

Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 19-25 March 2023

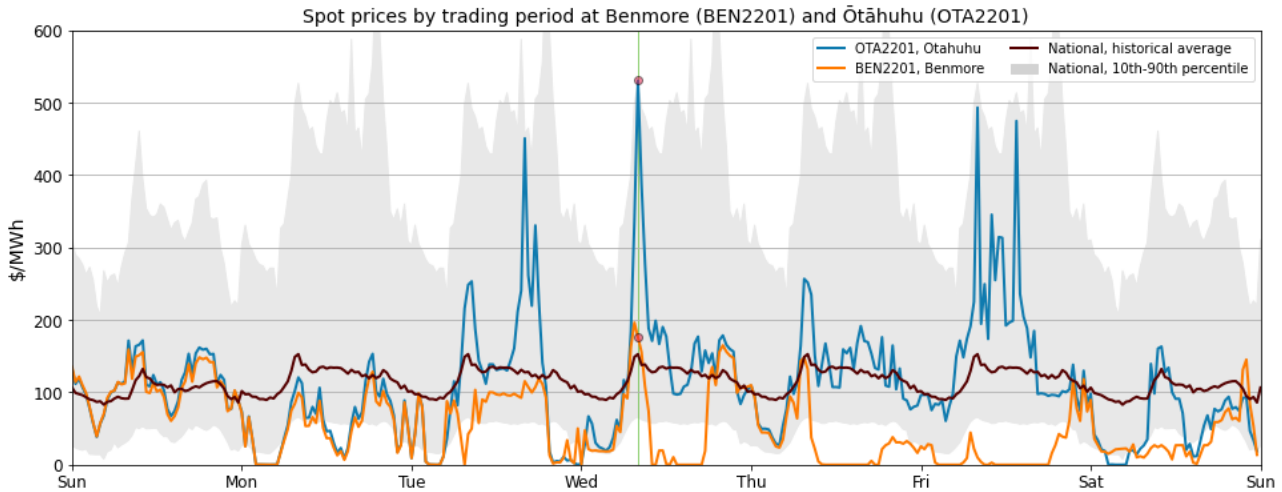
- 1.1. Increased hydro storage in the South Island resulted in a decrease in average spot prices. However, a combination of the HVDC outage, generation outages, low wind and high demand caused tight supply in the North Island at times, with Transpower issuing Customer Advice Notices (CANs) for low residual situations for the morning peak periods on 22, 23 and 24 March. While none of the situations escalated and there was sufficient generation, high prices occurred in both the energy and reserve markets. While spot prices between 19-25 March 2023 appear to be generally consistent with market conditions, further analysis of generator offers is planned, particularly for the trading periods for which the CAN notices applied.

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 identifying 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 its historical 90th percentiles. Note that this week, prices above the historic 90th percentile are highlighted with a translucent green line. Other notable prices, but which did not breach the 90th percentile, are marked in black dashed lines (if any).
- 2.2. Between 19-25 March 2023:
 - (a) The average wholesale spot price across all nodes was \$88/MWh.
 - (b) 95 percent of prices fell between \$0/MWh and \$252/MWh.
- 2.3. Figure 1 shows spot prices at Benmore and Ōtāhuhu alongside their historic median and historic 10th- 90th percentiles adjusted for inflation.
- 2.4. Prices were below \$200/MWh for both the North and South Islands until Tuesday when one of the HVDC poles went on outage (from 21 March 2023 to 30 March 2023) resulting in price separation. From Tuesday onwards prices in the North Island were mostly above the historic average with instances of several price spikes. The relatively high prices in the North Island were likely due to the HVDC outage, combined with low wind generation and high demand which resulted in high thermal generation.
- 2.5. Three CAN low residual notices were issued for the North Island for 22 - 24 March 2023 (08:00-08:30 am). A price spike above the 90th percentile occurred on Wednesday 22 March 2023 at 08:00 am (the same time as one of the CAN notices) when the spot price at Ōtāhuhu reached \$530/MWh and \$176/MWh at Benmore.

2.6. There were a few other instances of larger price separation on Friday 24 March at 8:00 am and 1:30 pm, where the Benmore price was \$0.01/MWh and at the same time Ōtāhuhu prices were around \$493/MWh and \$475/MWh respectively.

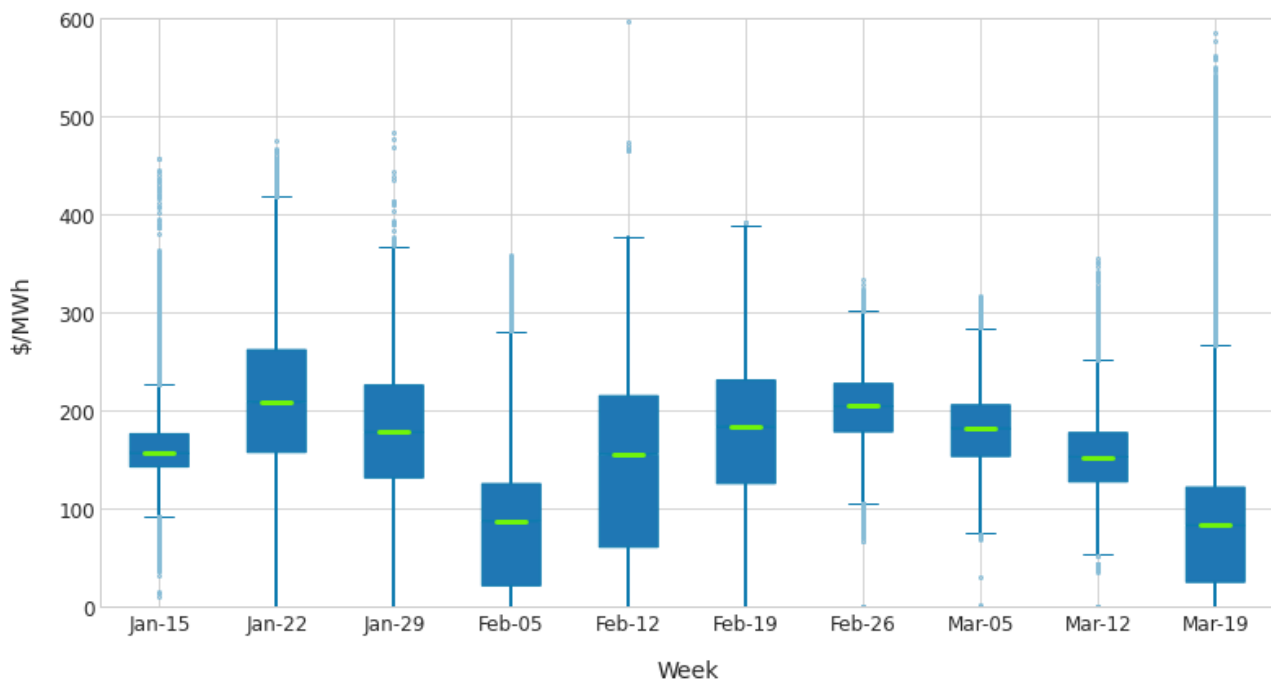
Figure 1: Wholesale Spot Prices between 19 March (Sunday) – 25 March (Saturday) 2023



2.7. Figure 2 shows a box plot with the distribution of spot prices during this week and the previous nine weeks. The green 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)¹ of the lower and upper quartile, and then observations that fall outside this range are displayed independently.

2.8. This week, the median was slightly lower compared to the week before. Most of the spot prices were below \$100/MWh as hydro generation was relatively higher, but due to the HVDC outage and low wind generation, thermal generation also increased. Hydro generation contributed 63 percent of total energy this week, 4 percent higher compared to last week.

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

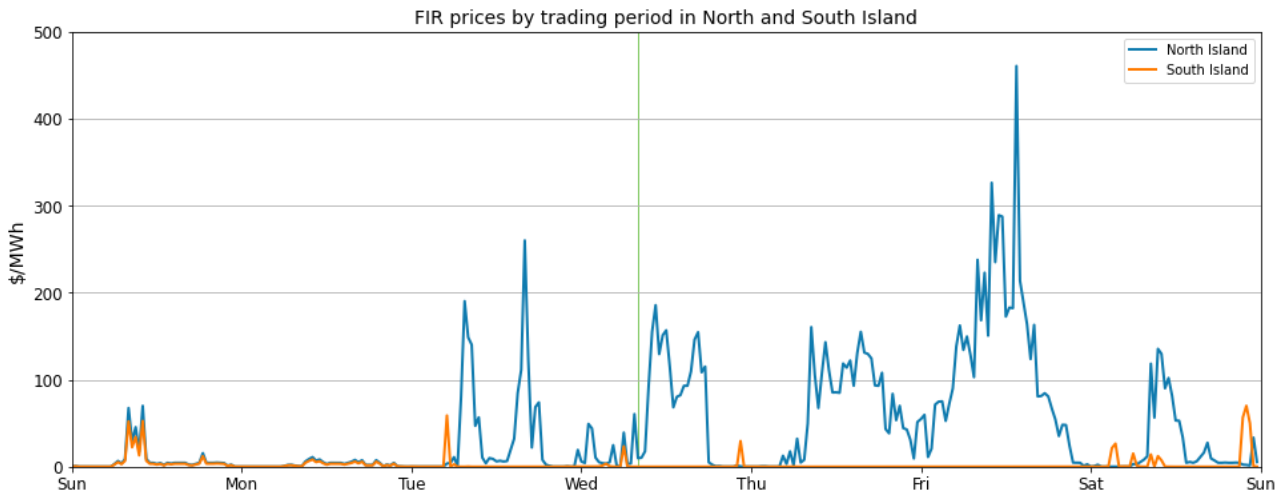


¹ Quartile - Wikipedia

3. Reserve Prices

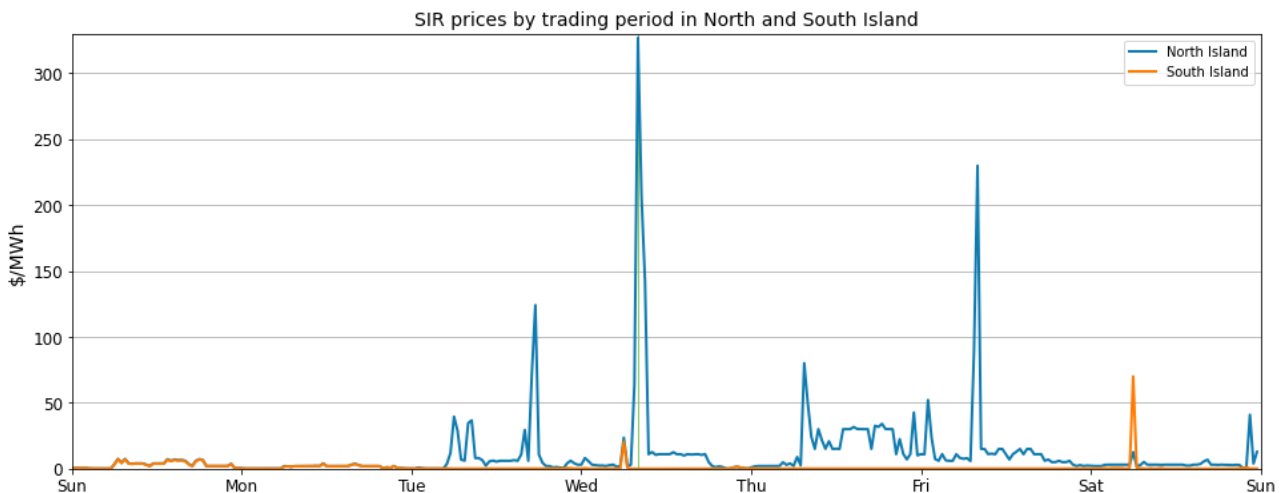
3.1. Fast instantaneous reserve (FIR) prices for the North and South Islands are shown below in Figure 3. This week there were several instances where the North Island FIR prices were high. The highest FIR price of \$460/MWh occurred on Friday at 1:30 pm in the North Island, and at the same time the FIR price was \$0/MWh in the South Island. The FIR price spikes were due to the HVDC outage which limited reserve sharing between the islands, so more reserves were needed in the North Island. The highest FIR price occurred on Friday at 1:30pm, coinciding with the high price for energy, indicating tight supply for both energy and reserve.

Figure 3: FIR prices by trading period and Island



3.2. Sustained instantaneous reserve (SIR) prices for the North and South Island are shown in Figure 4. The SIR prices in the South Island were mostly below \$5/MWh. Relatively high SIR prices in the North Island were observed due to the HVDC outage. These high SIR prices were due to tight supply of both energy and reserve in the North Island with the highest SIR on Wednesday at 8:00 am occurring in the same trading period as the price spike above the 90th percentile.

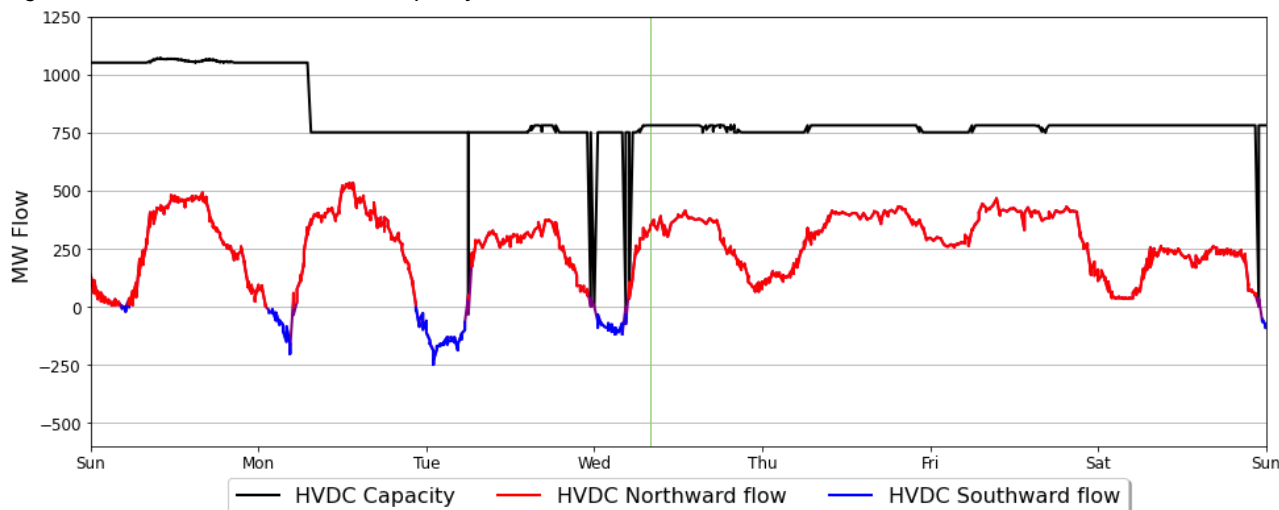
Figure 4: SIR prices by trading period and Island



4. HVDC

- 4.1. Figure 5 shows HVDC flow between 19-25 March. One of the HVDC poles went on outage (from 21 March 2023 to 30 March 2023²) and limited the maximum flow to around 750 MW. HVDC flows were mostly northward during the day from Sunday to Tuesday, and southward during the night. From Wednesday, the HVDC flows were always northwards (with no southward flows overnight), due to very low wind generation.

Figure 5: HVDC northward flow and capacity



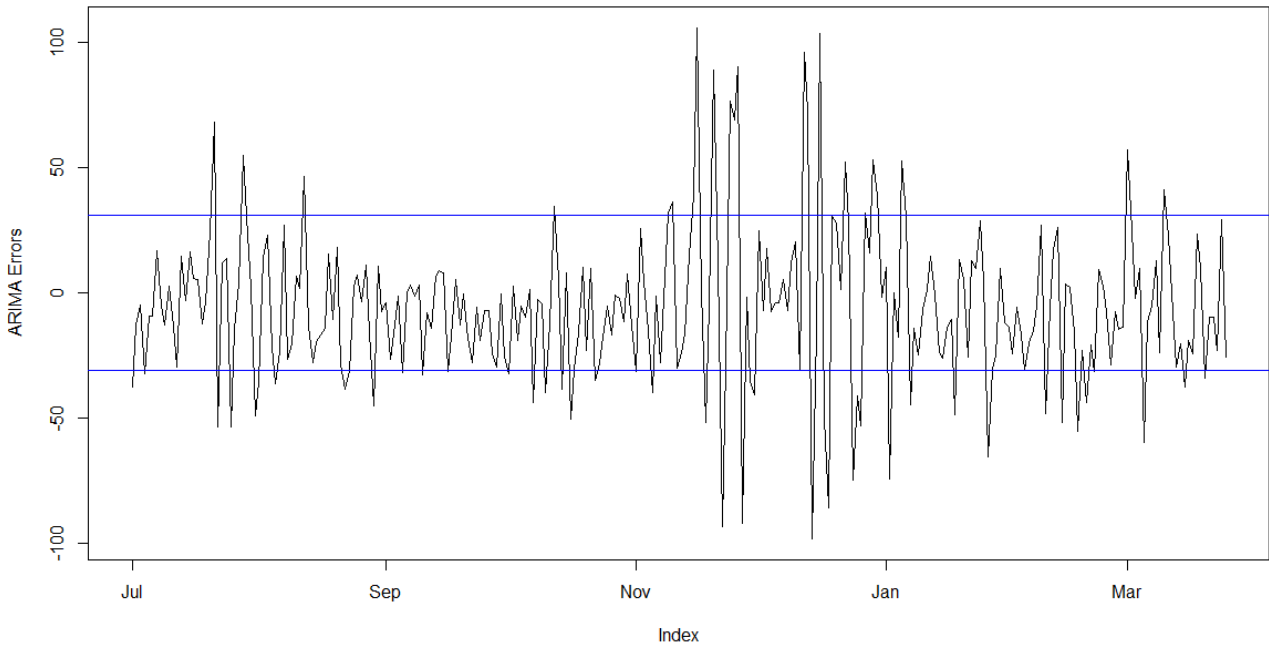
5. Regression Residuals

- 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 A³ on the trading conduct webpage.
- 5.2. Figure 6 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Residuals were mostly relatively small, suggesting that prices on those dates appear to be largely aligned with market conditions. There was a residual below one standard deviation of the data, which occurred on Wednesday. Here the residual was negative, indicating that the modelled price was slightly higher than predicted. This discrepancy is due to limitations of the model, as it does not account for the HVDC outage causing price separation.

² This HVDC outage was an extension of the HVDC outage which occurred earlier in the month. The extension was necessary due to decreased resources available during the original outage from staff being deployed to help with the aftermath of cyclone Gabrielle.

³ <https://www.ea.govt.nz/assets/dms-assets/29/Appendix-A-Regression-Analysis.pdf>

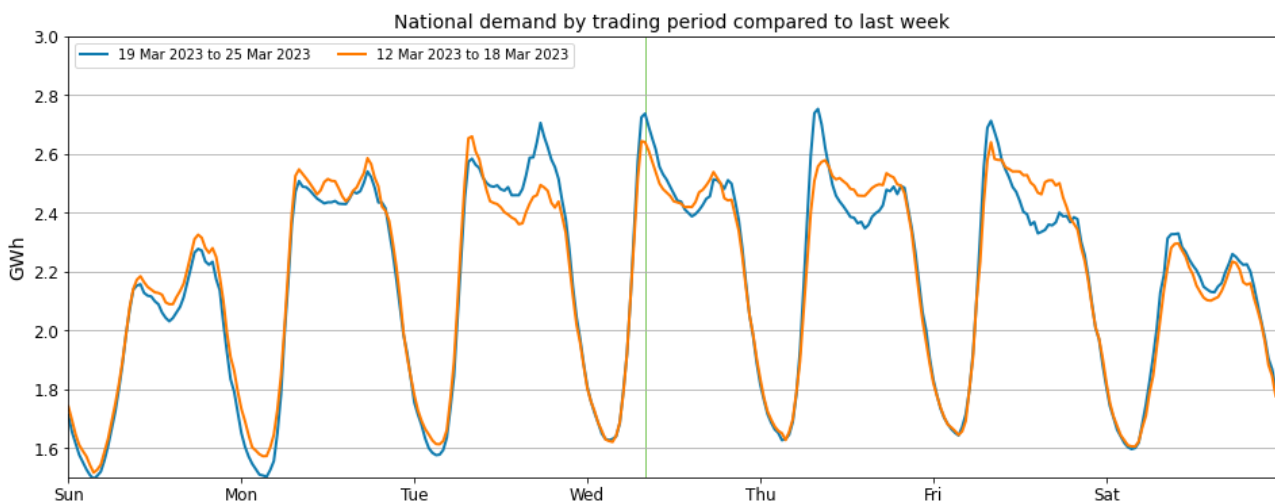
Figure 6: Residual plot of estimated daily average spot prices from 1 July 2022 – 25 March 2023. The blue lines show two standard deviations of the ARMA errors.



6. Demand

6.1. Figure 7 shows national grid demand between 19-25 March, compared to the previous week. Daily demand was similar on Sunday and Monday to the previous week. Tuesday saw a large increase in the evening peak, likely due to the drop in temperatures across the country. Wednesday to Friday saw an increase to the morning peak demand again likely due to low temperatures.

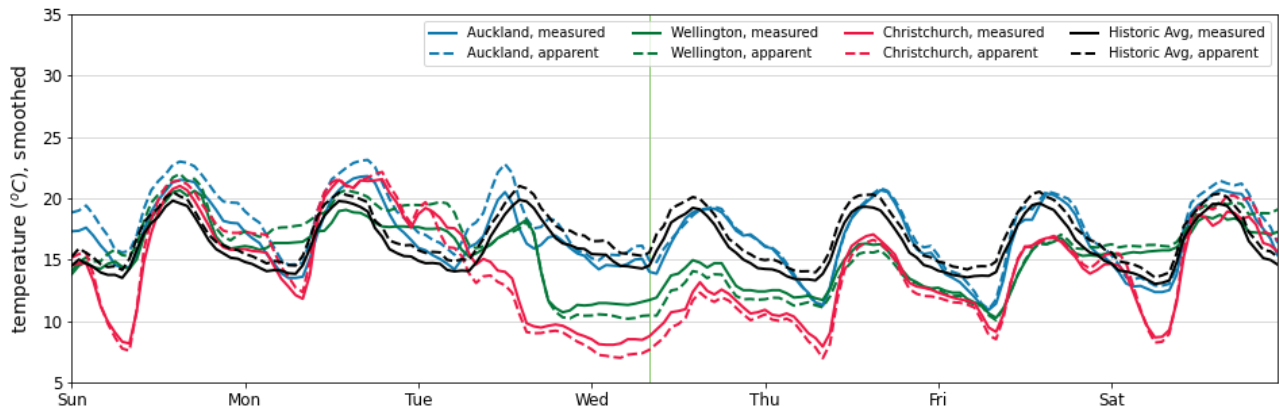
Figure 7: National demand by trading period compared to the previous week



6.2. Figure 8 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.

- 6.3. Between Tuesday and Friday, temperatures across Wellington and Christchurch were mostly below the historic average, with Christchurch dipping to around 6 degrees on Wednesday and Thursday morning. Temperatures were around average on Saturday afternoon. Apparent temperatures in Auckland were generally between 15 and 22 degrees, which is mostly around the historic average for the whole week.

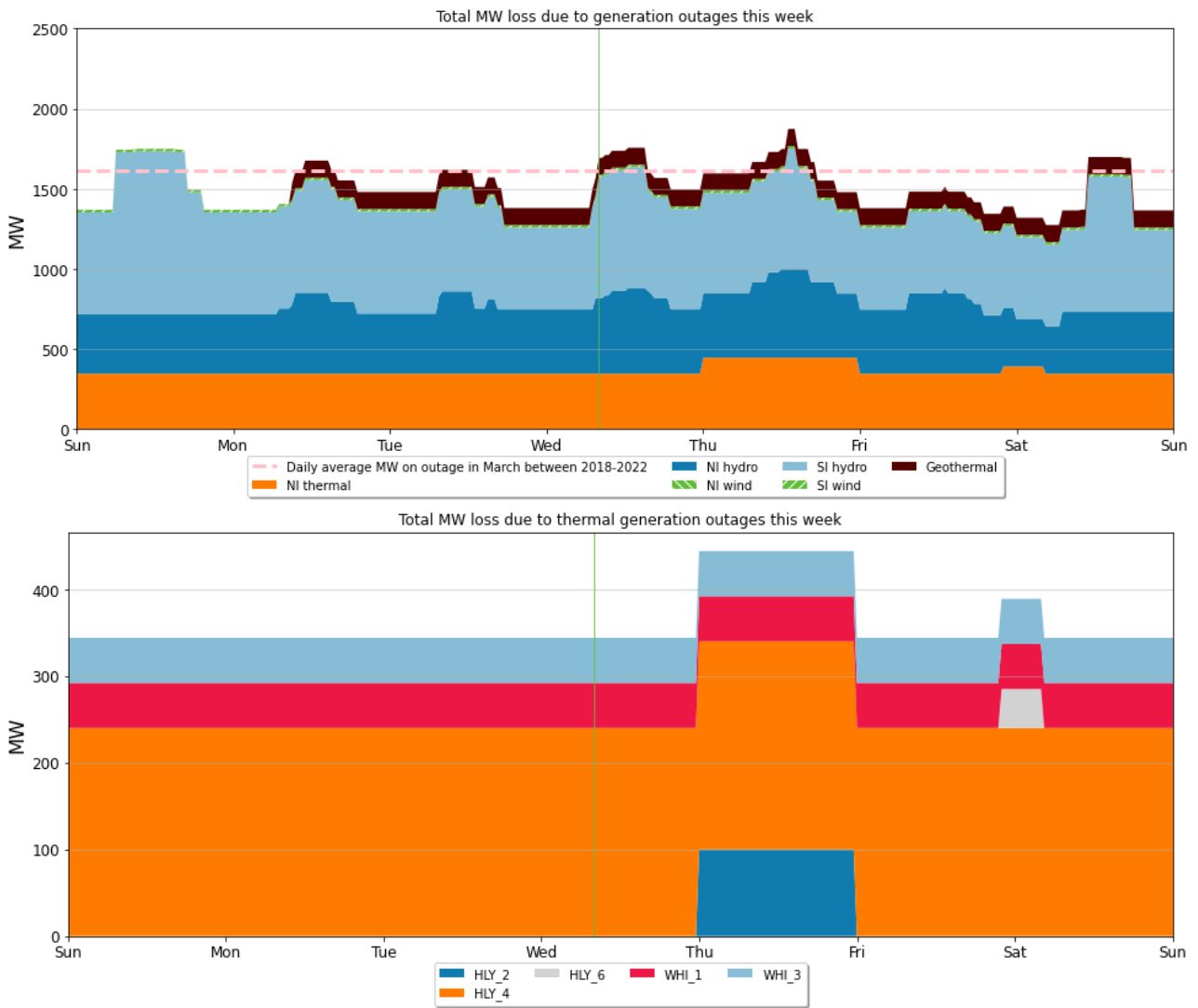
Figure 8: Temperatures across main centres



7. Outages

- 7.1. Figure 9 shows generation capacity on outage. Total capacity on outage between 19-25 March ranged between ~1,300 – 1,900 MW. Outages were highest on Wednesday and Thursday.
- 7.2. Notable outages include:
- Huntly 4 remains on outage until 28 April 2023.
 - Whirinaki Station came back from outage on Wednesday, but two units are still on outage until 11 April 2023.
 - Geothermal unit Kawerau is on outage from 20 March to 29 March 2023.
 - A few North and South Island hydro units remain on outage this week.

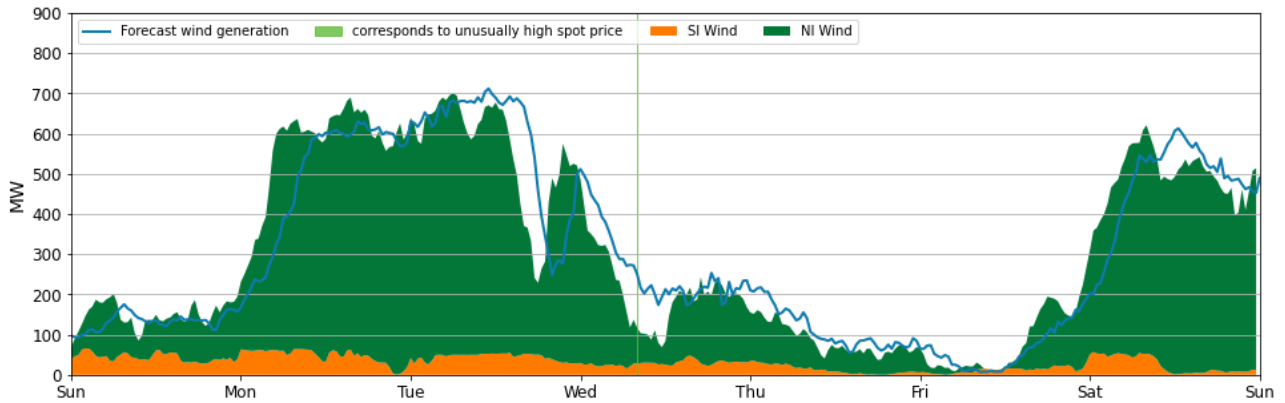
Figure 9: Total MW loss due to generation outages



8. Generation

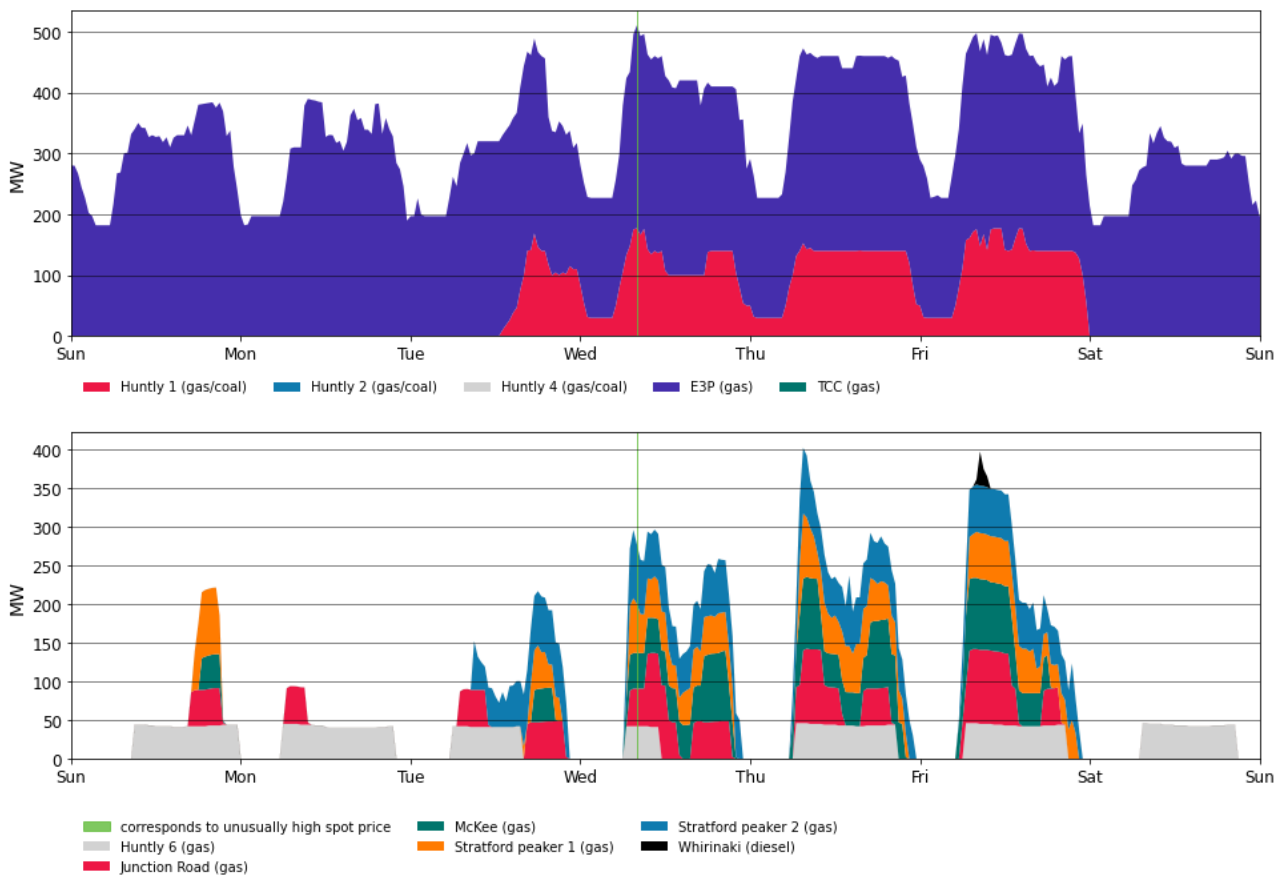
8.1. Wind generation, between 19-25 March, varied between 9-700 MW. Wind generation was low at around 200 MW at the start of the week and increased to 600 MW on Monday. From Tuesday afternoon wind started dropping and reached around 200 MW but had a brief resurgence up to around 600 MW on Tuesday night. From Wednesday wind generation dropped again and remained low until Saturday, reaching a minimum of 9 MW at 8:30 am on Friday. After reaching a peak of 600 MW on Saturday wind again dropped on Sunday. A difference between forecast and final wind generation has also been observed.

Figure 10: Wind Generation and forecast



- 8.2. Figure 11 shows generation of thermal baseload and thermal peaker plants between 19-25 March. E3P (Huntly 5) ran all week as baseload. Huntly 1 also ran from Tuesday to Friday.
- 8.3. Generation from peakers this week was highest on the days with very low wind generation and high demand. Junction road, McKee, and Huntly 6 ran most days this week. Stratford peaker 1 ran on Sunday for the evening peak when wind generation was low. Stratford peaker 1 and 2 also ran from Tuesday to Friday to cover peak demand. On Saturday only Huntly 6 ran as wind generation was relatively high. Whirinaki ran briefly on Friday in order to be able to provide reserve.

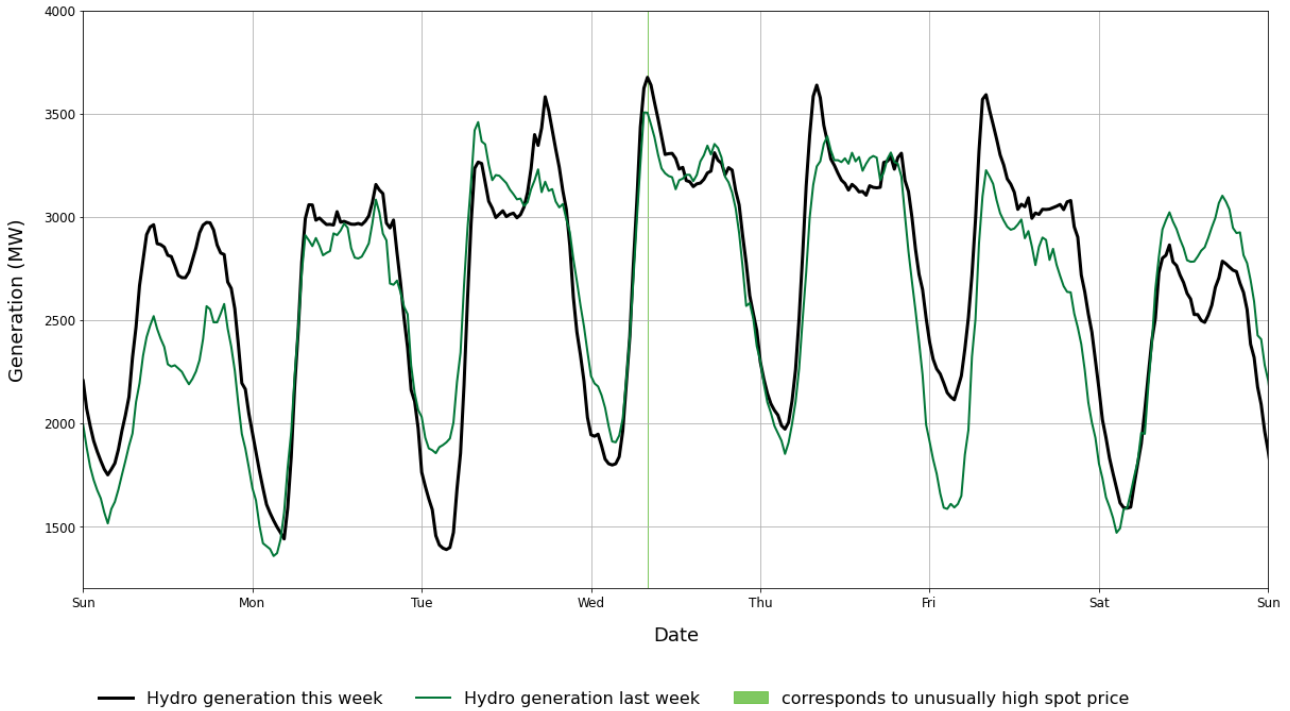
Figure 11: Thermal Generation



- 8.4. Figure 12 shows total hydro generation in MW produced each trading period, compared to the same time in the previous week. Overall hydro generation was 4 percent higher

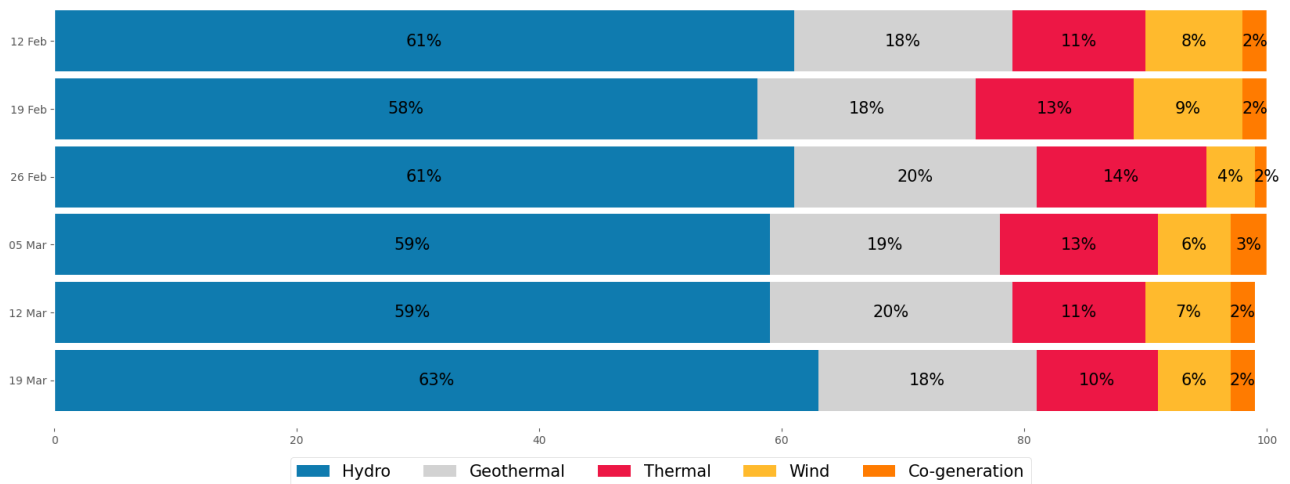
compared to the previous week. There was higher hydro generation compared to last week on Sunday and nearly equal on Monday. On Tuesday the evening peak generation was higher, while the morning peak was higher from Wednesday to Friday. On Saturday hydro generation was significantly lower compared to the previous week. The increase in hydro generation over the week coincided with increased hydro storage.

Figure 12: Hydro generation between 19 – 25 March compared to the previous week



8.5. As a percentage of total generation, between 19-25 March, total weekly hydro generation totalled 63 percent, geothermal 18 percent, thermal 10 percent, wind 6 percent, and co-generation 2 percent.

Figure 13: Total generation as a percentage each week between 12 February and 25 March 2023



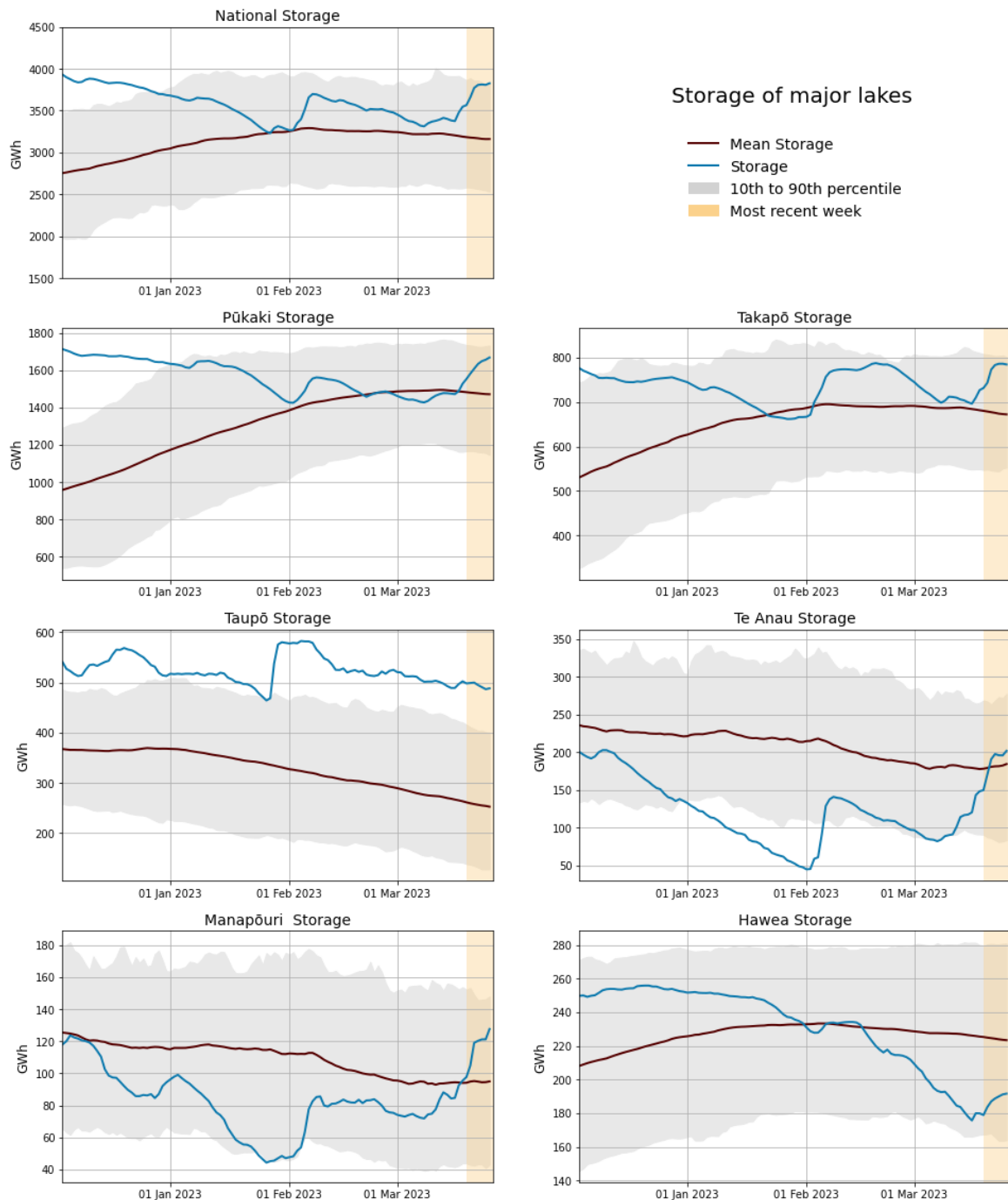
9. Storage/Fuel Supply

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

9.1. Overall, national hydro storage increased and by the end of the week touched its 90th percentile. Total national storage is around 92 percent of nominal full as of 25 March.

9.2. Storage at all South Island lakes increased with lakes Pūkaki, Takapō, and Manapōuri well above their historic average. Storage at Lake Te Anau increased and is slightly above its historic average. Lake Hāwea levels had an uptick at the end of the week and is now well above its historic 10th percentile. In the North Island Taupō remains above its historic 90th percentile.

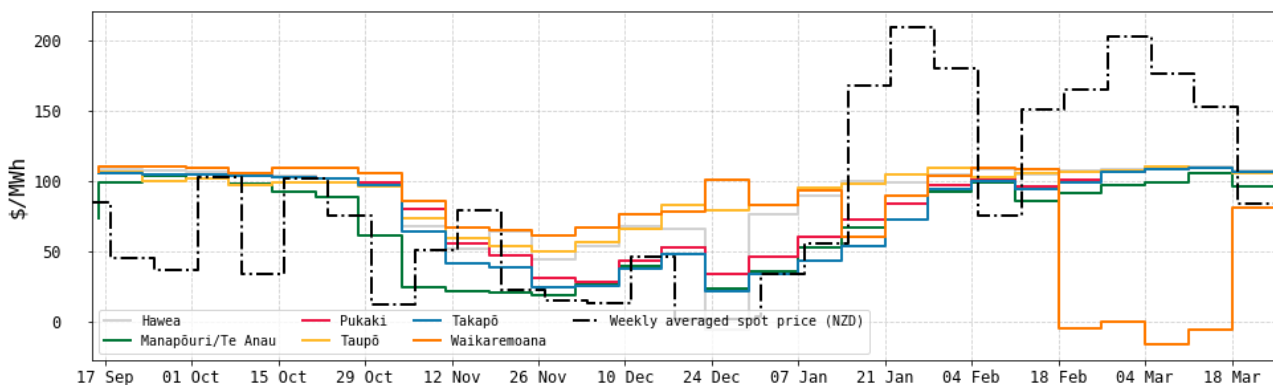
Figure 14: Hydro Storage



10. JADE Water Values

- 10.1. The JADE⁴ 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 25 March 2023 using values obtained from JADE. 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 B⁵ on the trading conduct webpage.
- 10.2. At the beginning of 2023, water values were rising, as lake levels were declining. Water values across all lakes slightly decreased last week, with most lakes receiving moderate inflows prior to 18 March. Note that when the water value for Waikaremoana dropped to below zero indicated that it was full and was only able to supply energy to parts of Hawkes Bay. Waikaremoana storage decreased this week, as reflected in its water value.

Figure 15: JADE water values across various reservoirs between 15 September 2022 and 25 March 2023



11. Price versus estimated costs

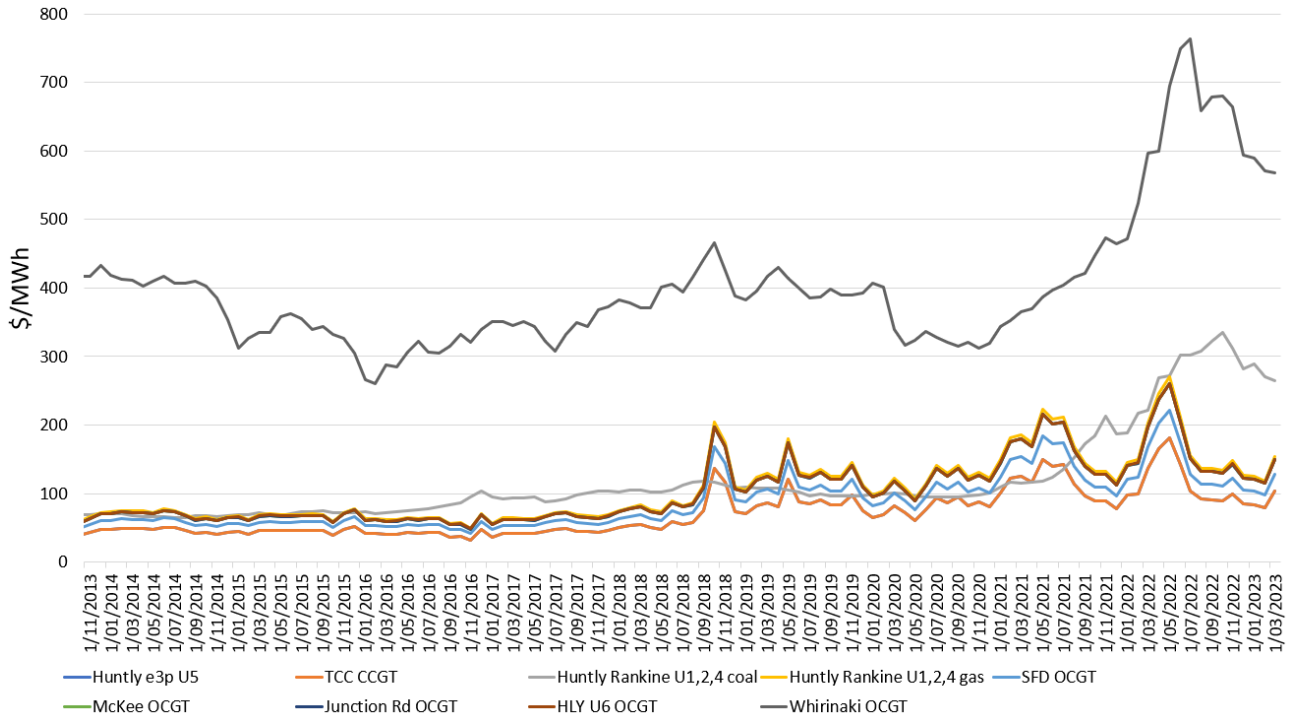
- 11.1. In a competitive market, prices should be close to (but not necessarily at) the short run marginal cost (SRMC) of the marginal generator (where SRMC includes opportunity cost).
- 11.2. The SRMC (excluding opportunity cost of storage) for thermal fuels is estimated using gas and coal prices, and 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 16 shows an estimate of thermal SRMCs as a monthly average up to 1 March 2023. The SRMC of gas fuelled plants has increased, while the SRMC of diesel and coal has slightly decreased.
- 11.4. In early March Indonesian coal fell to around ~\$450/tonne (NZD) putting the latest SRMC of coal fuelled Huntly generation at ~\$265/MWh.
- 11.5. The SRMC of Whirinaki has decreased slightly to ~\$567/MWh.
- 11.6. The SRMC of gas run thermal plants increased to between \$105/MWh and \$150/MWh, likely due to an increase in gas demand.

⁴ 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.

⁵ <https://www.ea.govt.nz/assets/dms-assets/29/Appendix-B-JADE-water-value-model.pdf>

11.7. More information on how the SRMC of thermal plants is calculated can be found in Appendix C⁶ on the trading conduct webpage.

Figure 16: Estimated monthly SRMC for thermal fuels



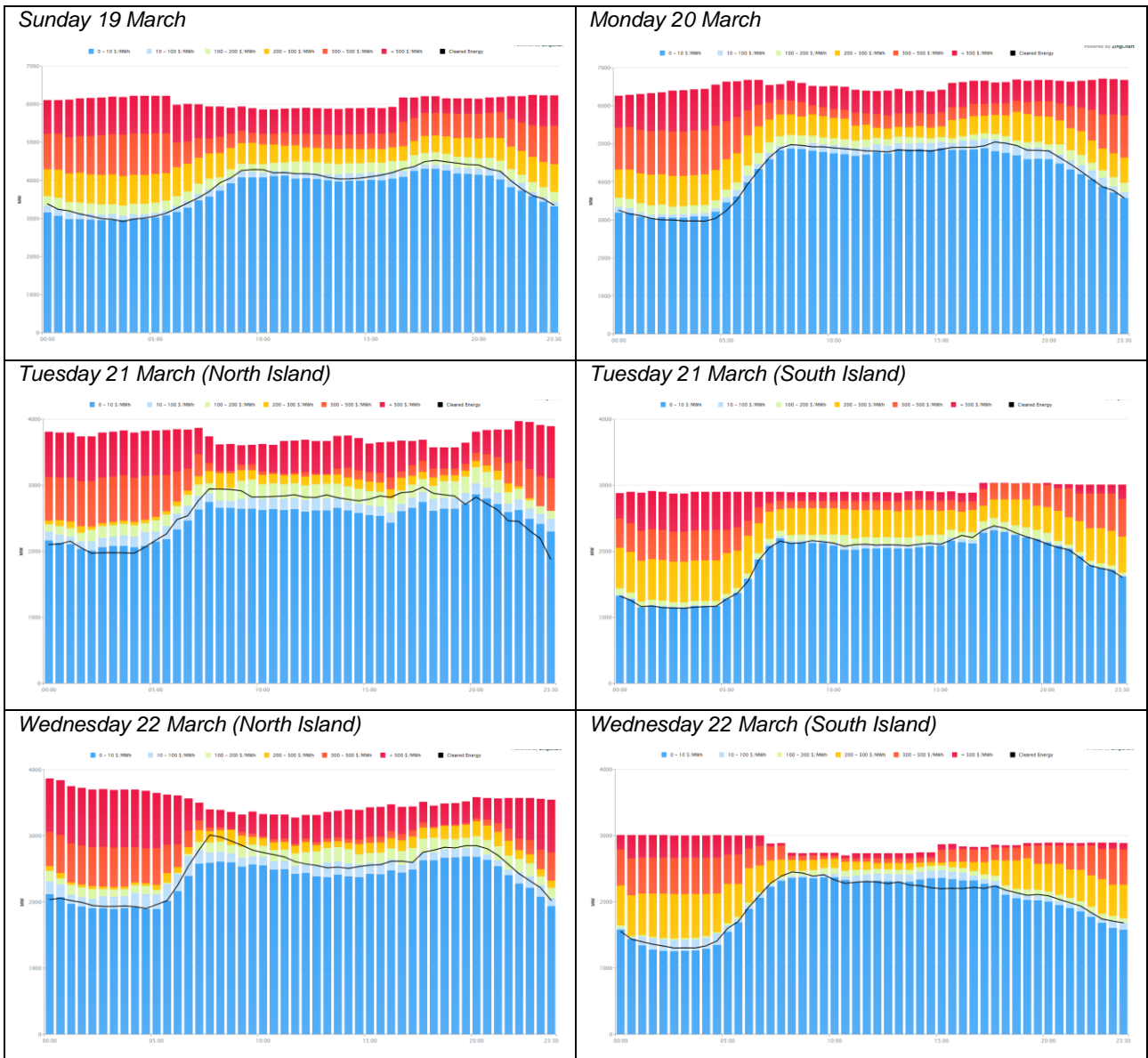
12. Offer Behaviour

- 12.1. Figure 17 shows this week's national daily offer stacks from WITS⁷. The black line shows cleared energy, indicating the range of the average final price. Most of the energy was cleared in the \$100-200/MWh or \$200-300/MWh band for the North Island and lower for the South Island.
- 12.2. Increased hydro inflows resulted in an increase in generation offers at lower priced tranches, especially towards the end of the week. There is less generation offered between \$200-\$300/MWh in the North Island relative to the South Island, creating a steeper price curve. This meant that the HVDC outage and tight supply in the North Island resulted in relatively large price spikes.

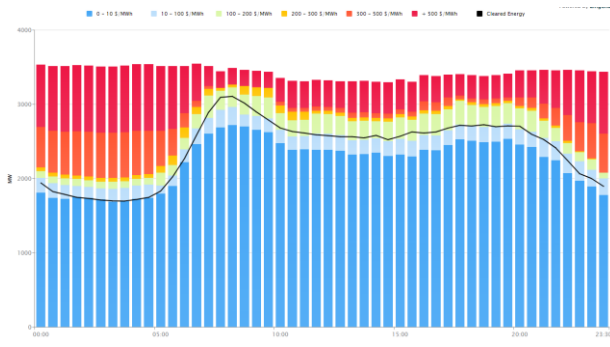
⁶ <https://www.ea.govt.nz/assets/dms-assets/30/Appendix-C-Calculating-thermal-SRMCs.pdf>

⁷ [Cleared Energy Stack | WITS \(electricityinfo.co.nz\)](https://www.electricityinfo.co.nz/cleared-energy-stack)

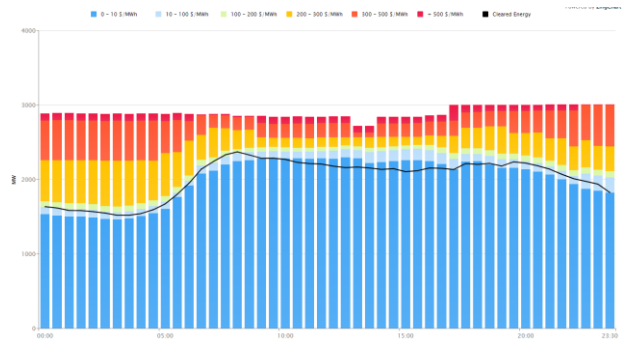
Figure 17: Daily offer stack from WITS



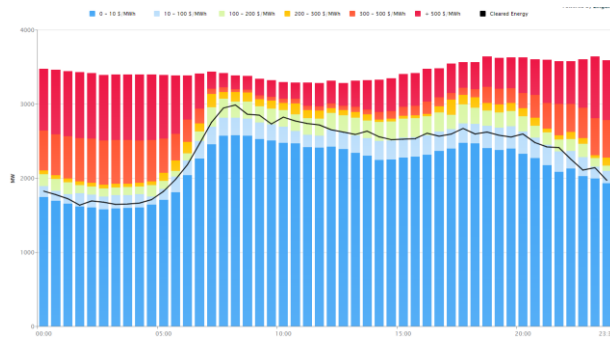
Thursday 23 March (North Island)



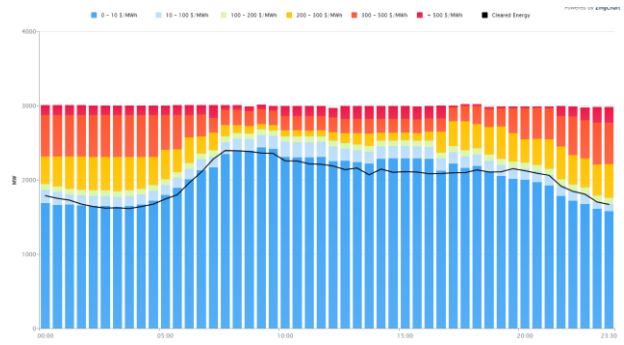
Thursday 23 March (South Island)



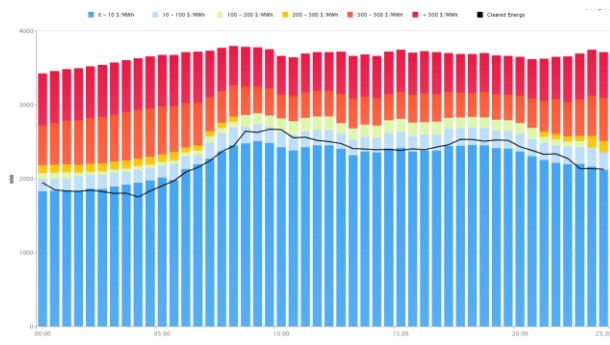
Friday 24 March (North Island)



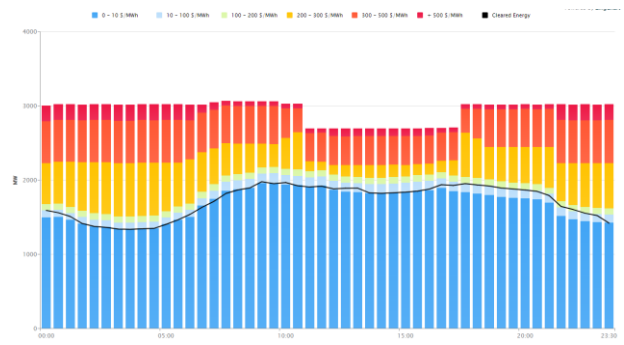
Friday 24 March (South Island)



Saturday 25 March (North Island)



Saturday 25 March (South Island)



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	Notes
07/10/2022	15-16	Further analysis	The Monitoring team is making enquires with Genesis regarding offer changes to final tranche prices at Huntly 5 for trading period 15-16.
13/12/2022- 16/12/2022	Several	Further analysis	The Authority will continue analysis into the high energy prices.
15/1/2023 4/2/2023	Several	Further analysis	The Authority will continue analysis into the high energy prices associated with high hydro offers.
21/3/2023	33	Further analysis	The Authority will continue analysis into the high energy and reserve prices.
22/3/2023	17-18	Further analysis	The Authority will continue analysis into the high energy and reserve prices in relation to the CAN notice.
23/3/2023	16-18	Further analysis	The Authority will continue analysis into the energy prices and participant response in relation to the CAN notice.
24/3/2023	17,28	Further analysis	The Authority will continue analysis into the high energy and reserve prices in relation to the CAN notice and for other high price TP.