20 April 2022

Trading Conduct Report

Market Monitoring Weekly Report

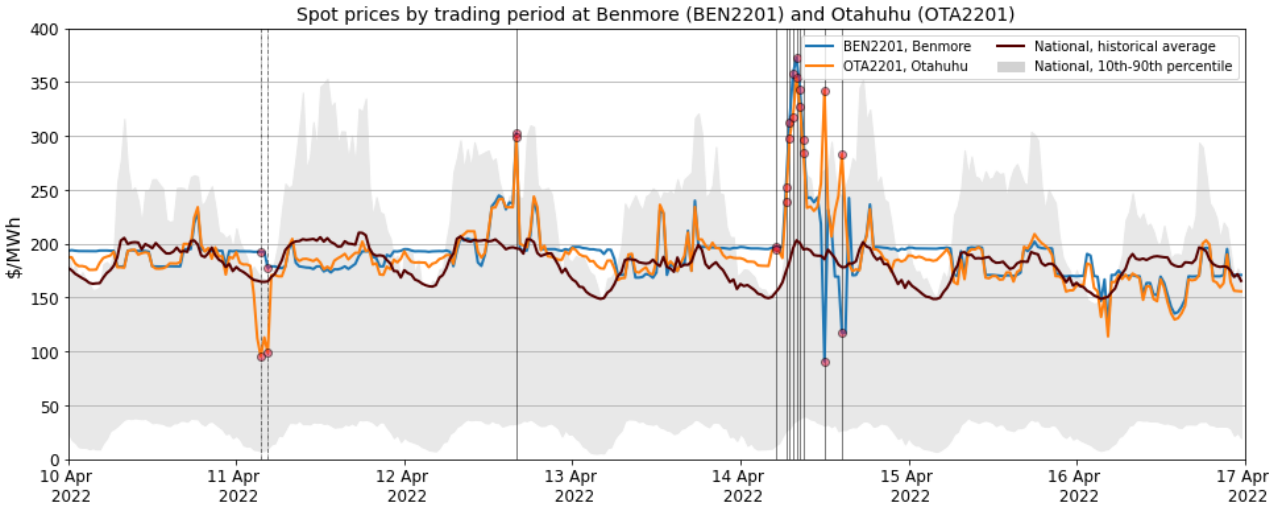
1. Overview for the week of 10 to 16 April

1.1. Wholesale spot prices this week appear to be consistent with supply and demand conditions.

2. Spot Prices

2.1. Figure 1 shows wholesale electricity spot prices from the past week at Benmore and Otahuhu alongside historic mean and historic 10th-90th percentiles with the highest priced trading periods (when Benmore or Otahuhu exceeds their historical 90th percentile) marked out by vertical lines. Spot prices between 10 and 16 April averaged $199.40/MWh, compared to a historical average of $130.88/MWh for the same period.

Figure 1: Wholesale Spot Prices



2.2. High priced periods for this week were mostly clustered on 14 April with one other high priced period on 12 April.

2.3. Note that at the time of writing prices for 14 and 16 April were interim so the high priced periods indicated by vertical lines in Figure 1 on 14 April may not hold.

2.4. The highest priced trading periods for the week are listed below in Table 1.

2.5. The highest priced period for the week between Benmore and Otahuhu was trading period 17 on 14 April at Benmore.

Table 1: High Priced Periods

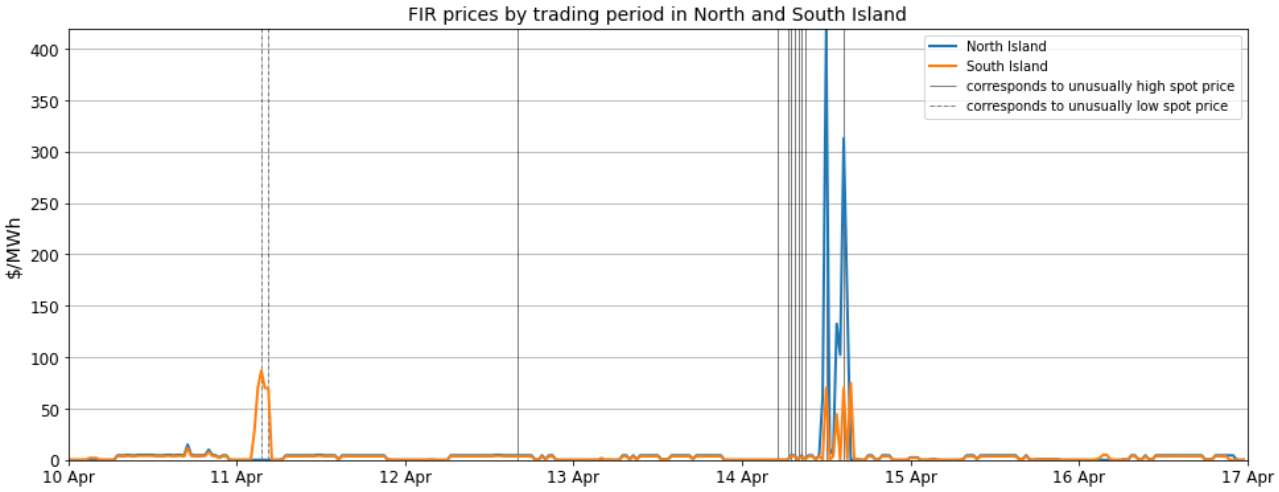
Date	Trading Period	Historic Mean	10th percentile	90th percentile	Benmore	Otahuhu
11/04/2022 3:30	8	164.8	7.57	168.6	192.47	95.41
11/04/2022 4:30	10	165.03	10.3	155.76	177.53	98.88
12/04/2022 16:00	33	195.73	33.23	248.42	302.72	299.55
14/04/2022 5:00	11	154.67	13.1	144.39	197	194.93
14/04/2022 6:30	14	174.22	27	201.22	252.01	239.23
14/04/2022 7:00	15	183.2	28.24	228.9	312.73	297.36
14/04/2022 7:30	16	195.56	33.81	260.61	357.51	317.82
14/04/2022 8:00	17	203.16	36.25	327.05	373.07	354
14/04/2022 8:30	18	200.61	37.93	291.65	343.56	326.66
14/04/2022 9:00	19	194.67	40.02	273.69	296.92	283.94
14/04/2022 12:00	25	185.63	31.32	268.78	90.68	342.43
14/04/2022 14:30	30	178.19	27.51	244.01	117.27	283.05

2.6. Not featured in Figure 1 was price separation at lower South Island nodes around Invercargill which caused prices to reach up to ~$600/MWh from the average of ~$200/MWh. This was due to line import constraints in the region.

3. Reserve Prices

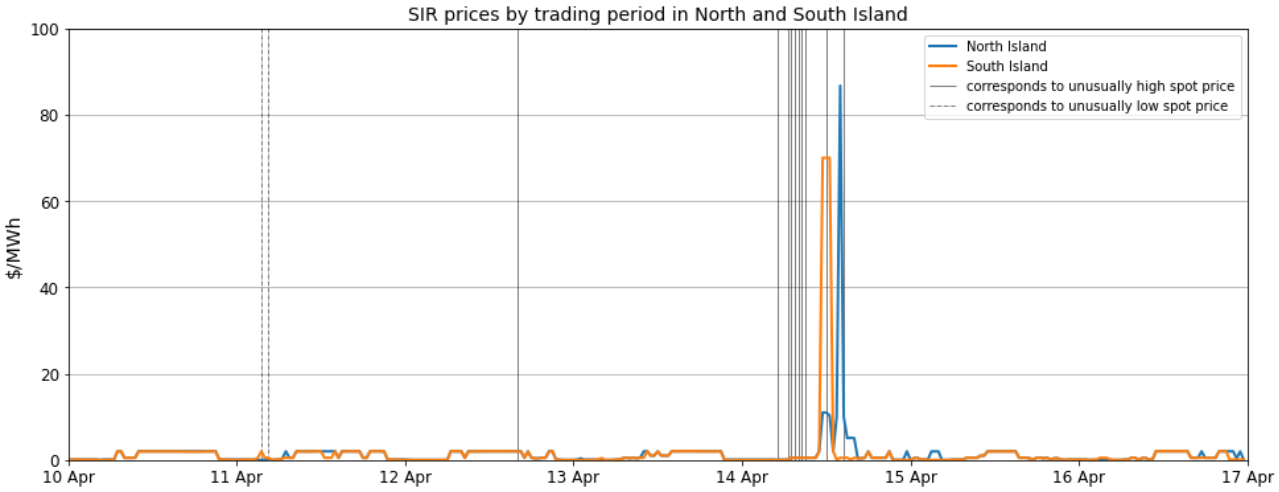
3.1. Fast instantaneous reserves (FIR) prices this week are shown in Figure 2. Reserve prices mostly remained within normal bounds this week except for a price spike on 14 April which reached up to ~$400/MWh. An outage at the HVDC link during this period was likely the cause as it prevented reserve sharing between islands (the required reserve in each island was higher, and due to co-optimisation, this may have resulted in higher energy prices).

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices this week are shown in Figure 3. Similarly to FIR reserve prices, SIR reserve prices this week remained within historical bounds except for prices on 14 April due to the impact of the HVDC outage.

Figure 3: SIR prices by trading period and Island



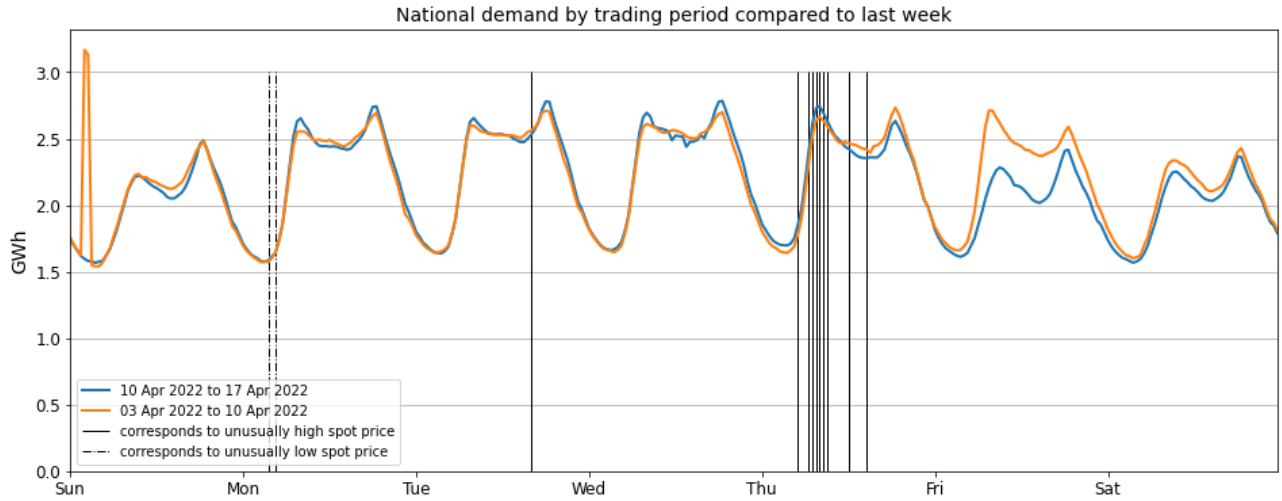
4. Demand

4.1. Figure 4 shows national grid demand against national grid demand from the previous week. Peak demand this week was slightly higher than peak demand from the previous week, this may be related to colder temperatures this week (as shown in Figure 5) than last week with temperatures averaging around ~3-4 degrees lower.

4.2. Friday and to a lesser extent Saturday showed a significant difference in demand to the previous week due to the Easter public holiday period reducing demand.

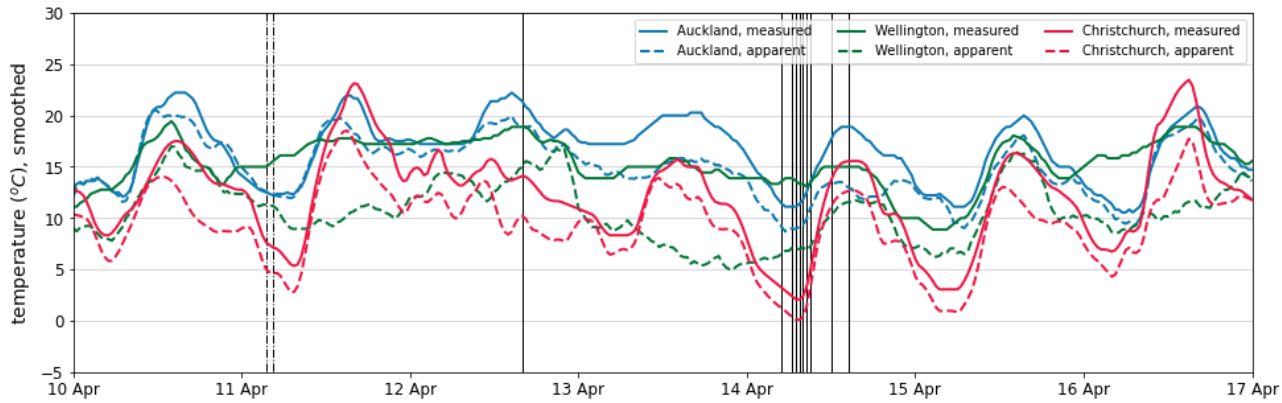
4.3. High priced periods on 14 April coincided with morning peak demand possibly indicating that high demand partially contributed to the high prices.

Figure 4: National demand by trading period compared to the previous week



4.4. Figure 5 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. Temperatures, especially in the South Island, were amongst their lowest of the week during high priced periods on 14 April possibly indicating that the low temperatures are what contributed to increased peak demand and high prices.

Figure 5: Hourly temperature data (actual and apparent) and humidity data at main population centres

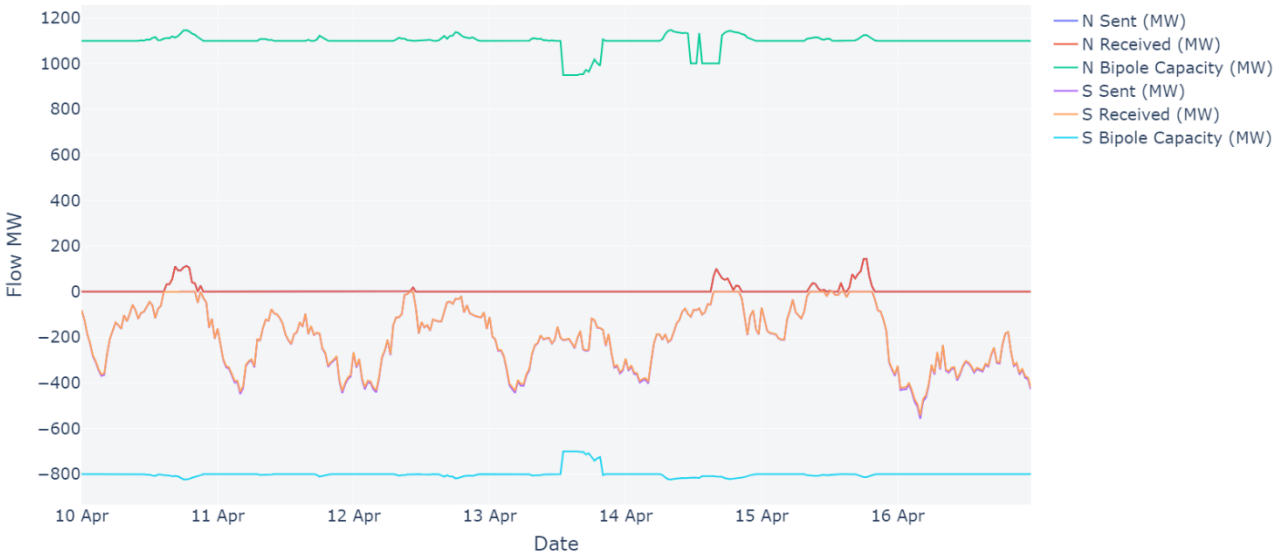


5. Outages

5.1. There was an unplanned outage at HVDC Pole 3 on 14 April between 11:00am and 4:30pm, leaving only Pole 2 with 489 MW (Southwards) – 500 MW (Northwards) capacity.

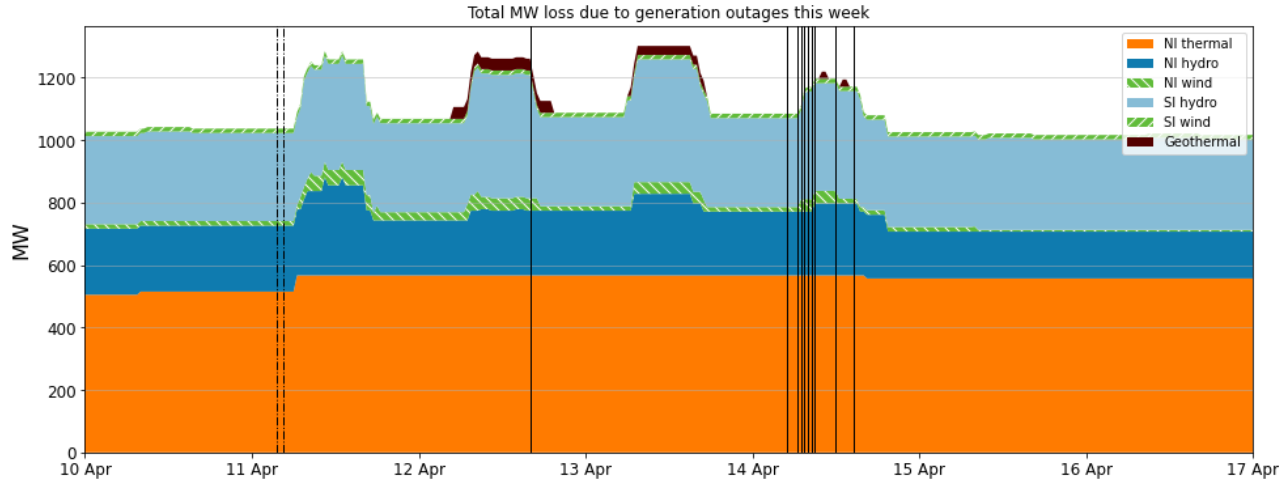
5.2. Figure 6 shows flow at the HVDC. Though the date of the outage coincided with the majority of high priced periods this week as flow remained below outage capacity limits for most of the outage spot prices were not adversely affected by the outage except for trading periods 25 and 30.

Figure 6: HVDC Flow



5.3. Figure 7 shows generation capacity lost due to outages by fuel type. Compared to the previous week total generation capacity lost due to outages has reduced, remaining mostly below 1,200 MW. The reduction has been due to geothermal and thermal generation being restored.

Figure 7: Total MW loss due to generation outages

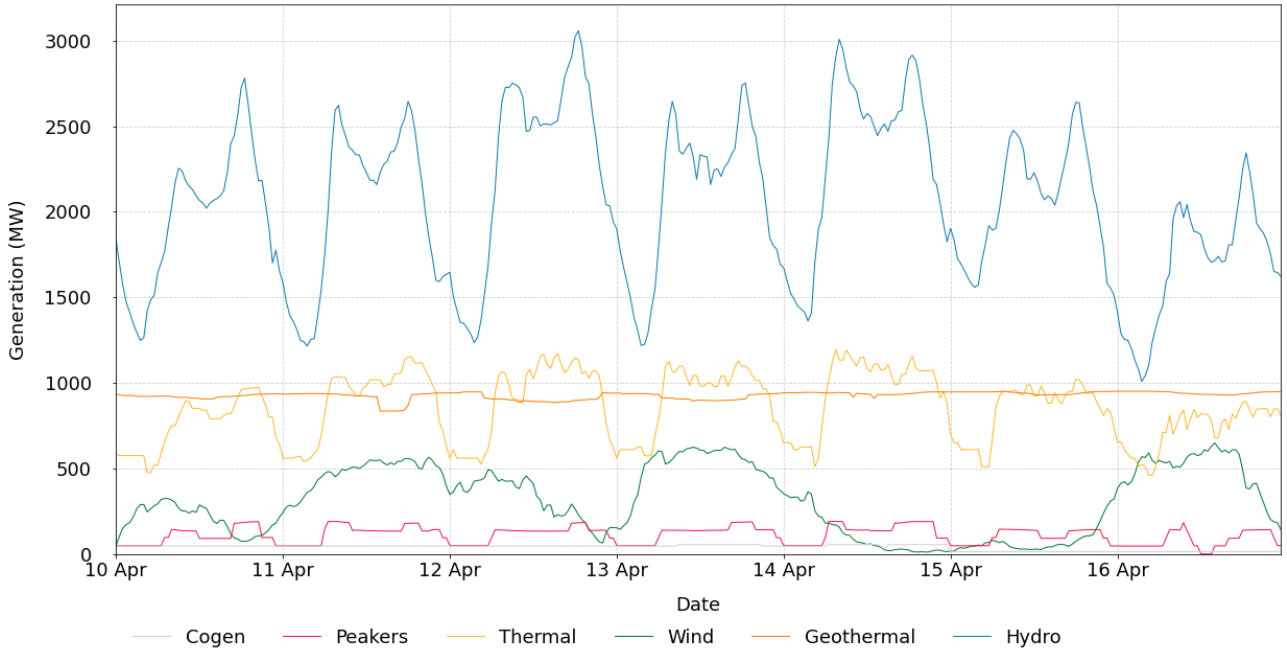


6. Generation

6.1. High prices continue to occur during periods of low wind and high thermal generation. Despite periods of high wind, thermal generation has noticeably increased, regularly exceeding 1,000 MW during the day as seen in Figure 8. Hydro generation also appears to be more volatile.

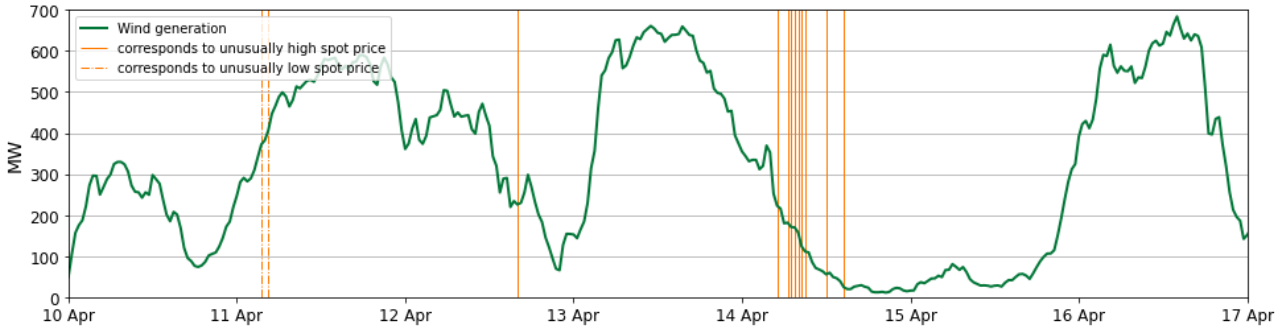
6.2. As a percentage of total generation, the percentage of hydro generation has dropped significantly. This week hydro generation totalled 46.9 per cent of total generation when usually we would expect it to be in the high 50s for this time of year. Thermal generation conversely has increased, totalling 19.6 per cent of total generation with thermal peaker generation also totalling 2.37 per cent of total generation. Usually we would expect thermal generation to be around ~10 per cent for this time of year. Generally drops in hydro generation and increases in thermal generation lead to increases in spot prices which would explain a large part of why average prices were historically high this week.

Figure 8: Generation by Fuel



6.3. The highest priced periods this week occurred on the day when wind generation dropped to its lowest as seen in Figure 9 suggesting that declining wind generation compounded with peak demand to increase prices. Wind generation falling below 200 MW likely meant the loss of low priced generation pushed the marginal price for those periods into higher priced tranches.

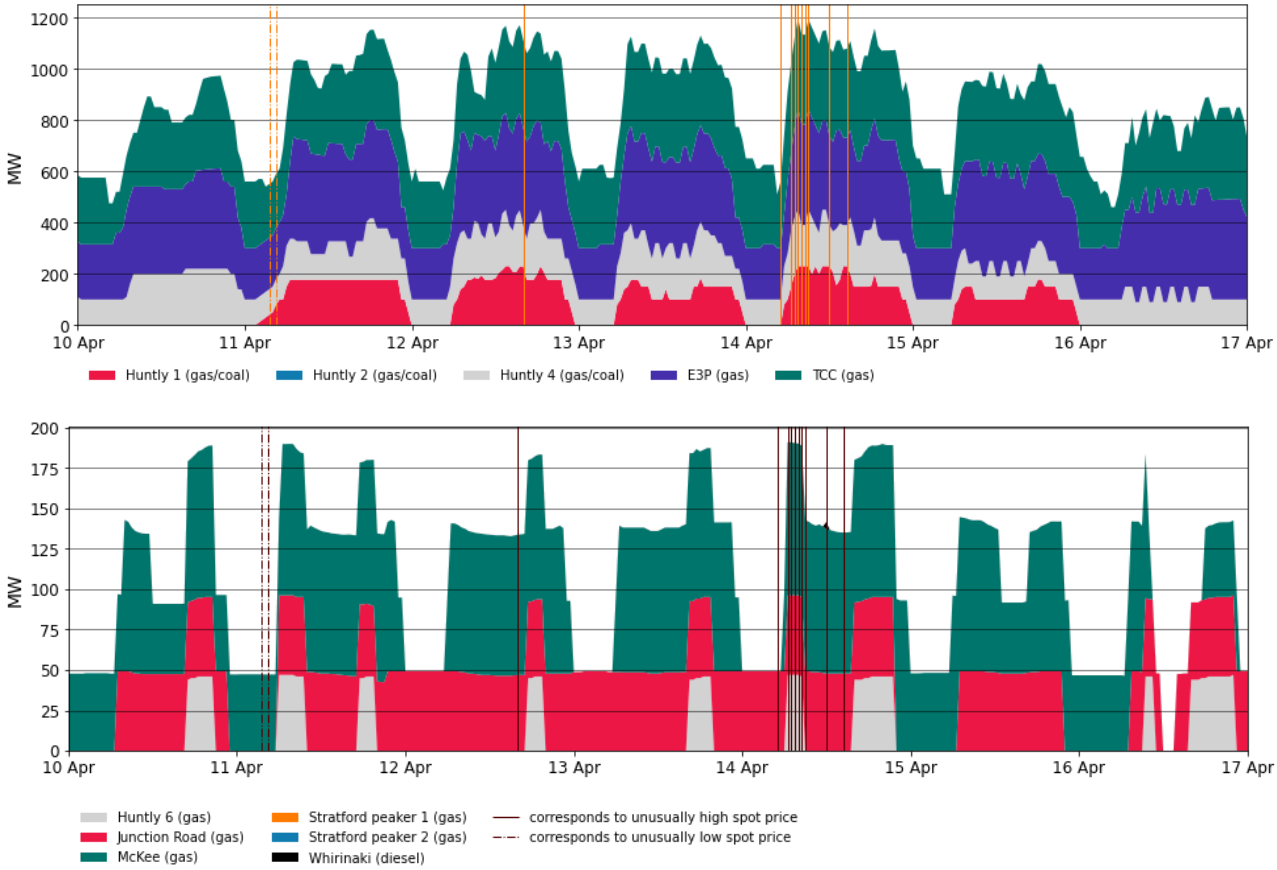
Figure 9: Wind Generation



6.4. Thermal generation as seen in Figure 10, which shows generation at thermal and thermal peaker plants, was higher than previous weeks. Unlike previous weeks thermal generation was also fairly regular following demand trends rather than changes in wind generation as it usually has in previous weeks. This suggests that thermal generation is playing a greater role in supporting baseload generation, making up for reduced hydro generation not just reduced wind generation now.

6.5. All thermal plants are running regularly during the week with the exception of Huntly 2. Of the peaker plants the Stratford Peakers continue to remain on outage with McKee and Junction Road continuing to have the greatest output.

Figure 10: Thermal Generation



7. Storage/Fuel Supply

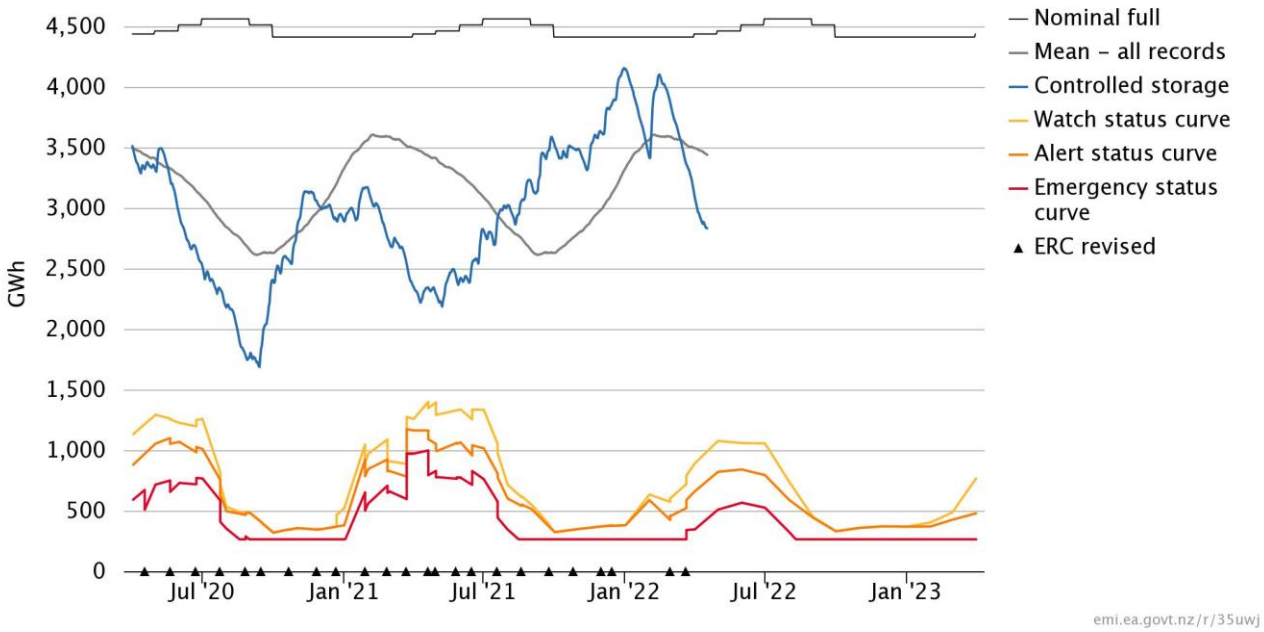
7.1. Continually declining hydro storage has had a greater impact on generation this week with the total percentage of hydro generation dropping as hydro storage continues to drop.

7.2. Figure 11 shows total controlled national hydro storage which had decreased by 1,269 GWh since 14 February to 2,833 GWh on 16 April, an average decrease of ~20.5 GWh/day. National hydro storage is now just below its historical 10th percentile.

7.3. The decline continues to be from low hydro inflows with current inflows almost ~50 per cent of historical average inflows.

7.4. Hydro generators have become more conservative with their hydro offers as a result, placing more water in higher priced tranches, steepening the offer curve and pushing marginal prices up.

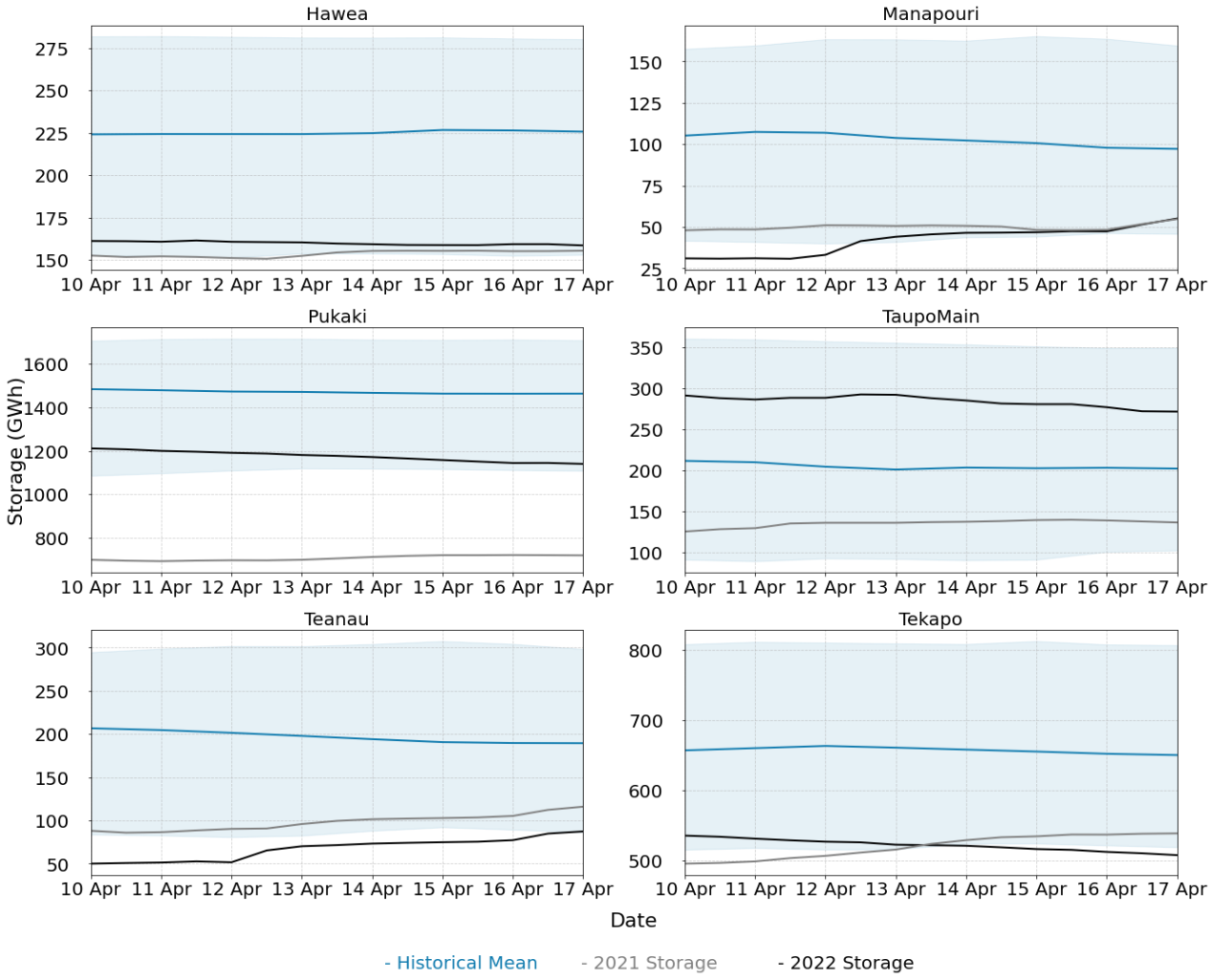
Figure 11: Hydro Storage



7.5. Figure 12 shows the storage of major lakes over the week 10 to 16 April. Of the individual lakes only Lake Taupo is above its historical mean.

7.6. Lake Hawea has fallen close to its historical 10th percentile along with Lake Pūkaki and Lake Tekapo. Lake Pūkaki still remains well above its low operating range however (~518masl) and well above 2021 levels. Lake Tekapo is also still above its low operating range (by around ~5m). Lake Manapōuri has risen to just above its low operating range while Lake Te Anau also appears to have just met its low operating range though generation from Manapōuri continues to be offered in at higher priced tranches to deter dispatch as levels are still very low.

Figure 12: Major Lake Storage



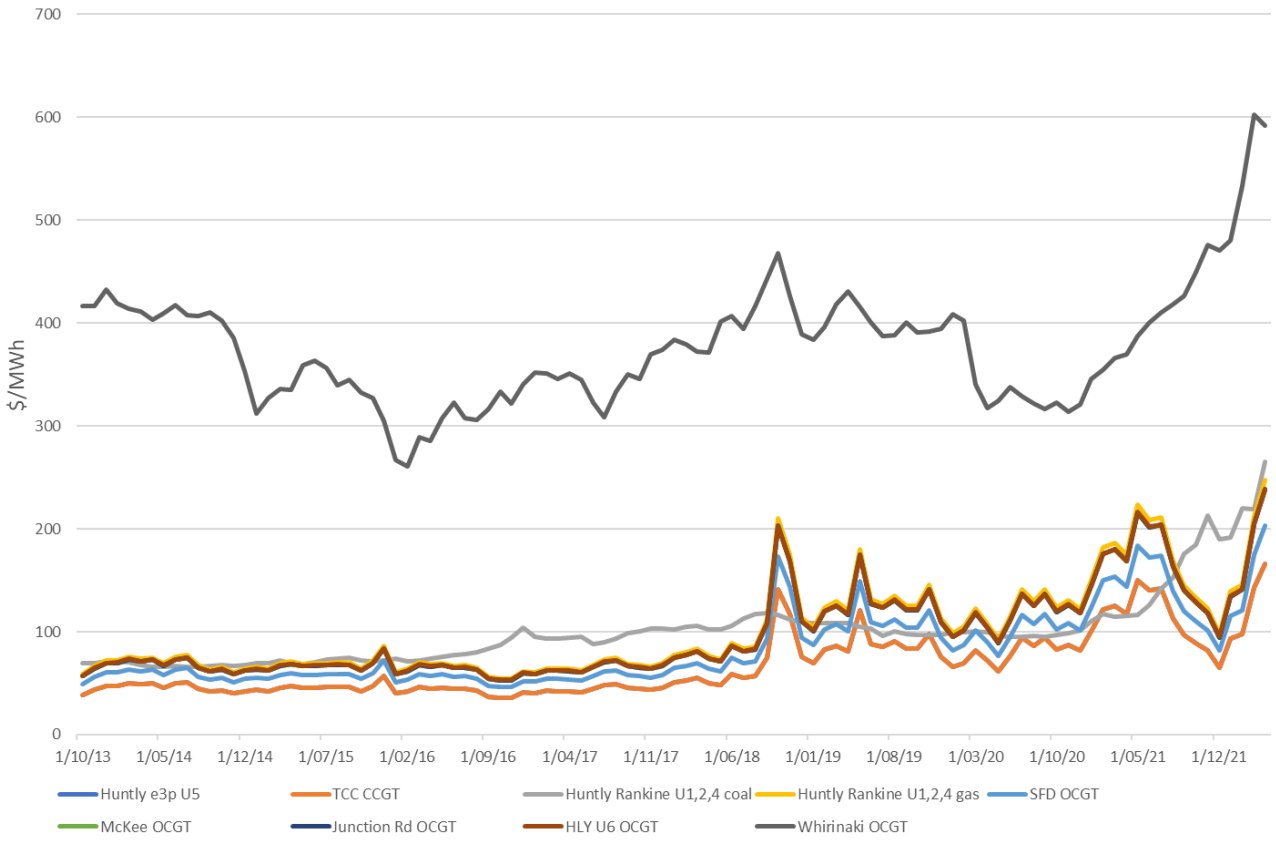
8. Price versus estimated costs

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 13 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.

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 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 13: Estimated monthly SRMC for thermal fuels



9. JADE Water values

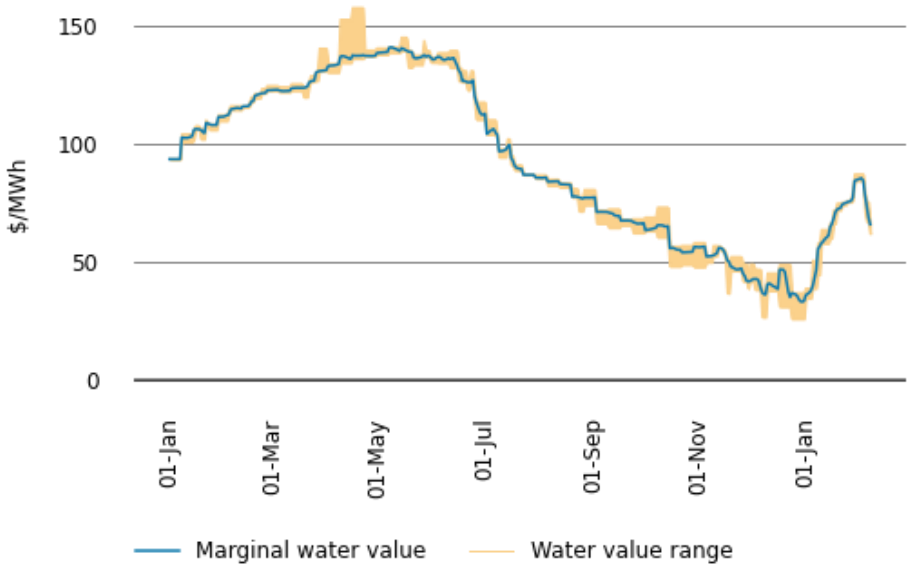
9.1. The JADE[1] model gives a consistent measure of the opportunity cost of water, by seeking to minimise the expected fuel cost of thermal generation and the value of lost load and provides an estimate of water values at a range of storage levels. Figure 14 shows the national water values[2] to 20 February 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, indicated by the blue line. More details on how water values are calculated can be found in Appendix B on the trading conduct webpage.

9.2. The marginal water value declined from June to December as hydro storage levels increased and gas costs decreased. In January, the water values increased as hydro storage decreased and gas costs increased. Between February 1 and 13 hydro storage increased which caused a steep decline in the water value, shown in figure 17. Since 20 February hydro storage has declined so the water value has likely increased

[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.

[2] The national water values are estimated assuming all hydro storage reservoirs are equally full.

Figure 14: JADE water values for January 2021 to February 2022



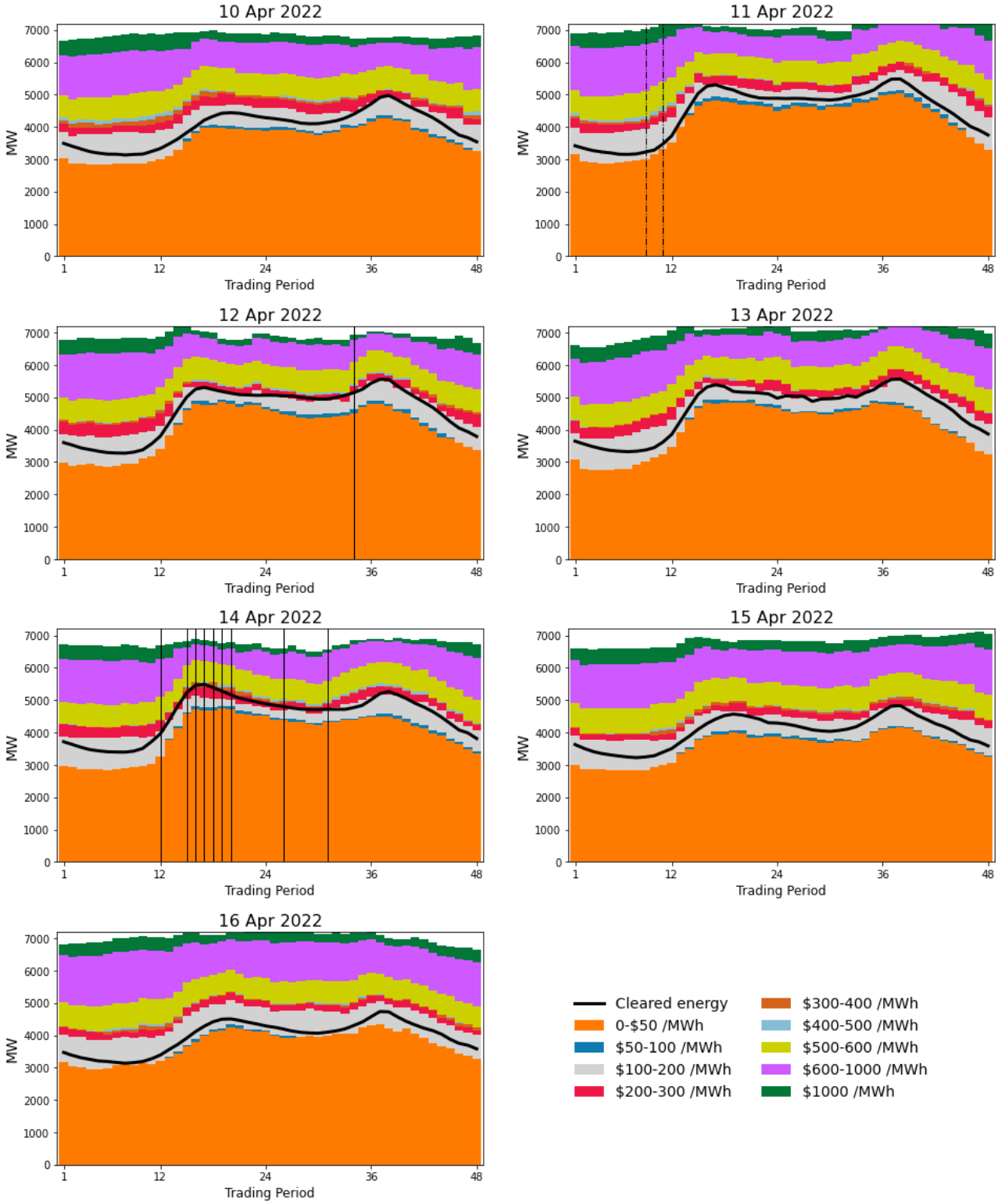
10. Offer Behaviour

10.1. Figure 15 shows this week's daily offer stacks, adjusted to take into account wind generation, transmission constraints, reserves and frequency keeping.[3] The black line shows cleared energy, indicating the range of the average final price.

10.2. High thermal and hydro costs have created a steep offer curve. While most cleared generation has remained within the $100-200/MWh tranche any small increase in demand or loss of generation pushes cleared generation to the $200-300/MWh tranche. Beyond that the $300-500/MWh tranche holds limited generation with the next sizeable amount of generation offered from $500/MWh. This is likely due to hydro generators pricing generation to avoid dispatch where possible in order to conserve hydro storage as they are still required to offer in all available generation.

[3] 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.

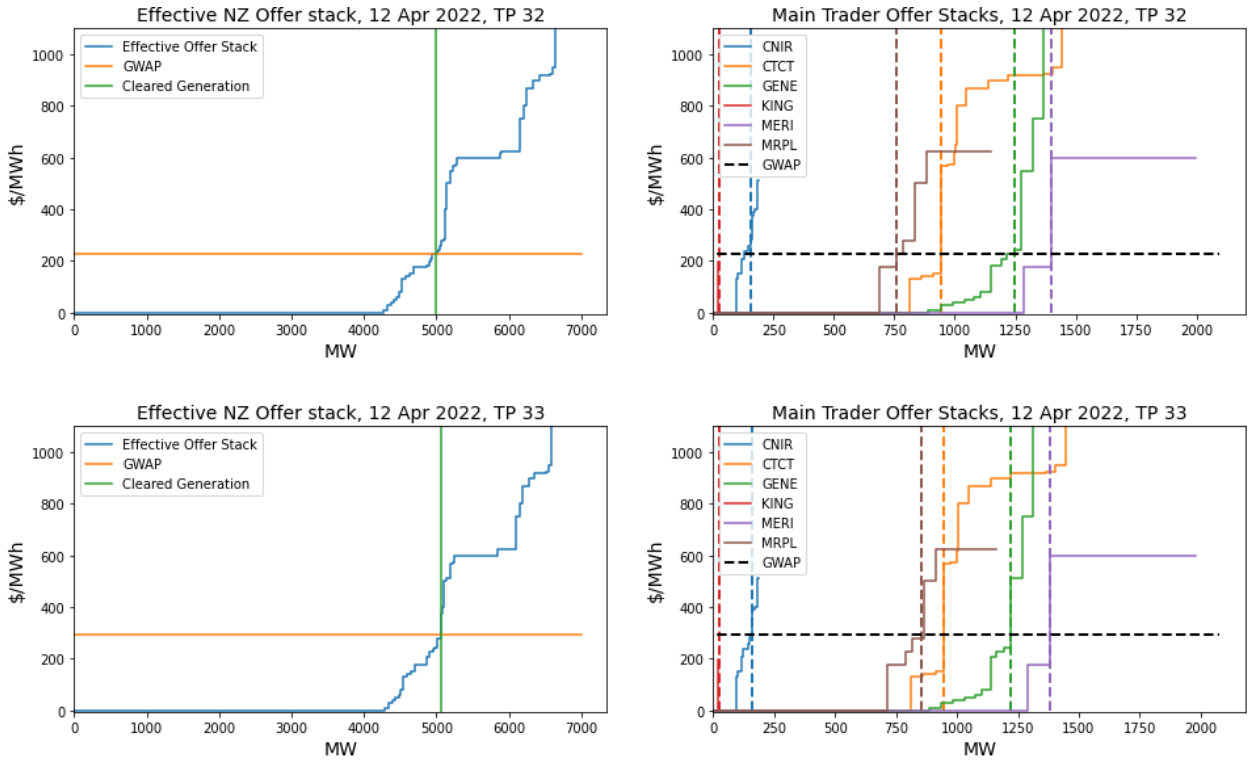
Figure 15: Daily offer stack



10.3. The steepness of current offer curves is demonstrated by the high priced trading period marked out on 12 April (TP 33). Despite renewable generation being reasonable, demand increased just enough to push the marginal price into the next highest tranche increasing spot prices significantly compared to the previous trading period. Figure 16 shows the difference between the period (TP 33) and the period before (TP 32).

10.4. 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.

Figure 16: Offer Stack TP 32,33 12 April



11. Ongoing Work in Trading Conduct

11.1. High prices on 12 and 14 April appear to be driven by high demand, low renewable generation and decreasing hydro storage.

11.2. 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	Further Analysis	High inflows but continued high prices
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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