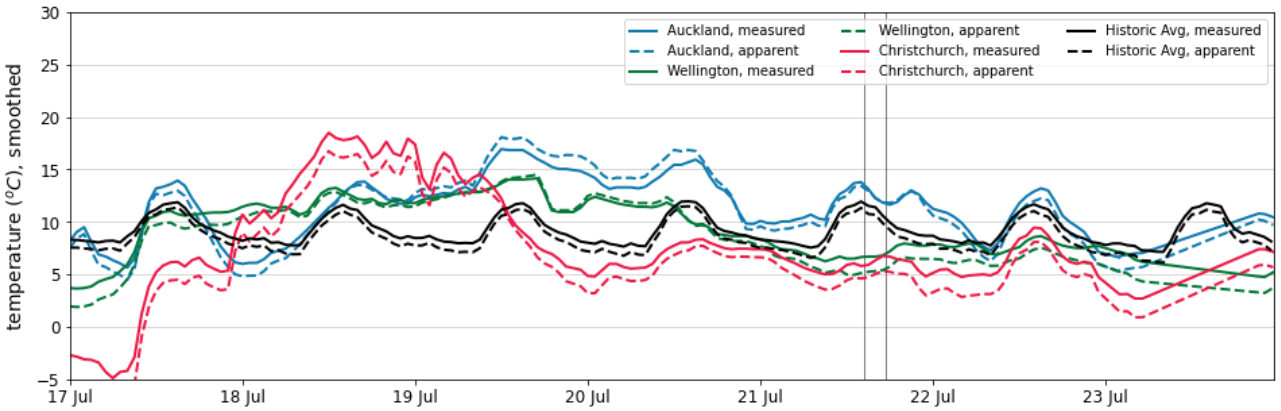
Figure 5: National demand by trading period compared to the previous week



5.4. Figure 6 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.

5.5. Apparent temperatures this week were low, averaging around 10°C. Grid demand continues to follow seasonal trends, increasing when temperatures decrease.

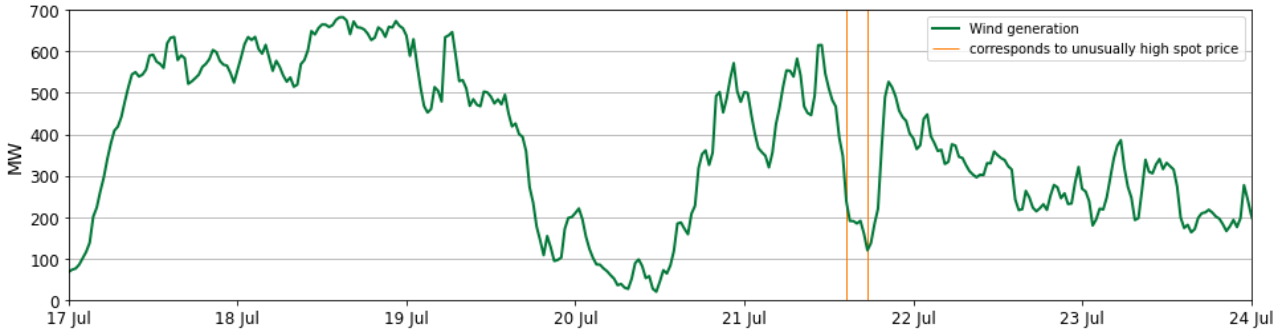
Figure 6: Temperatures across main centres



6. Generation

6.1. Wind generation from the past week as seen in Figure 7 decreased from around ~600 MW on 17 July to around ~200 MW on 23 July. Wind generation took two large dips below 200 MW between 19 and 21 July, coinciding with when spot prices exceeded their historical 90th percentiles. High wind also tended to coincide with periods of low prices. It is therefore likely that low wind generation was a large contributor towards high spot prices.

Figure 7: Wind Generation

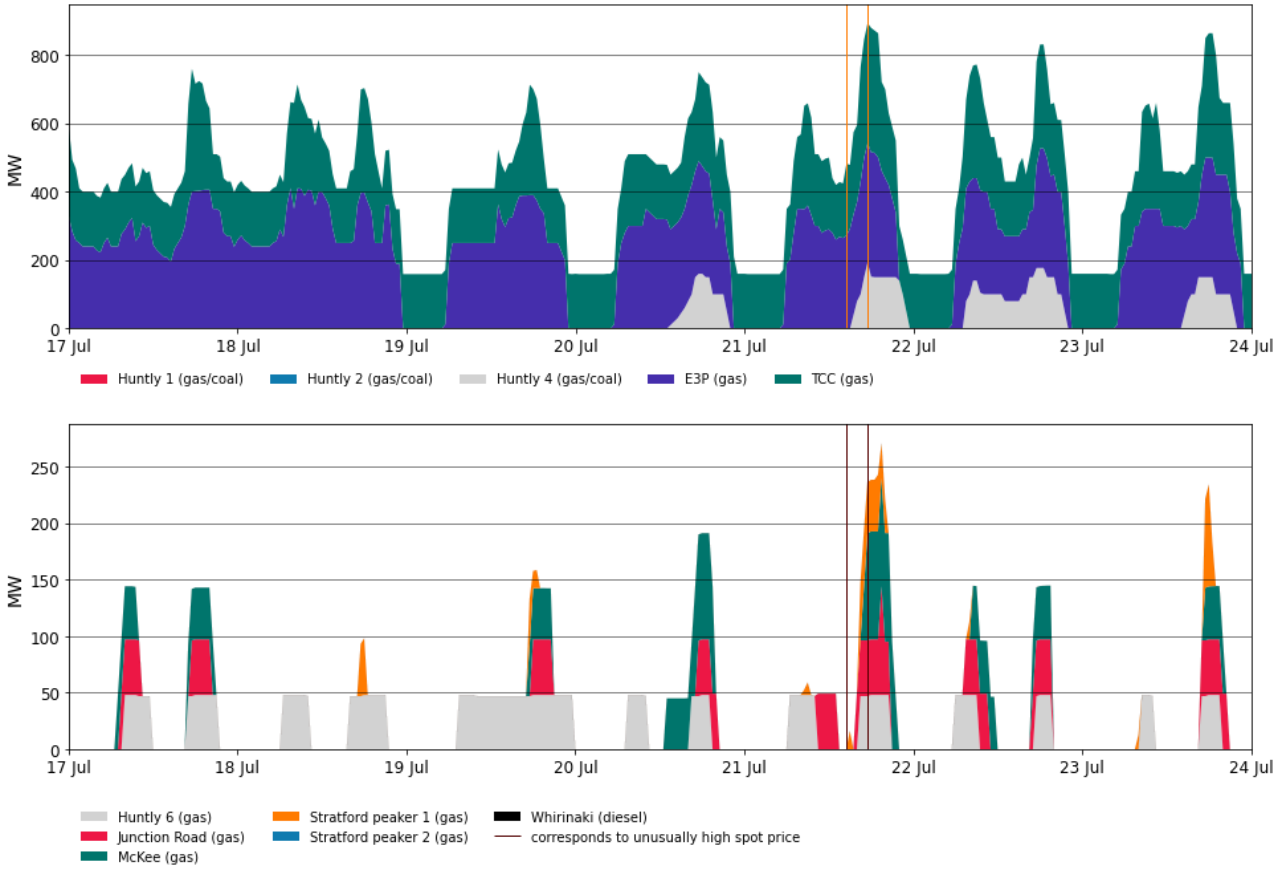


6.2. Figure 8 shows generation at thermal and thermal peaker plants from the past week. Peak thermal generation showed a tendency to increase when wind generation decreased. Above average thermal generation was a likely contributor towards high spot prices this week.

6.3. While initially it looked as though generation from Stratford from 5:30pm on 19 July would set the marginal price it became constrained on by SPD to provide reserves instead.

6.4. High priced generation dispatched from thermal peakers contributed to the spike in prices seen at 5:30pm on 21 July. Whirinaki was also constrained on by SPD to provide reserves on 21 July.

Figure 8: Thermal Generation



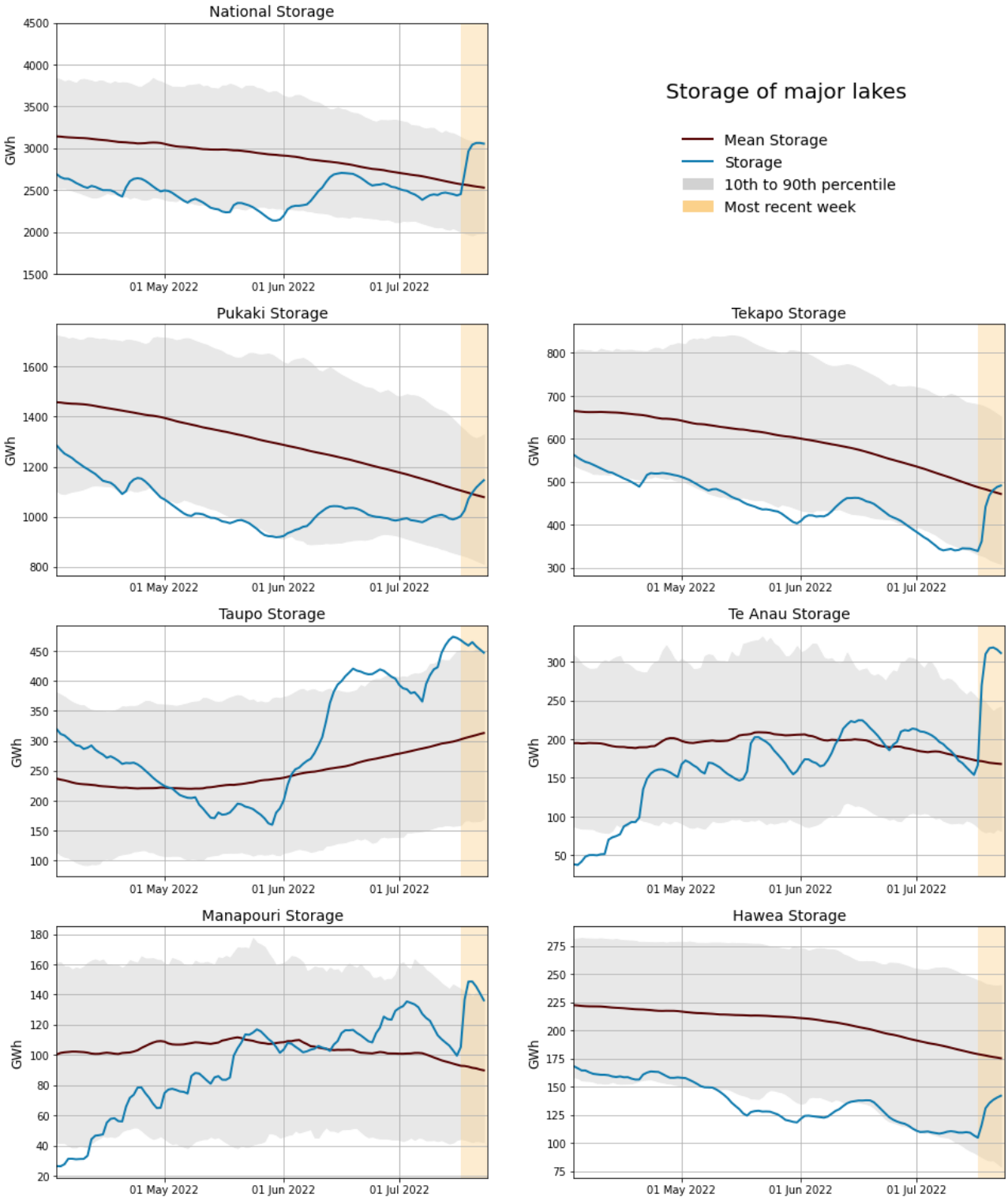
7. Storage/Fuel Supply

7.1. Figure 9 shows total controlled national hydro storage as well as the storage of major catchment lakes including their historical mean and 10th to 90th percentiles.

7.2. High hydro inflows, a result of heavy rainfall over the past week, have contirbuted to a large increase in controlled hydro storage across all major catchments. All major lakes with the exception of Lake Hawea have risen above their historical mean storage.

7.3. The sudden increase in inflows likely contributed to below average spot prices this week with increased generation at run of river schemes and the opportunity cost of hydro generation lowering resulting in increased low priced hydro generation offers.

Figure 9: Hydro Storage



8. Price versus estimated costs

8.1. 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).

8.2. The SRMC (excluding opportunity cost of storage) for thermal fuels can be 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. Figure 10 shows an estimate of thermal SRMCs as a monthly

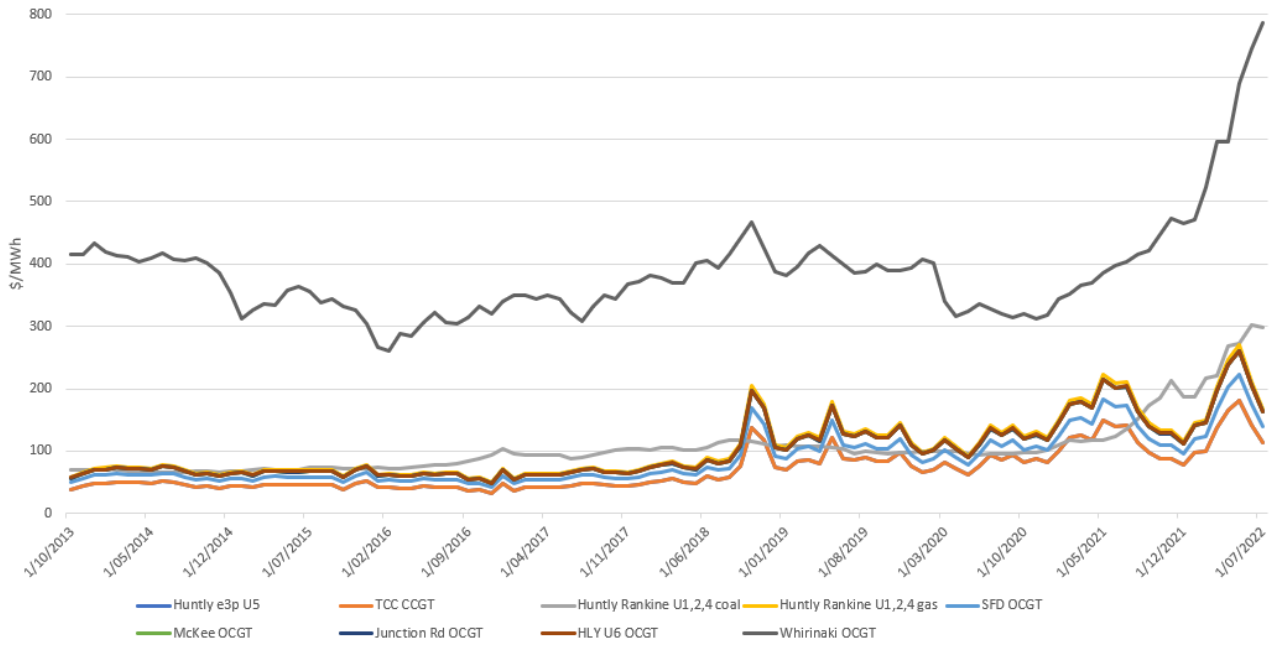
average up to 1 July 2022. The SRMC of gas fuelled plants has fallen from its peak in May 2022 while the SRMC of diesel and coal fuelled plants continues to increase.

8.3. The SRMC of coal and diesel have both increased due to global supply and demand conditions. As well as supply disruptions caused by Covid, the Russian-Ukraine conflict has increased the premium on all international coal due to sanctions placed on Russia. The most recent price for Indonesian coal was around $510/tonne. The increase in diesel and coal prices has put the latest SRMC of Whirinaki and coal fuelled Huntly generation to $786/MWh and $299/MWh respectively.

8.4. SRMCs of gas run thermal plants have decreased to between $100/MWh and $200/MWh with the outlook for gas supply in the second half of 2022 looking increasingly positive.

8.5. More information on how the SRMC of thermal plants is calculated can be found in Appendix C[2] on the trading conduct webpage.

Figure 10: Estimated monthly SRMC for thermal fuels



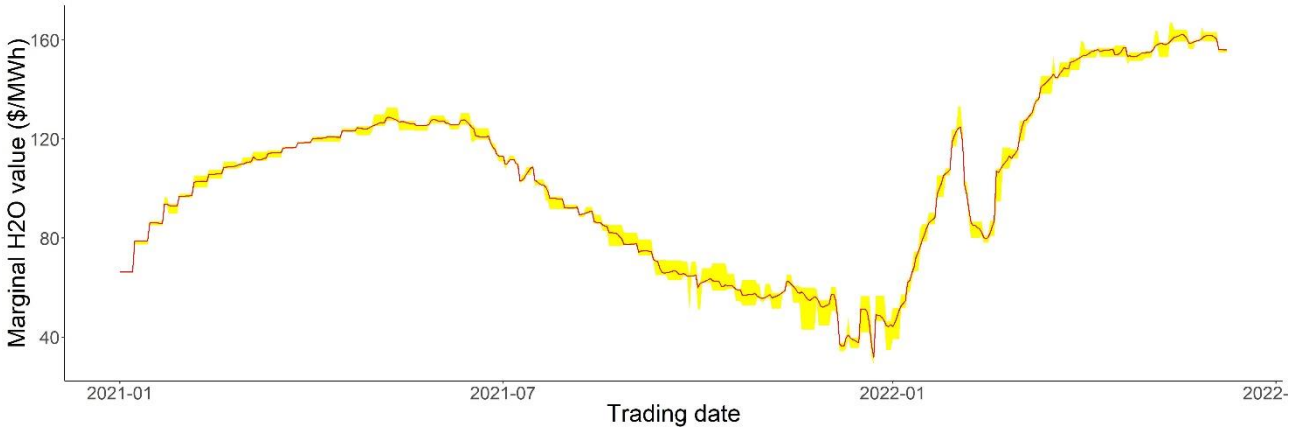
9. JADE Water values

9.1. 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 11 shows the national water values to 8 June 2022 using values obtained from JADE. The outputs from JADE closest to actual storage levels are shown as the yellow water value range. 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[4] on the trading conduct webpage.

9.2. In general, marginal water values have increased when total national hydro storage has decreased. For the last two months water values have been gradually increasing as hydro storage has declined putting the latest water values at around ~$150/MWh.

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

Figure 11: Water Values



10. Offer Behaviour

10.1. Figure 12 shows this week's daily offer stacks, adjusted to take into account wind generation, transmission constraints, reserves and frequency keeping.[5] The black line shows cleared energy, indicating the range of the average final price.

10.2. High thermal and hydro generation opportunity costs as detailed above continue to drive a steep offer curve.

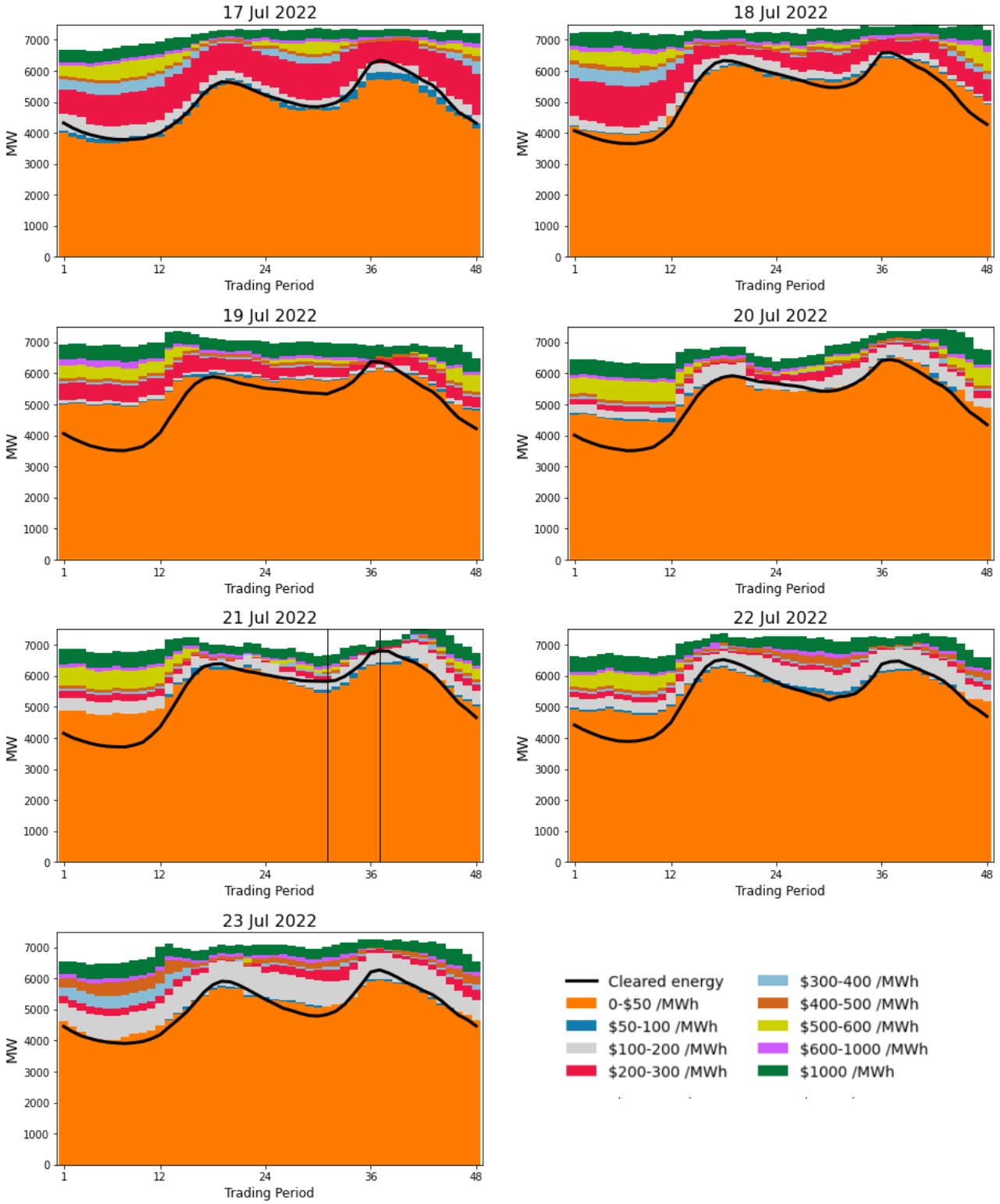
10.3. Cleared energy during the week remained primarily within or below the $300/MWh range with high wind generation and high hydro inflows increasing the amount of low priced generation offers.

10.4. Prices reached above $300/MWh during periods of above average demand and decreasing wind generation with high priced thermal peakers being dispatched despite being intentionally priced out of expected dispatch range. These high priced offers were subsequently lowered after initial dispatch with spot prices following suit.

10.5. The pre-dispatch offers in the short term lead up to high prices showed no changes that would suggest generators were trying to take advantage of market conditions.

[5] The offer stacks show all offers bid into the market (where wind offers are truncated at their actual generation and excluding generation capacity cleared for reserves) in price bands and plots the cleared quantity against these.

Figure 12: Daily offer stack



11. Ongoing Work in Trading Conduct

11.1. This week prices appeared to be consistent with supply and demand conditions. High spot prices were likely a result of higher than expected demand and decreasing wind generation forcing high priced generation to be dispatched. Periods with constrained on generation were looked into.

11.2. 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
19/02/22-24/02/22	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.
29/06/2022	26-48	Further analysis	The Authority is making enquires with Genesis regarding offers at both Huntly 1 and Huntly 4 - the addition of only high priced offers at Huntly 1 lead to $700/MWh+ pricing on trading period 36.
19/07/2022, 21/07/2022	36	Completed	An enquiry was made to Transpower about constrained generation during certain periods on 19 and 21 July. Transpower responded that generation was constrained on by SPD to provide reserves.