4 May 2022

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 24 to 30 April

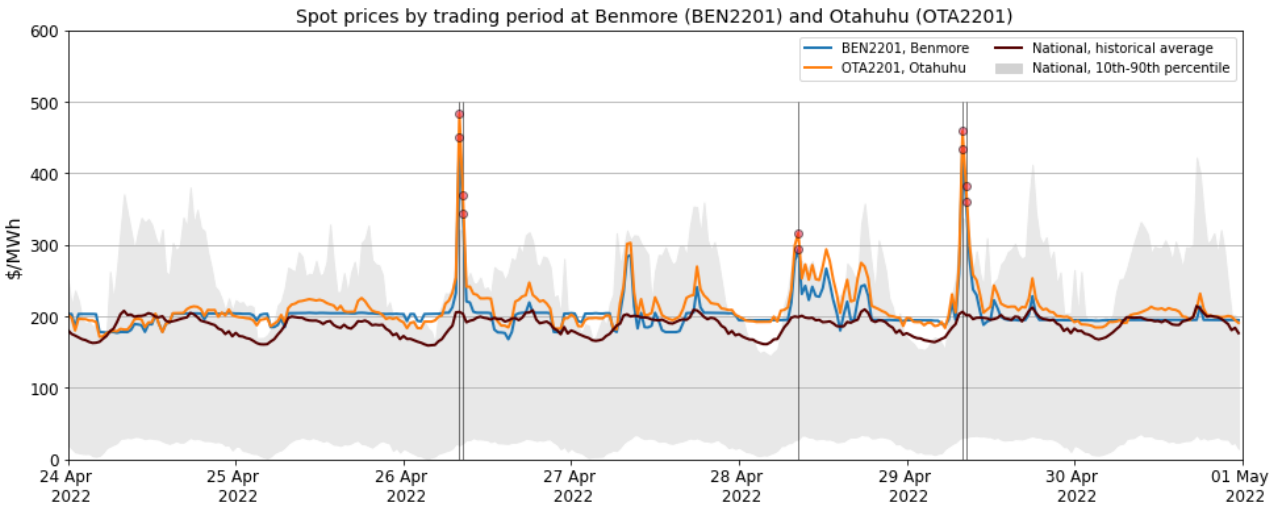
1.1. Wholesale spot prices for the week between 24 and 30 April appear to be consistent with supply and demand conditions.

2. Spot Prices

2.1. On top of monitoring underlying wholesale price drivers to ensure spot prices are behaving as we would expect we have singled 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 wholesale electricity spot prices between 24 and 30 April at Benmore and Otahuhu alongside their historic mean and historic 10th-90th percentiles. Spot prices averaged $209.95/MWh, compared to a historical average of $140.58/MWh for the same period.

Figure 1: Wholesale Spot Prices



2.3. A total of five trading periods were identified as being historically high in the past week. All these periods were peak morning periods at 8:00am or 8:30am on a weekday. The trading periods are listed below in Table 1.

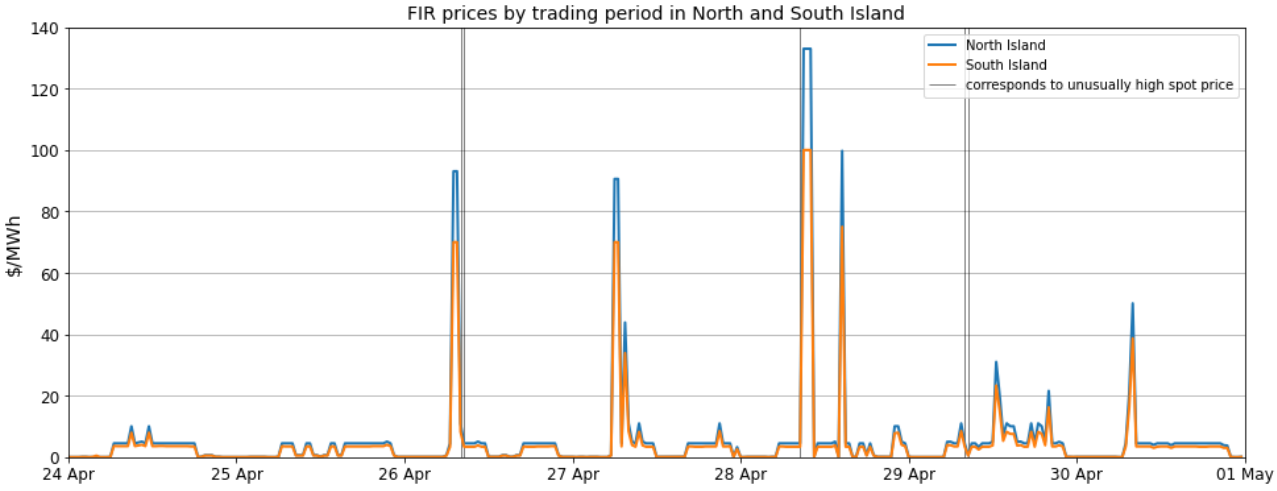
Table 1: High Priced Periods

Date	Trading Period	Historic Mean	10th percentile	90th percentile	Benmore	Otahuhu
26/04/2022 8:00	17	206.15	20.16	321.01	450.90	483.24
26/04/2022 8:30	18	203.69	22.83	319.65	342.88	369.02
28/04/2022 8:30	18	198.91	28.22	277.43	294.04	316.46
29/04/2022 8:00	17	206.37	30.61	337.70	434.67	459.11
29/04/2022 8:30	18	201.67	30.80	333.40	360.81	381.59

3. Reserve Prices

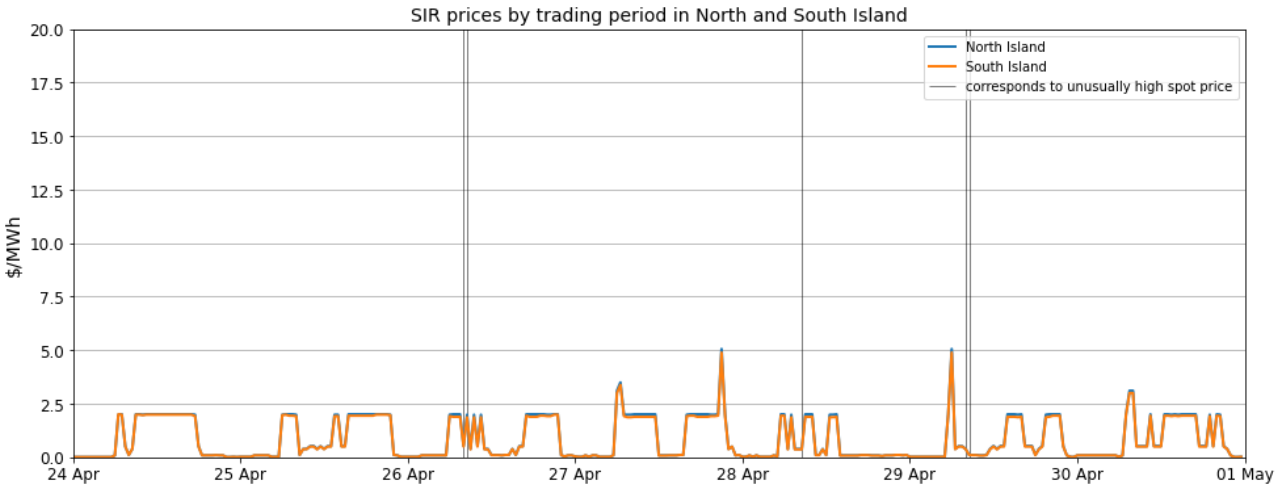
3.1. Fast instantaneous reserves (FIR) prices for the North and South Island this week are shown below in Figure 2. The mean national FIR price between 24 and 30 April was $6/MWh. Reserve prices mostly remained within normal bounds except for occasional price spikes reaching up to ~$135/MWh. These price spikes, like high wholesale spot prices, occurred during peak morning periods and were likely due to the system choosing to dispatch lower priced reserves when it looked like energy spot prices were going to be significantly higher.

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices for the North and South Island this week are shown below in Figure 3. The mean national SIR price between 24 and 30 April was $1/MWh. SIR reserve prices were well within historical bounds, remaining below ~$5/MWh, this week.

Figure 3: SIR prices by trading period and Island

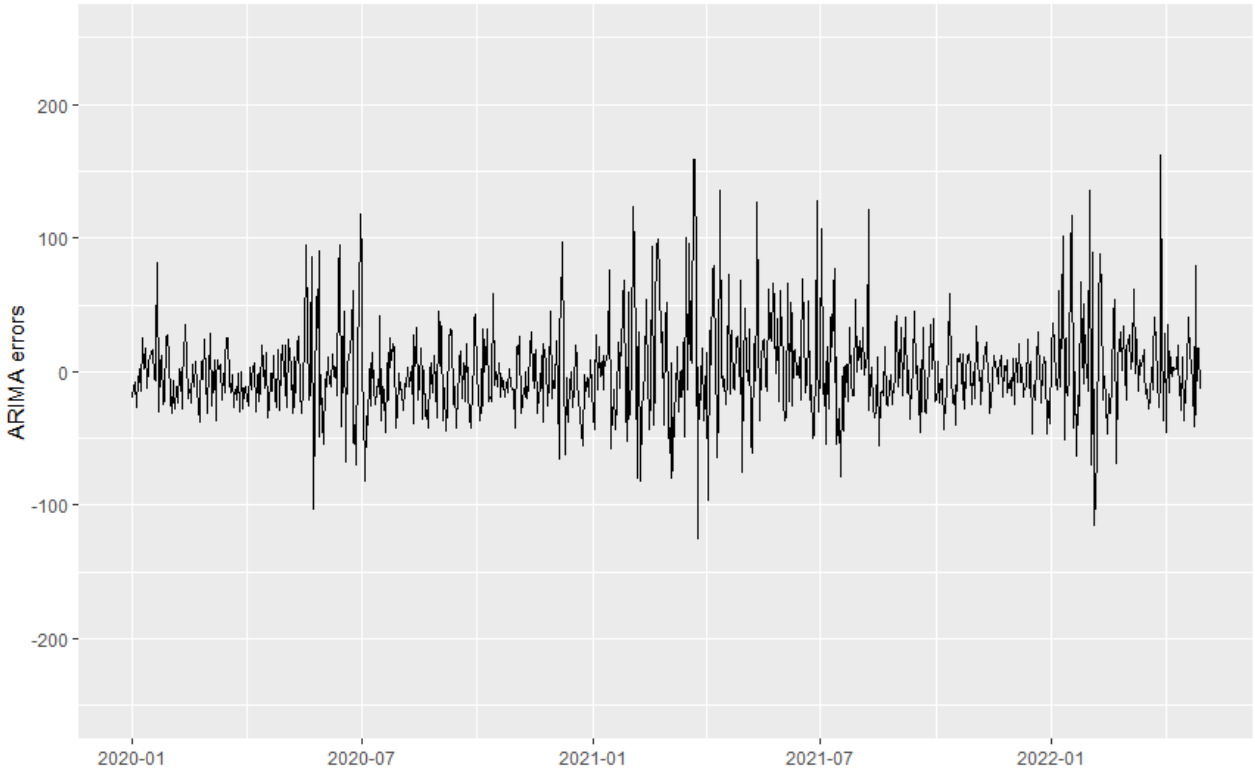


4. Regression Residuals

4.1. The Authority's monitoring team has developed two regression models of the 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.

4.2. Figure 4 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Residuals for the week were stable with few fluctuations indicating prices aligned with market conditions. A trend of increasing prices from 24 to 26 April resulted in the largest residual falling on 26 April.

Figure 4: Residual plot of estimated daily average spot price YTD

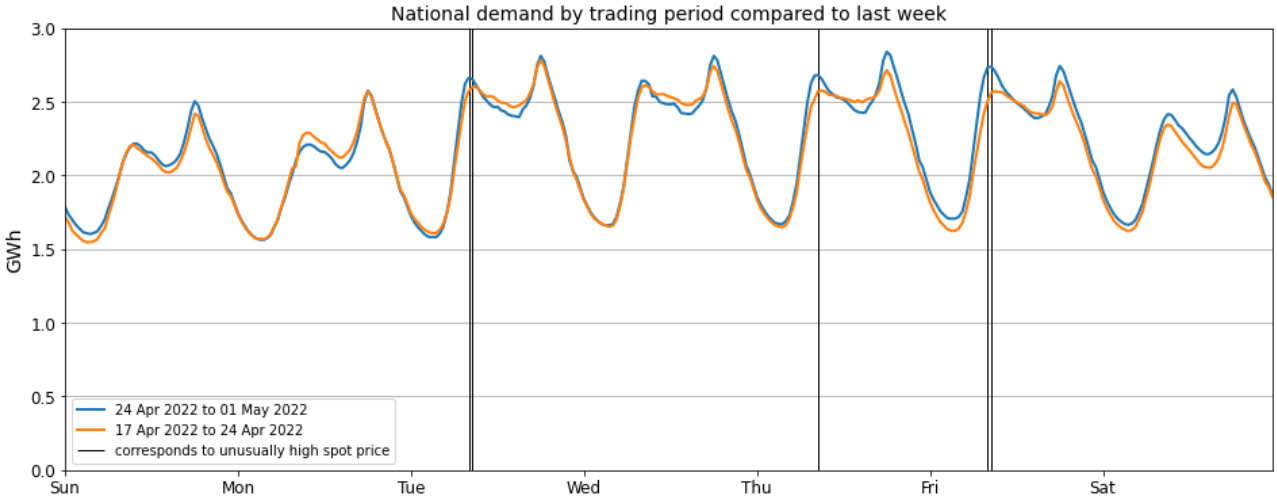


5. Demand

5.1. Figure 5 shows national grid demand between 23 and 30 April against national grid demand from the previous week. As Easter Monday and ANZAC day both fell on a Monday there was little difference in variation in demand between weeks for Monday though demand was noticeably lower than usual for a weekday (demand on a public holiday tends to resemble the demand profile of a weekend day).

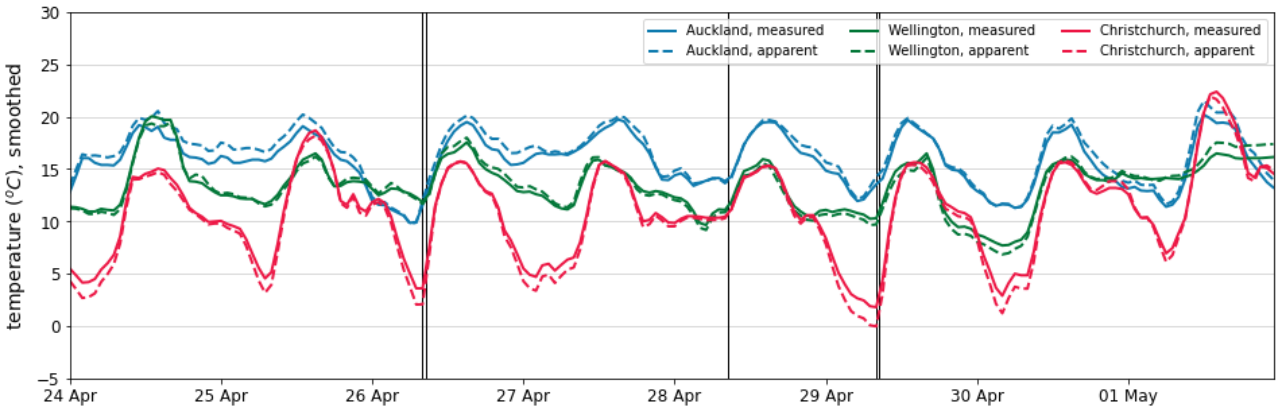
5.2. Excluding Monday, peak demand this week during weekdays has been noticeably higher than peak demand from the previous week (with differences reaching up to 438 MW). As every high priced period this week coincided with morning peak demand the increase in peak demand has likely played a predominant role in contributing to high prices this week.

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



5.3. The increase in peak demand from the previous week is likely due to lower temperatures. Figure 6 shows hourly temperature at main population centres. Measured temperature is the recorded temperature, and apparent temperature is the measured temperature adjusted for factors like wind speed and humidity to estimate how cold it feels. Temperatures, especially in the South Island, were at their lowest of the week during high priced periods this week pointing to low temperatures as the reason for increased peak demand and high prices.

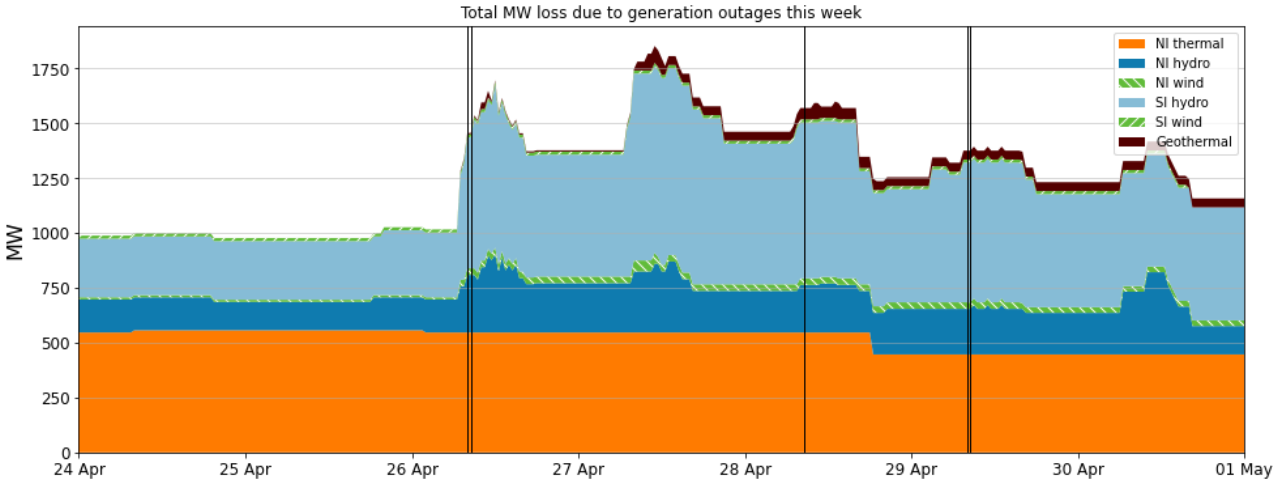
Figure 6: Temperatures across main centres



6. Outages

6.1. Figure 7 shows generation capacity lost due to outages by fuel type. Compared to the previous week total generation capacity lost due to outages this week has increased. Capacity lost reached just above 1,750 MW on 27 April with the majority of the increase in lost capacity coming from South Island hydro outages. These outages may have been timed to coincide with local transmission outages and may be due to South Island generators holding back due to low hydro storage and resource consent limits.

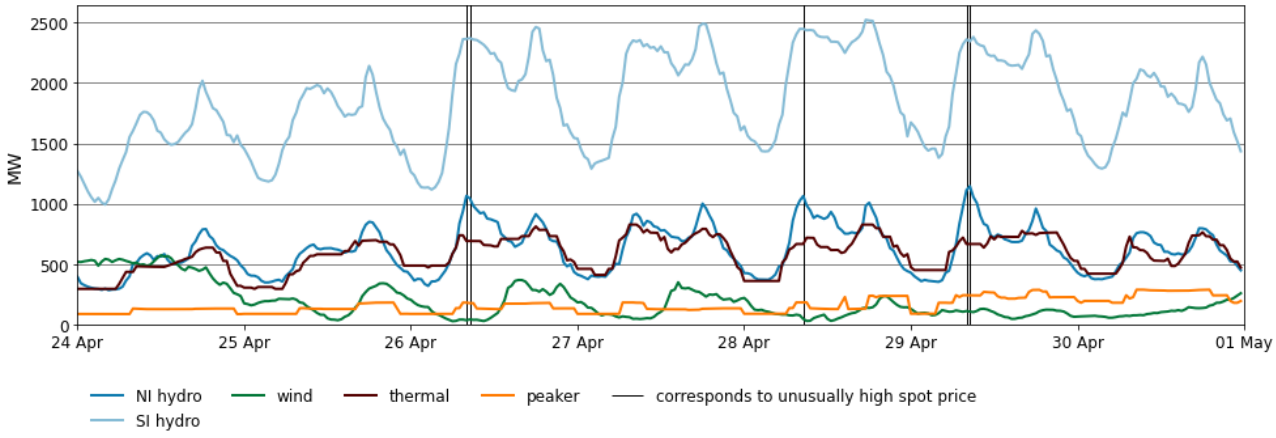
Figure 7: Total MW loss due to generation outages



7. Generation

7.1. High prices this week coincided with periods of low wind generation, high hydro generation and high thermal generation. Peak prices coincided with spikes in North Island hydro generation implying a certain degree of North Island hydro generation was used to cover peak load while thermal generation was used to support base load in which case we would expect high spot prices. Current low South Island hydro storage and constrained thermal fuel availability has increased hydro and thermal generation prices meaning we would expect spot prices to be higher during periods of high thermal and hydro generation.

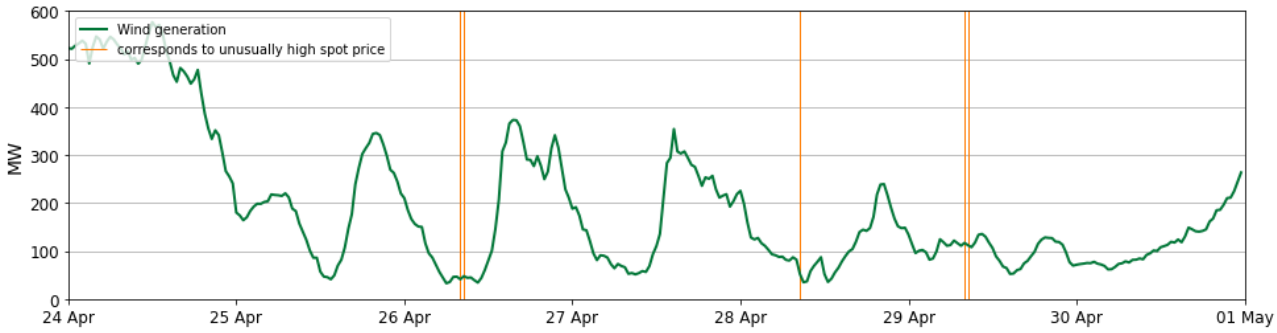
Figure 8: Generation by Fuel



7.2. Historically high prices this week occurred when wind generation was around its lowest for the week as shown in Figure 9 suggesting that declining wind generation compounded with peak demand to increase prices. Wind generation declined to between ~50 and ~100 MW

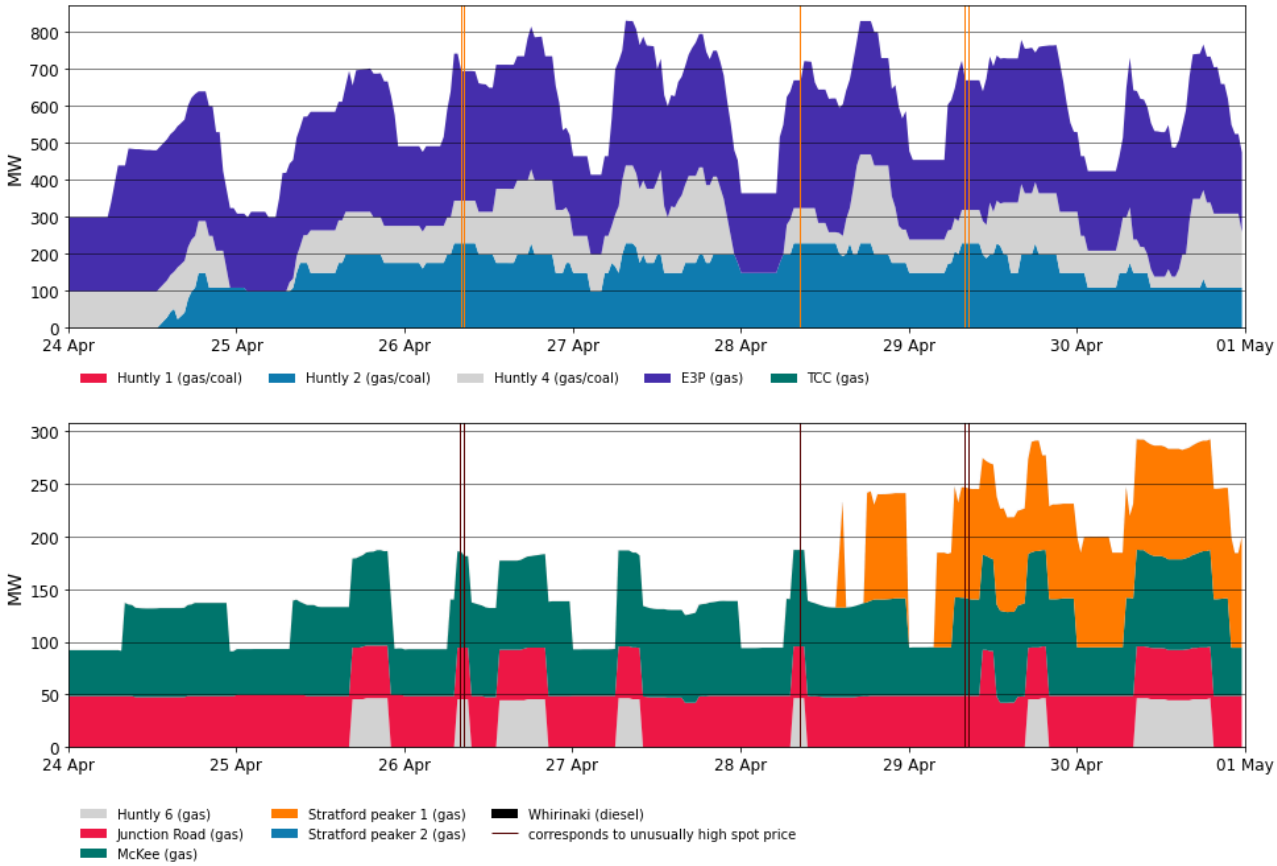
during high priced periods this week which would have increased the amount of cleared generation in higher priced tranches.

Figure 9: Wind Generation



7.3. Correspondingly thermal generation was high during historically high prices this week. Figure 10, which shows generation at thermal and thermal peaker plants, shows strong thermal generation this week, totalling just over 800 MW during peak periods, though compared to the previous week thermal generation was lower due to TCC not running (likely to conserve the limited hours it is able to run at full cycle). Huntly 1 was put on outage but was replaced by Huntly 2. Stratford Peaker 1 also returned. Stratford Peaker 2 though is not due to return until 1 July.

Figure 10: Thermal Generation



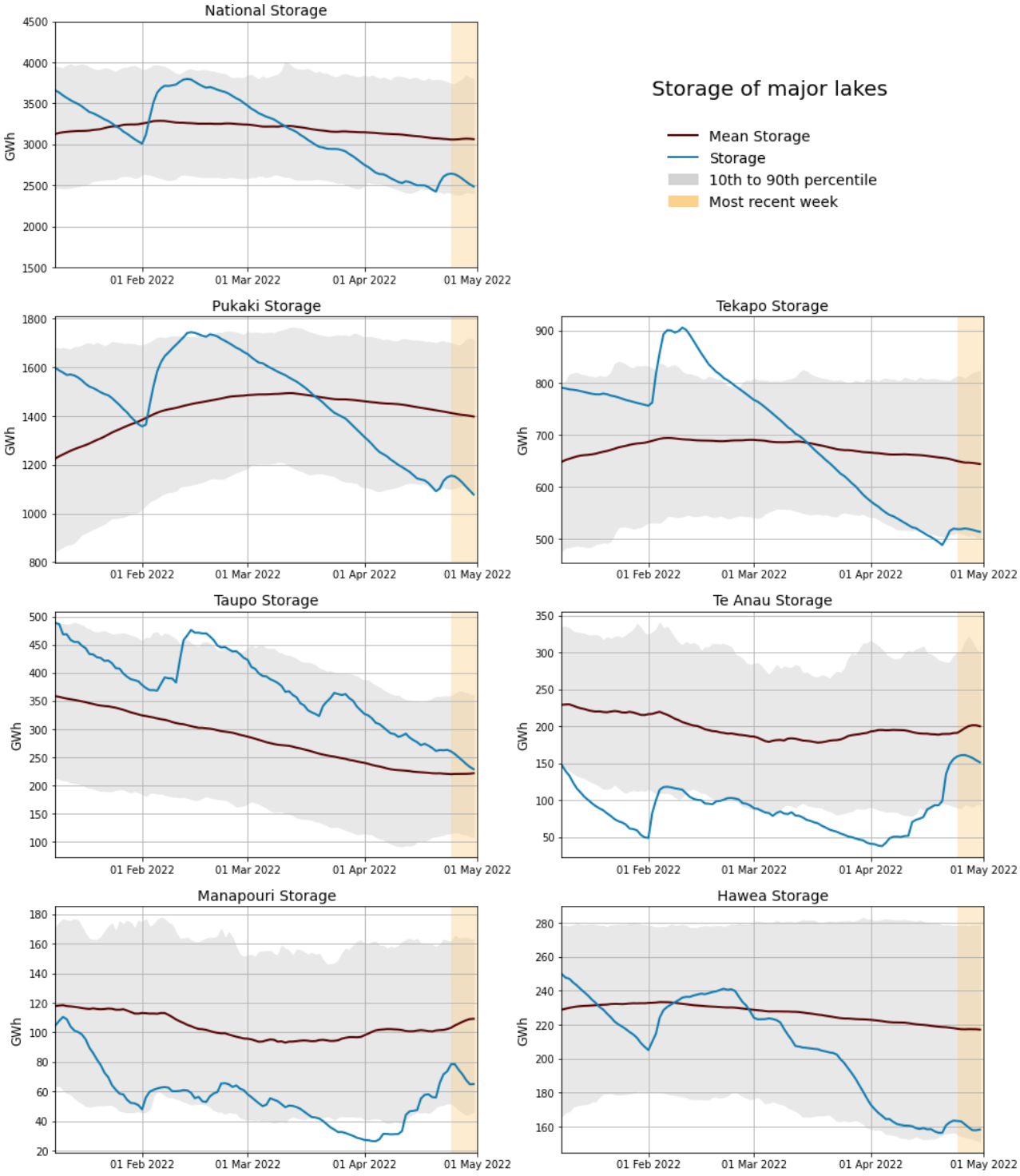
8. Storage/Fuel Supply

8.1. Figure 11 shows total controlled national hydro storage as well as the storage of major lakes from the last four months. As total hydro storage continues to show no substantial

improvement hydro generators continue to be conservative with their hydro offers, placing more water in higher priced tranches than we would expect for this time of year, steepening the offer curve and pushing marginal prices up. With an upcoming month long outage at Maui gas field scheduled to begin on 14 May cutting off a large source of thermal fuel the pressure on hydro generation is expected to be greater for the near future.

8.2. Storage at all major storage lakes has decreased. With generation from Lake Taupo having to increase to make up for lower South Island hydro generation, storage at Lake Taupo has rapidly decreased to just above its historical mean. Lake Hawea, Lake Pūkaki and Lake Tekapo are all near their 10th percentiles. Lake Manapōuri and Lake Te Anau have managed to conserve their gains from the previous week due to conservative generator behaviour.

Figure 11: Major Lake Storage



9. Price versus estimated costs

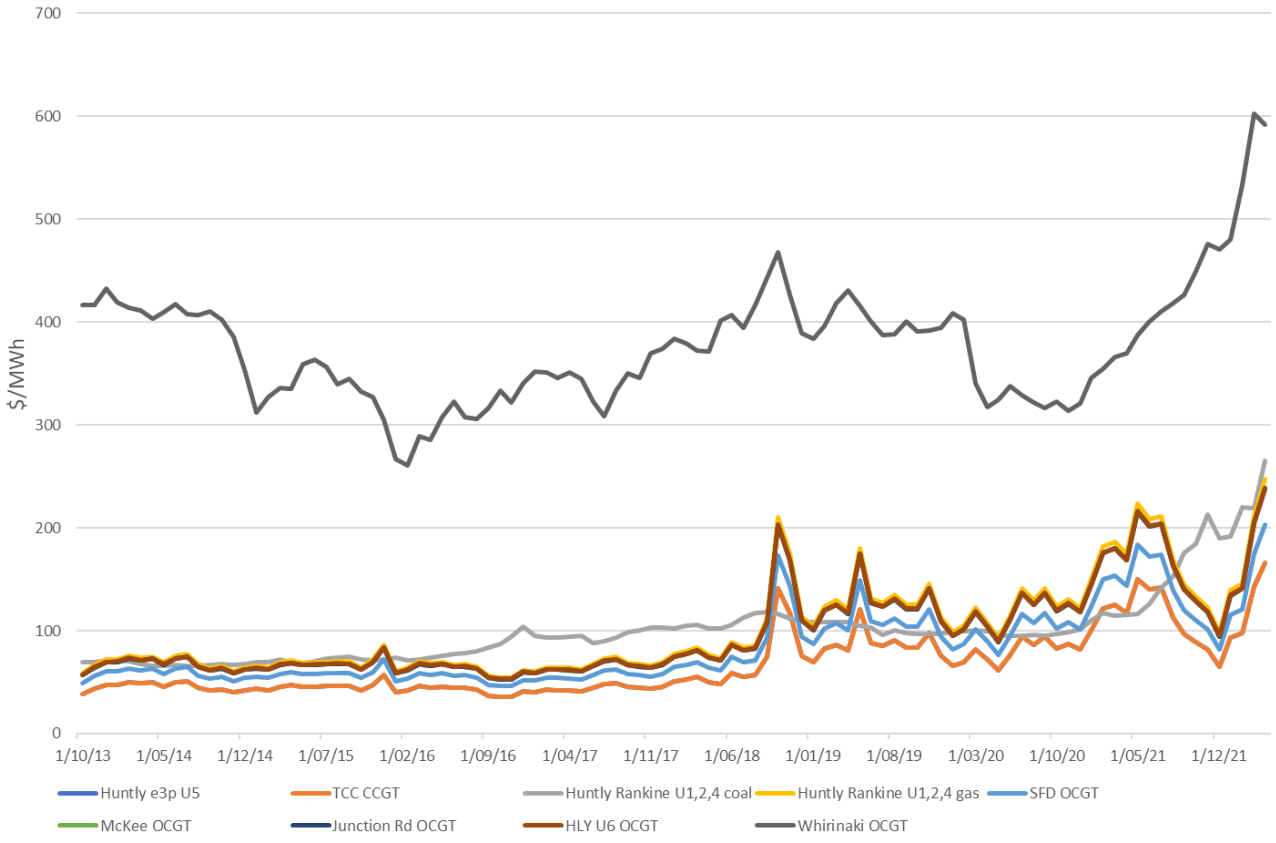
9.1. In a competitive market, prices should be close to (but not necessarily at) the short run marginal cost (SRMC) of the marginal generator (where SRMC includes opportunity cost).

9.2. 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 12 shows an estimate of thermal SRMCs as a monthly average up to 1 April 2022. The SRMC of all plants has increased sharply in March.

9.3. 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 third largest exporter of coal and largest exporter of gas in the world). Indonesian coal prices are currently around US$280/tonne (~$415NZD). Limited local gas production also puts a premium on gas spot prices. High historical carbon prices have also affected all generation with prices on the secondary market currently averaging ~$75/tonne and only set to increase. This puts the current SRMC of Huntly generation at around ~$250/MWh.

Figure 12: Estimated monthly SRMC for thermal fuels



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.

10.2. An error occurred when calculating JADE water values the previous week resulting in an erroneous chart – as a result water values this week have been excluded from the report until the error can be resolved.

[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. Offer Behaviour

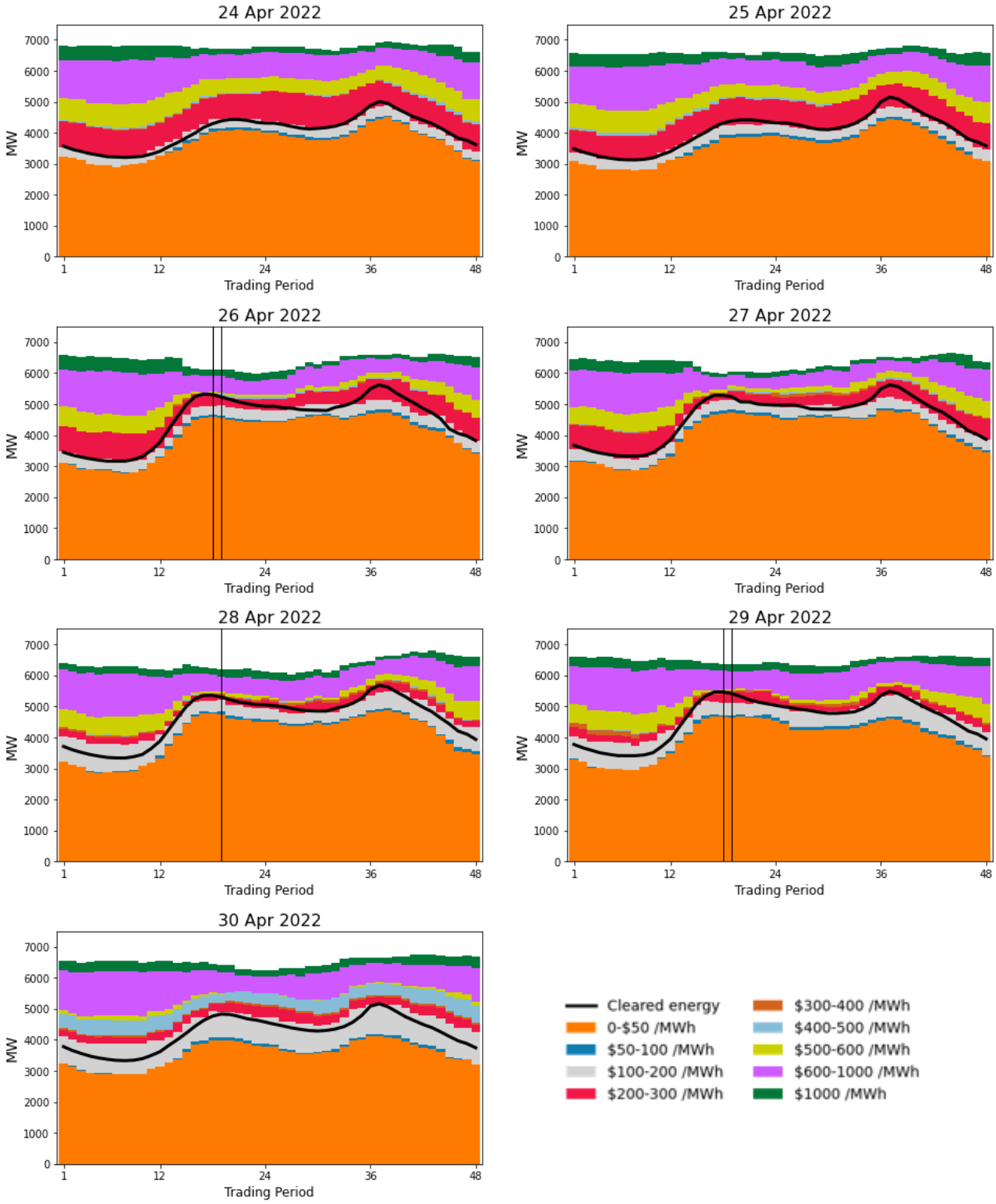
11.1. Figure 13 shows this week's daily offer stacks, adjusted to take into account wind generation, transmission constraints, reserves and frequency keeping.[2] The black line shows cleared energy, indicating the range of the average final price.

11.2. Currently the offer stack is such that there are very few offers between the $200-$300/MWh range and $500-600/MWh range. This means any small increase in demand or loss of generation can easily push prices from $300/MWh to $500/MWh. Outside of low priced offers that cover their portfolio obligations generators have set high prices for hydro and thermal generation due to current low hydro storage and high thermal costs.

11.3. During most weekdays this week cleared generation fell within the $200-$300/MWh range, however during peak demand periods the increase in demand increased the amount of cleared energy required just enough to fall within the $300-500/MWh range. 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.

[2] 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 13: Daily offer stack



12. Ongoing Work in Trading Conduct

12.1. High priced trading periods this week appear to be due to high peak demand, low wind generation and a steep offer curve.

12.2. Further analysis is being done on the trading periods in Table 2 as indicated.

Table 2: Trading periods identified for further analysis

Date	TP	Status	Notes
19/02-24/02		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.
19/02-21/02	Several	Further Analysis	Further information has been received and will be further analysed
08/02-12/02	Several	Resolved	Offers did change for hydro generators that had inflows, but Manapouri was still quite low and North Island had inflows after that period.
30/06/21-20/08/21	Several	Compliance enquiries in progress	The Authority's compliance team has obtained information regarding withdrawn reserve offers and high energy prices. Further clarification and analysis is under way to consider compliance with the Code.
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