12 February 2024

Trading conduct report

Market monitoring weekly report

Trading conduct report

1. Overview for week of 4–10 February

1.1. Prices were low at the start of the week due to increased wind generation and hydro storage remaining above historical average for this time of the year. There was an increase to spot prices in the middle of the week, with a price spike on Wednesday due to a combination of high demand with demand and wind forecasting errors. Like the previous week, Huntly 5 provided baseload while peakers ran to meet the higher demand requirements mid-week. Hydro storage decreased this week, currently at ~103% of mean as of 10 February.

2. Spot prices

2.1. This report monitors underlying wholesale price drivers to assess whether trading periods require further analysis to identify 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 are outliers compared to historic prices for the same time of year.

2.2. Figure 1 shows the wholesale spot prices at Benmore and Ōtāhuhu alongside the national historic median and historic 10th-90th percentiles adjusted for inflation. Prices greater than quartile 3 (75th percentile) plus 1.5 times the inter-quartile range[1] of historic prices, are highlighted with a vertical black line. Other notable prices are marked with black dashed lines.

2.3. Between 4-10 February:

(a) The average wholesale spot price across all nodes was $114/MWh.

(b) 95%of prices fell between $0.01/MWh and $254/MWh.

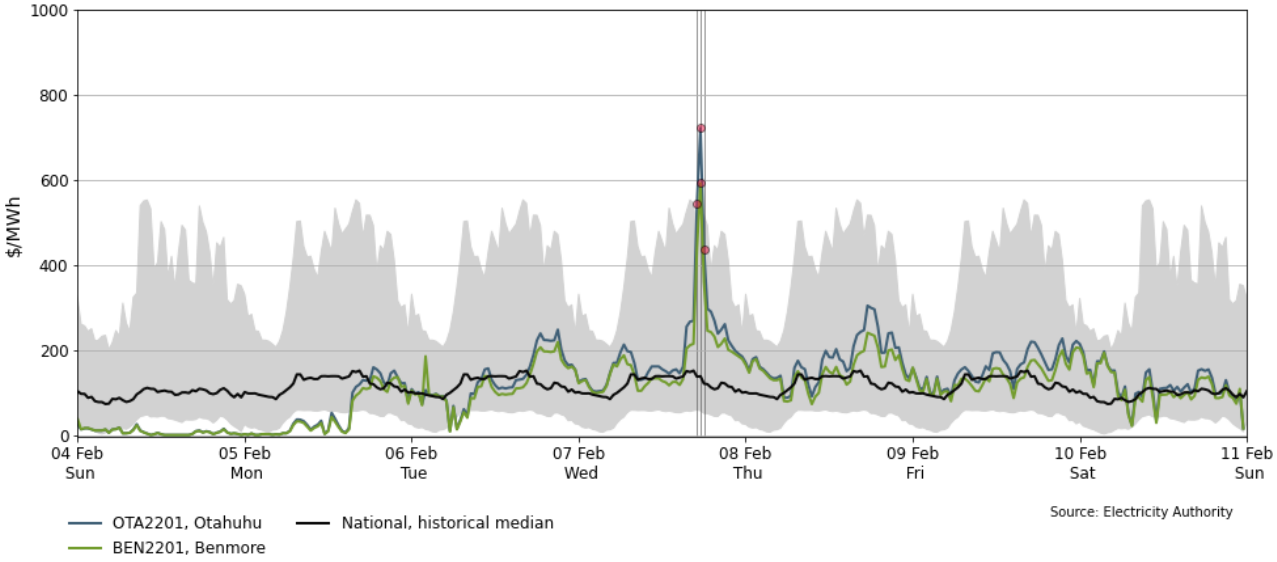
2.4. The week started with some very low prices from Sunday through to Monday afternoon. The weekly average price increased by around $10/MWh compared to the previous week.

2.5. This week there was one price spike on Wednesday at 5:30pm, with half hourly prices reaching $722/MWh at Ōtāhuhu and $592/MWh at Benmore. The price spike was related to high demand, a rapid decrease in wind generation, and wind and demand forecast inaccuracies.

2.6. The remainder of the week saw prices close to or just above the historical average.

[1] We are identifying any significantly high prices by using the historic distribution of prices depending on whether it is a weekday or weekend day, and looking for prices that lie 1.5 times the interquartile range above the 75th percentile of the distribution. This is using the outlier calculation Q_3+1.5×IQR, where Q_3 is the 75th percentile (or third quartile value) and IQR is your inter-quartile range.

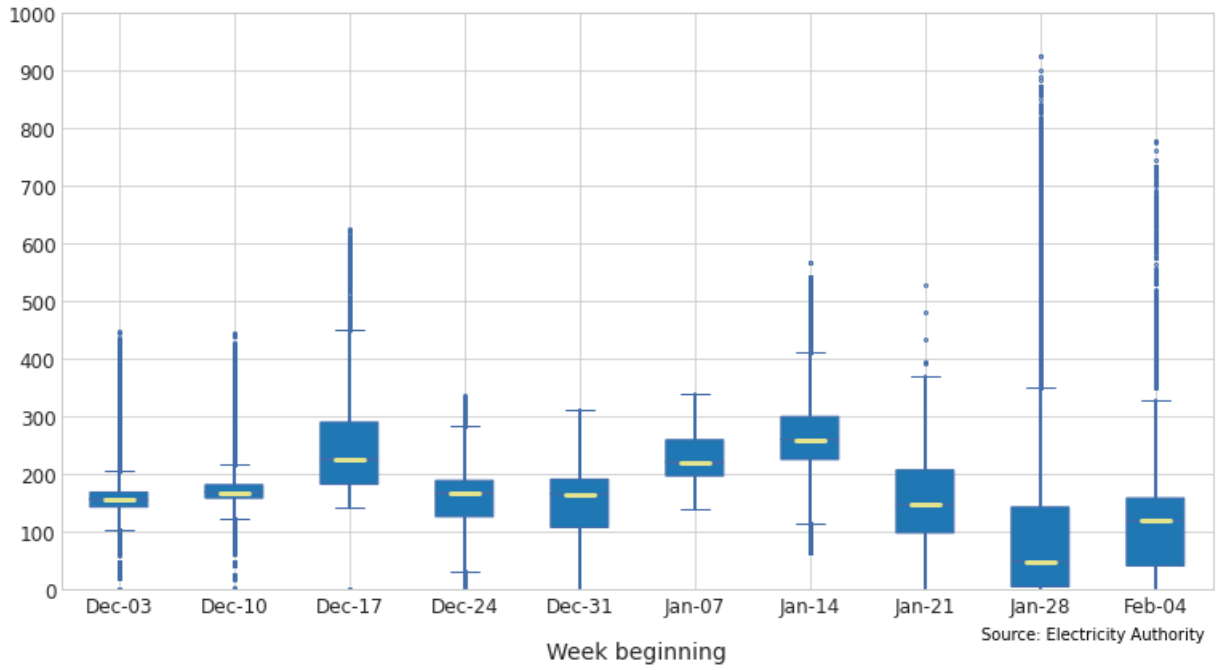
Figure 1: Wholesale spot prices at Benmore and Ōtāhuhu between 4-10 February



2.7. Figure 2 shows a box plot with the distribution of spot prices during this week and the previous nine weeks. The yellow line shows each week's median price, while the box part shows the lower and upper quartiles (where 50%of prices fell). The "whiskers" extend to points that lie within 1.5 times the inter-quartile range (IQR) of the lower and upper quartile, and then observations that fall outside this range are displayed independently.

2.8. The middle 50% of spot prices this week was between $40-$158/MWh, somewhat similar to the previous week, but the median price increased to $118/MWh this week compared to $48/MWh the week before.

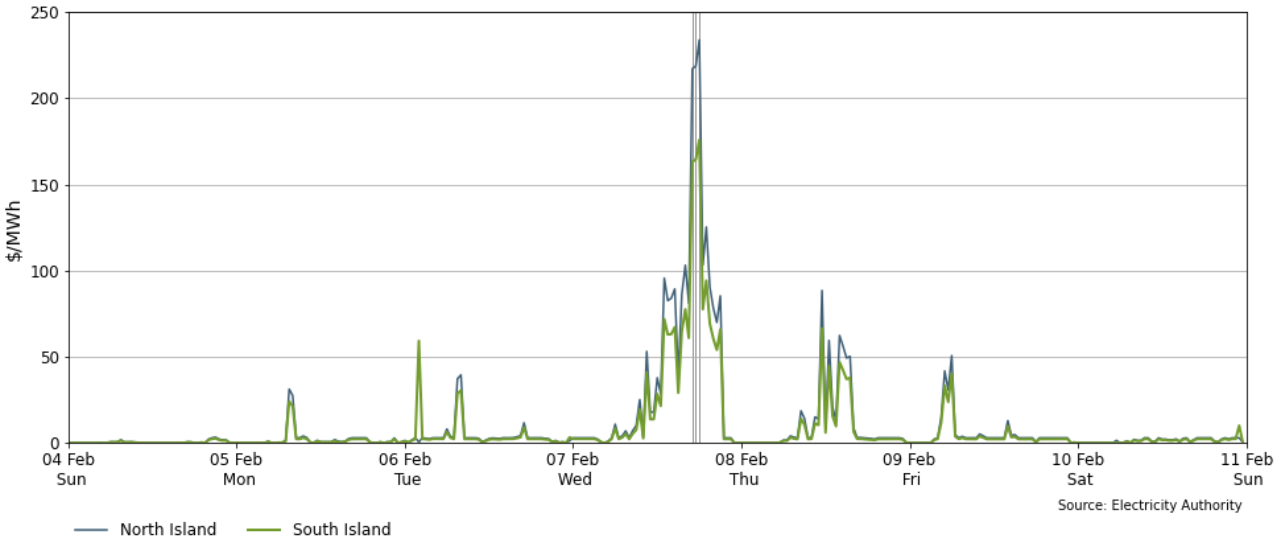
Figure 2: Boxplots showing the distribution of spot prices this week and the previous nine weeks



3. Reserve prices

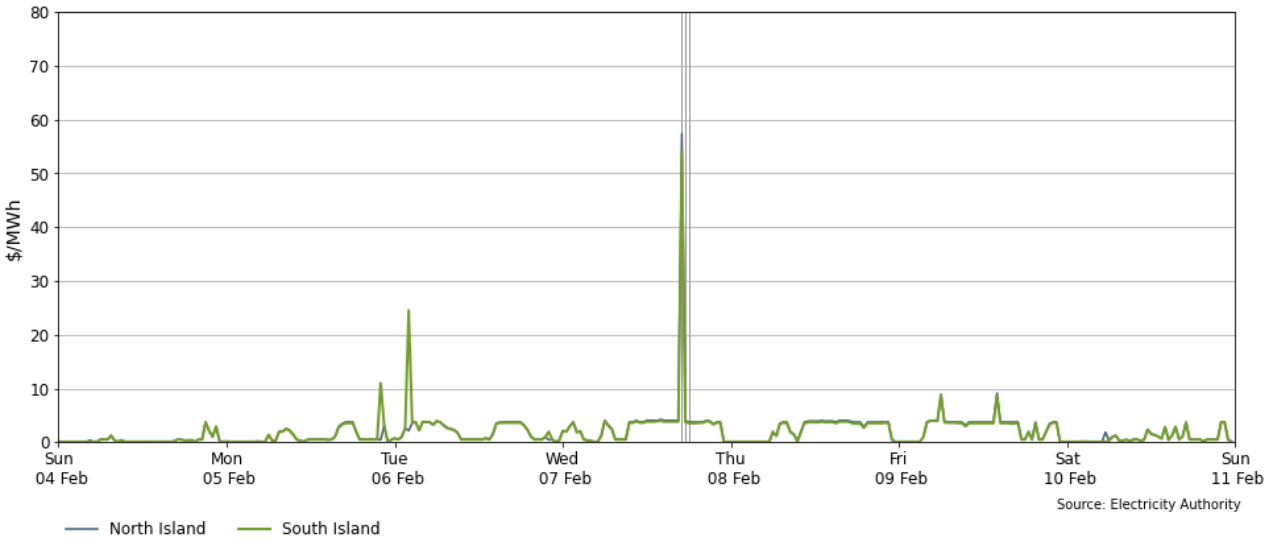
3.1. Fast Instantaneous Reserve (FIR) prices for the North and South Islands are shown below in Figure 3. During the weekdays, FIR prices in both islands spiked at times, with FIR prices on Wednesday and some of Thursday remaining high for several consecutive trading periods. High FIR prices on Wednesday and Thursday were related to a relative shortage of generation capacity to supply both energy and FIR—contributing factors included outages at Clyde and Ohau and Huntly 5 being the only baseload thermal plant offered. Thus, more expensive energy offers (including Whirinaki) had to be cleared to free up capacity to provide FIR.

Figure 3: Fast Instantaneous Reserve (FIR) price by trading period and island



3.2. Sustained Instantaneous Reserve (SIR) prices for the North and South Islands are shown in Figure 4. SIR prices were mostly low during the week with a large spike happening on Wednesday, when SIR prices reached around $55/MWh on average between both islands.

Figure 4: Sustained Instantaneous Reserve (SIR) by trading period and island

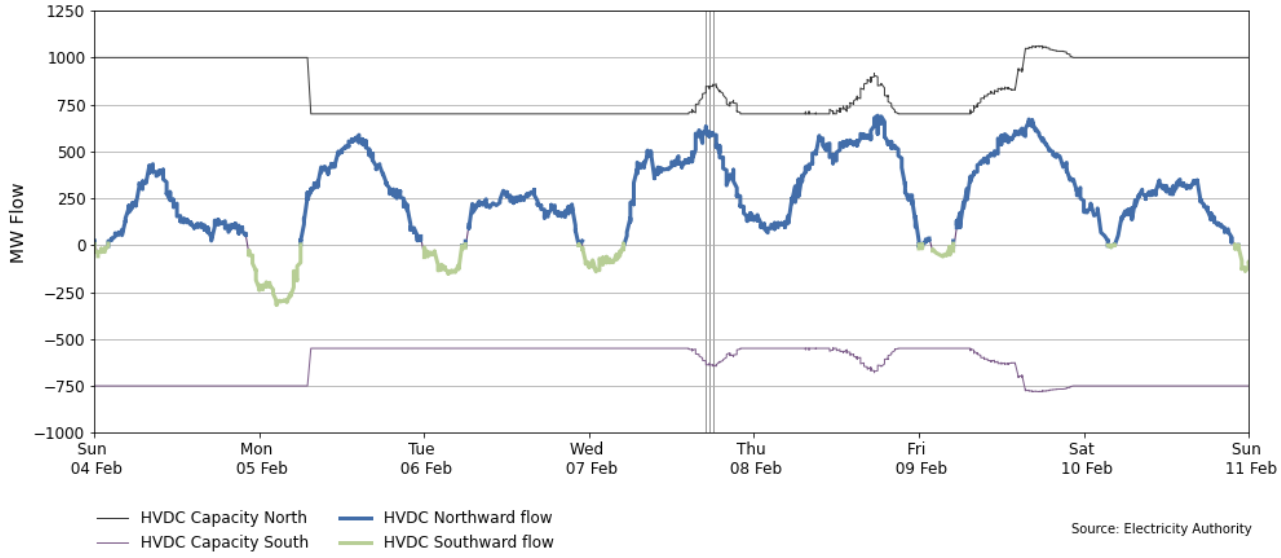


3.3. At 2:00am, during trading period 5 on Tuesday, energy and reserve prices were higher in the South Island, when compared to the North. High wind generation in the North Island resulted in a southward HVDC flow, and the HVDC then setting the risk for the South Island. The HVDC went from transferring ~-40MW in trading period 4 to over -135 MW during trading period 5. Initially only Pole 2 was running, which meant the entire DC southward transfer was at risk. Once Pole 3 started in trading period 6, the HVDC was able to self-cover and the price separation disappeared.

4. HVDC

4.1. Figure 5 shows HVDC flow between 4-10 February. HVDC flows were mostly northwards this week, with a few southward flows happening mostly overnight and earlier in the week. From Monday to Friday, HVDC capacity northwards reduced to less than 750MW for some of the time.

Figure 5: HVDC flow and capacity



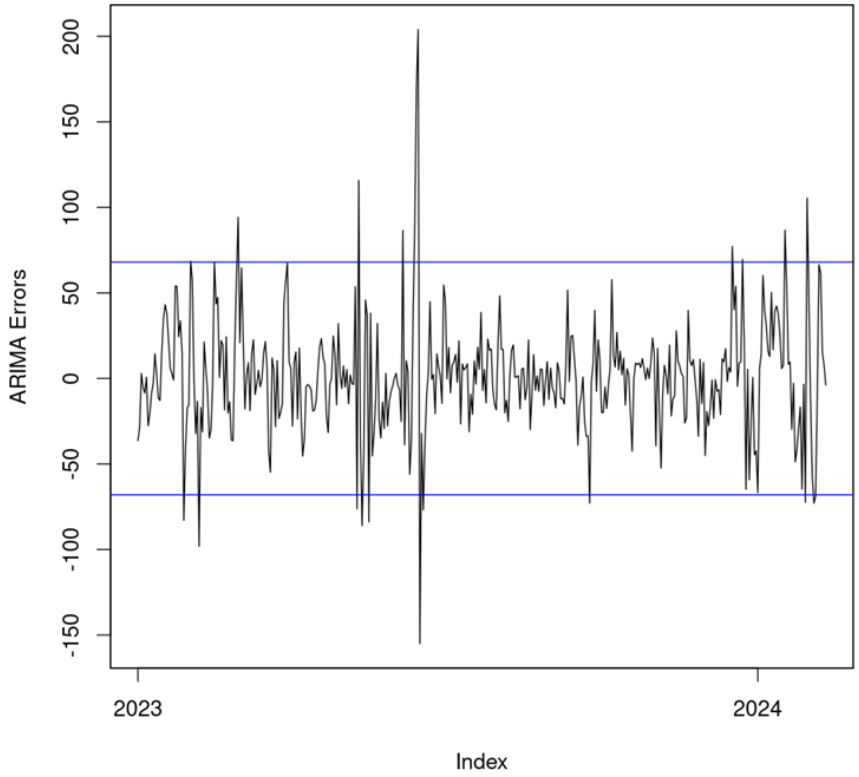
5. Regression residuals

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 on the trading conduct webpage.

5.2. Figure 6 shows the residuals of autoregressive moving average (ARMA) errors from the daily model. Positive residuals indicate that the modelled daily price is lower than actual average daily price and vice versa. When residuals are small this indicates that average daily prices are likely largely aligned with market conditions. These small deviations reflect market variations that may not be controlled for in the regression analysis.

5.3. This week there was one residual below two standard deviations of the data, indicating that prices were lower than the model expected. This was on Sunday when spot prices were very low and mostly below $10/MWh.

Figure 6: Residual plot of estimated daily average spot prices from 1 January 2023 to 10 February 2024

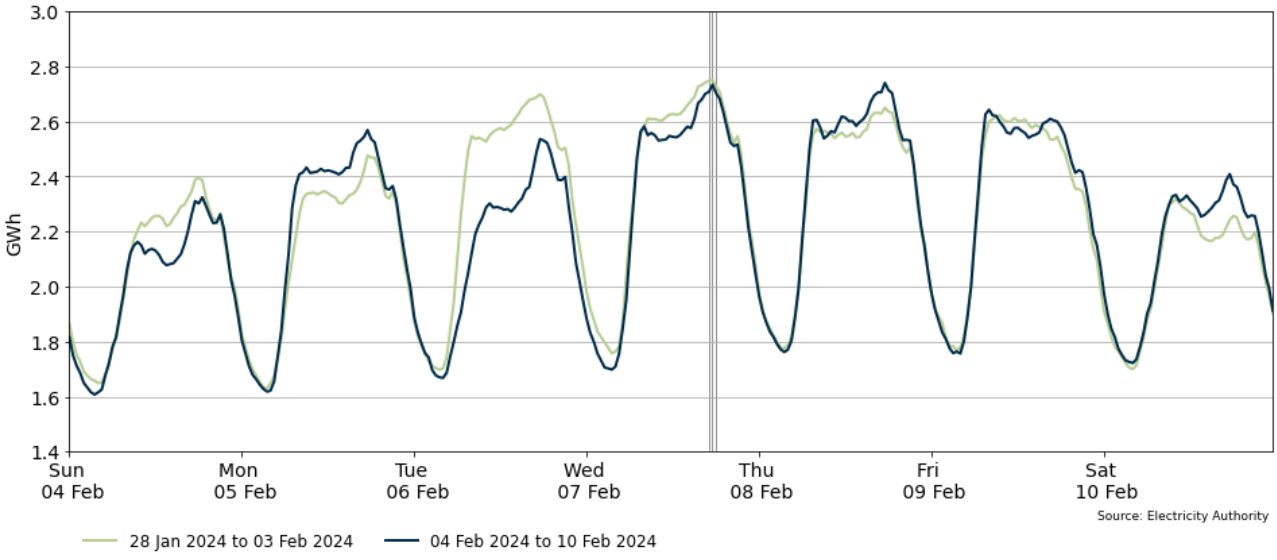


Source: Electricity Authority/see Appendix A

6. Demand

6.1. Figure 7 shows national demand between 4-10 February, compared to the previous week. Demand was similar to the previous week except for Tuesday, with the Waitangi Day holiday reducing demand compared to the previous Tuesday. On Wednesday, demand forecast inaccuracies of more than 70 MW in the North Island also contributed to the high spot prices.

Figure 7: National demand between 4-10 February compared to the previous week

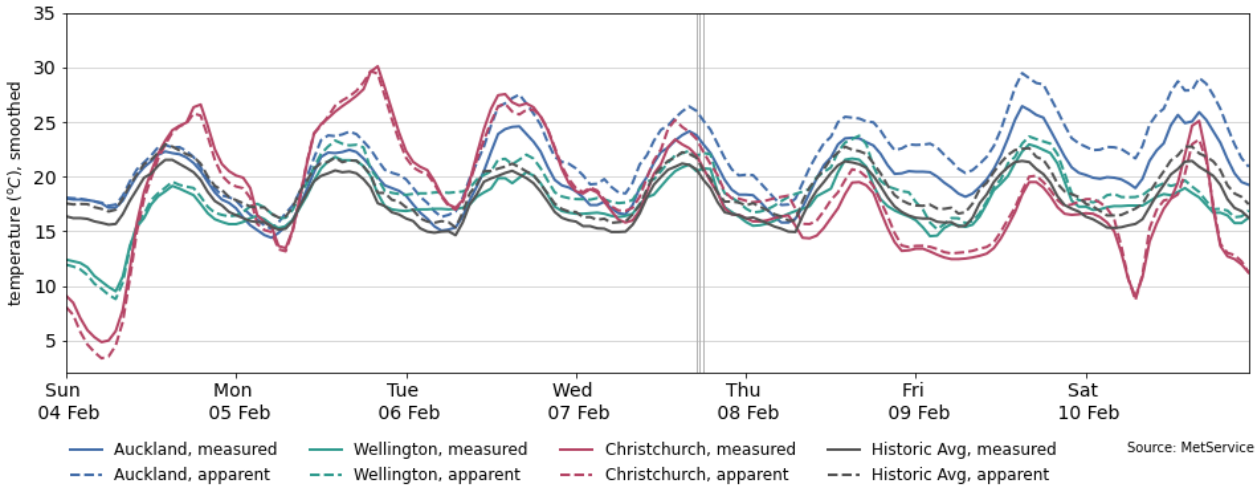


6.2. Figure 8 shows the hourly temperature at main population centres from 4-10 February. The measured temperature is the recorded temperature, while the apparent temperature adjusts

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. Temperatures were close to the historic national average for most of this week, though there were several particularly hot days across the country. Apparent temperatures reached 29ºC in Auckland on Friday and Saturday. Christchurch saw the biggest variation in temperatures with apparent temperature on Sunday ~4 ºC and a maximum of ~30 ºC on Monday. Temperatures in Wellington ranged from ~8ºC to ~24ºC.

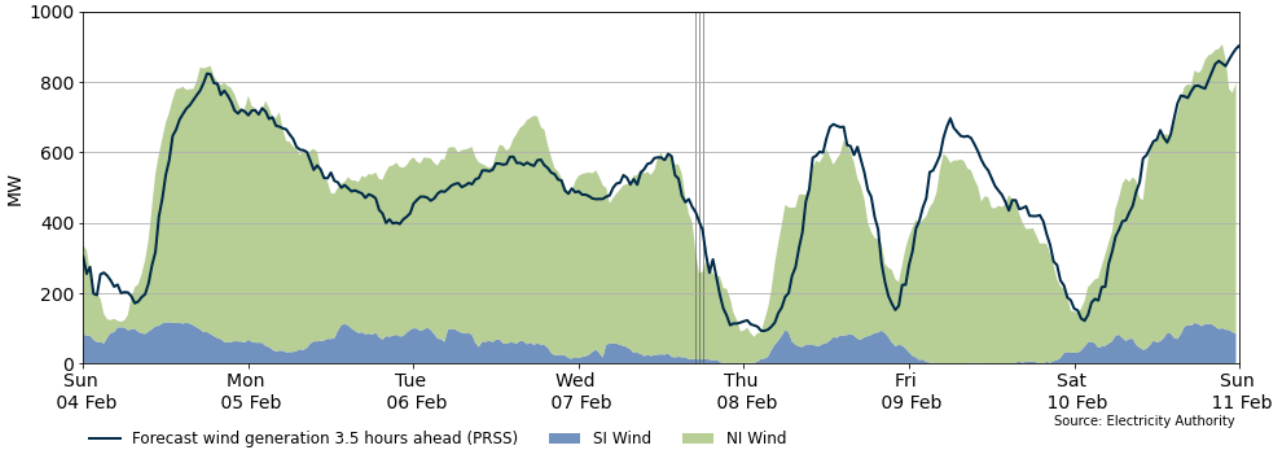
Figure 8: Temperatures across main centres



7. Generation

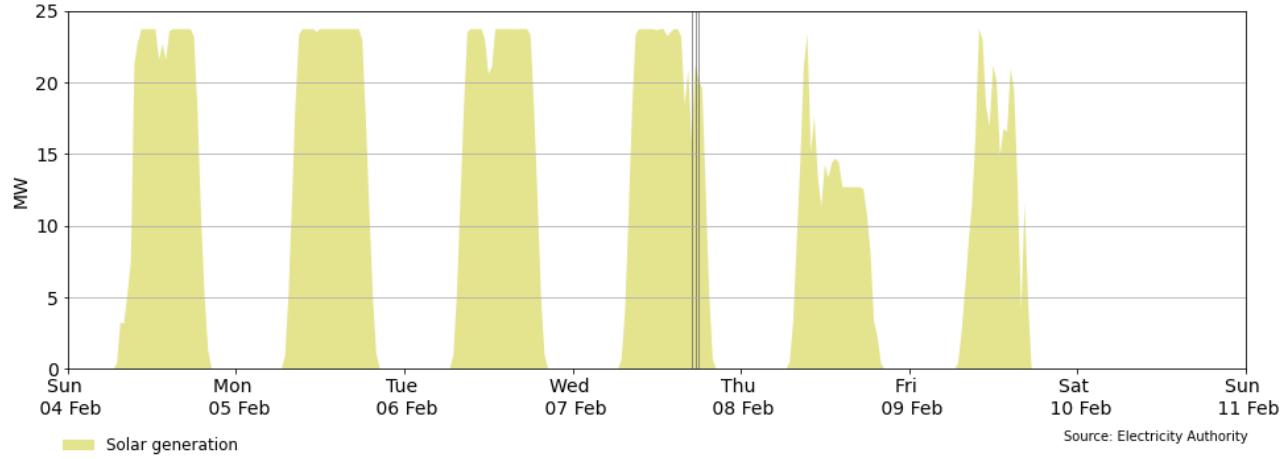
7.1. Figure 9 shows wind generation and forecast from 4-10 February. This week wind generation varied between 76MW and 907MW, with an average of 506MW. Wind generation was above 400MW for a good part of the week but a rapid drop in wind generation on Wednesday combined with more than 100MW of wind forecast inaccuracies contributed to the high prices seen that day.

Figure 9: Wind generation and forecast between 4- 10 February



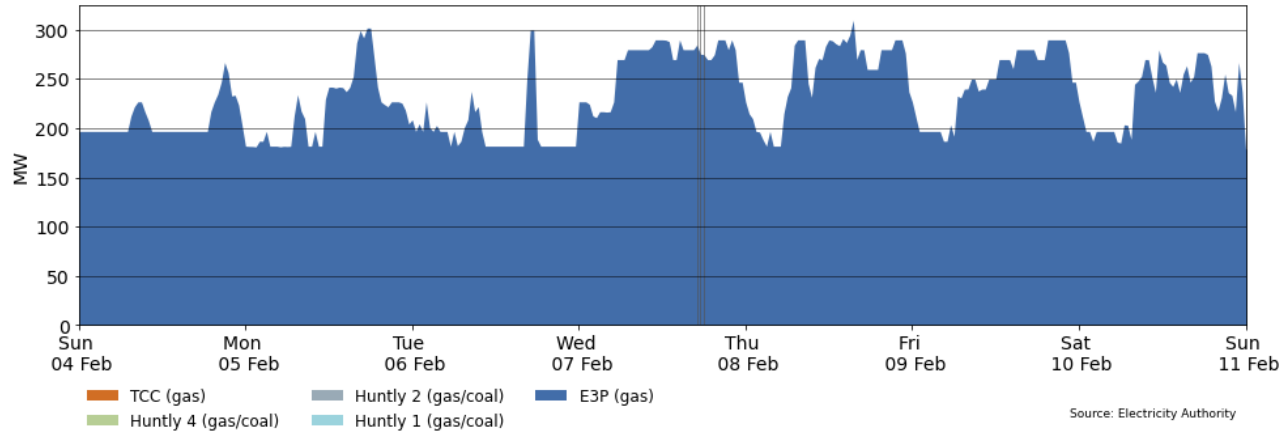
7.2. Figure 10 shows solar generation from 4-10 February. Overcast events might have impacted solar generation on Thursday and Friday. On Saturday, a Top Energy outage required Kaitaia solar farm to be completely switched off.

Figure 10: Solar generation between 4-10 February



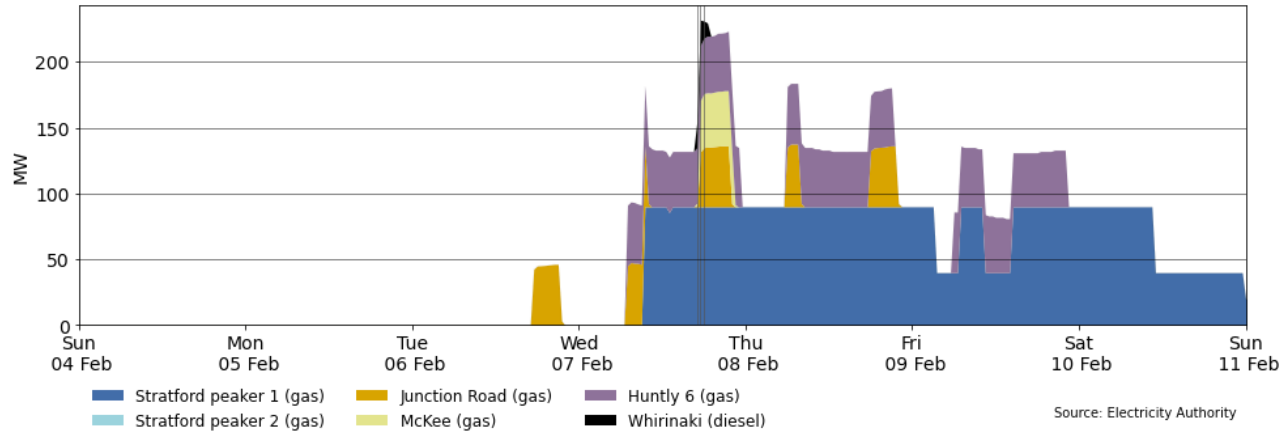
7.3. Figure 11 shows the generation of thermal baseload between 4-10 February. Huntly 5 (E3P) provided baseload during the whole week, generating between 178MW and 310MW.

Figure 11: Thermal baseload generation between 4-10 February



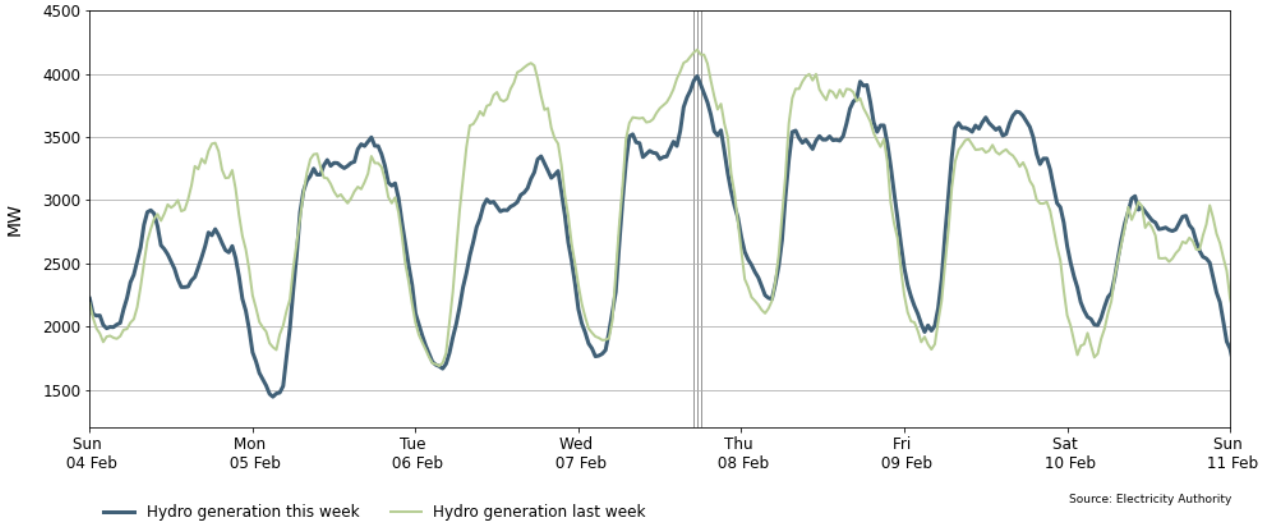
7.4. Figure 12 shows the generation of thermal peaker plants between 4-10 February. Peakers ran mostly from Wednesday onwards this week, with Stratford 1 running every day possibly to support baseload generation from Wednesday to the end of the week. Junction Road ran for a few trading periods between Tuesday and Thursday and Huntly 6 ran for a few hours between Wednesday and Friday. On Wednesday, Whirinaki was constrained on from the last trading period when spot prices spiked until the next trading period.

Figure 12: Thermal peaker generation between 4-10 February



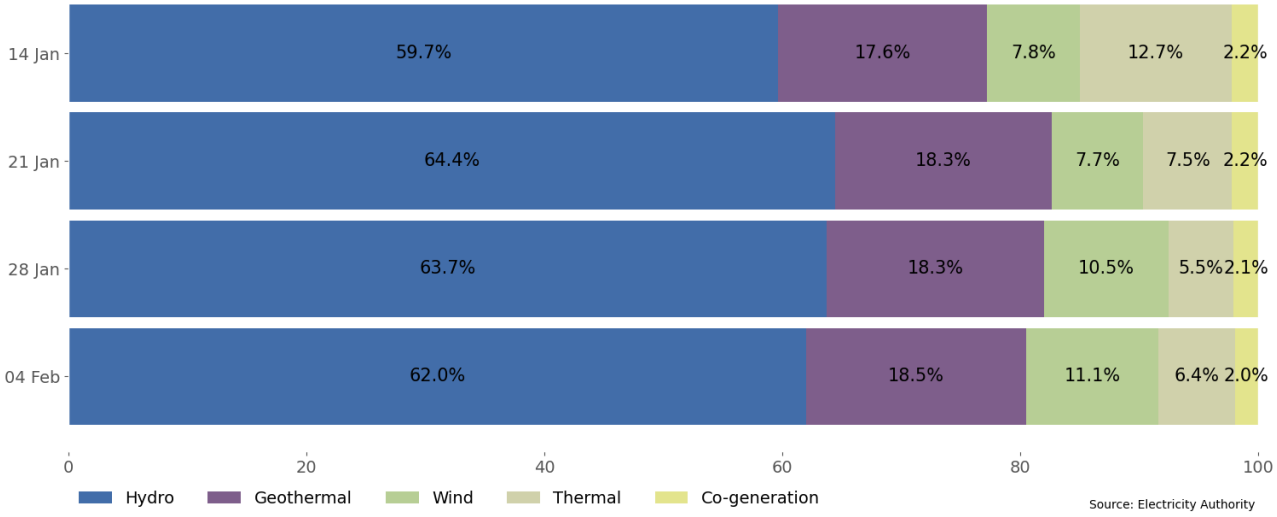
7.5. Figure 13 shows hydro generation between 4-10 February. Compared to the previous week, this week hydro generation was lower on Sunday and during the holiday on Tuesday; all the other days being similar or slightly higher than last week. During the period where prices spiked, hydro generation ramped up, aligned to the peak in demand.

Figure 13: Hydro generation between 4-10 February



7.6. As a percentage of total generation, between 4-10 February, total weekly hydro generation was 62%, geothermal 18.5%, wind 11.1%, thermal 6.4%, and co-generation 2%.

Figure 14: Total generation b type as a percentage each week between 14 January and 10 February



8. Outages

8.1. Figure 15 shows generation capacity on outage. Total capacity on outage between 4-10 February ranged between ~1,400MW and ~1,990MW.

8.2. Notable outages include:

(a) Huntly 1 is on outage until 29 April 2024

(b) Stratford 2 is on outage until 1 May 2024

(c) Junction Road was on outage on 10 February

(d) McKee was on outage on 6 February

(e) Poihipi geothermal plant is on outage until 24 March 2024

(f) Te Mihi geothermal plant is on outage until 15 February 2024

(g) Several North and South Island hydro generating units were on outage this week.

Figure 15: Total MW loss due to generation outages

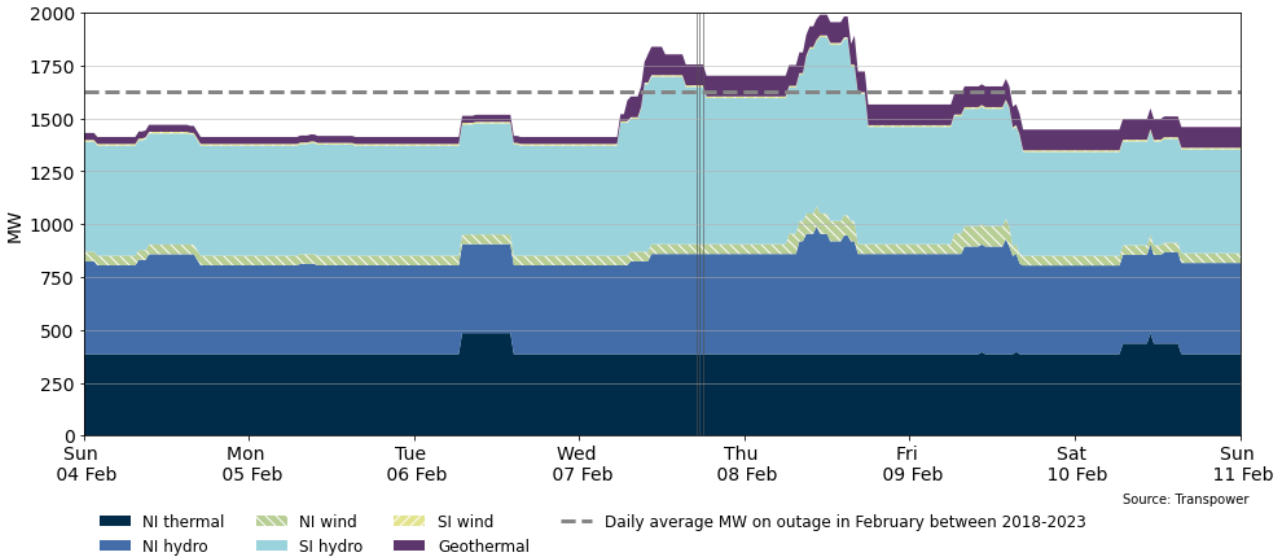
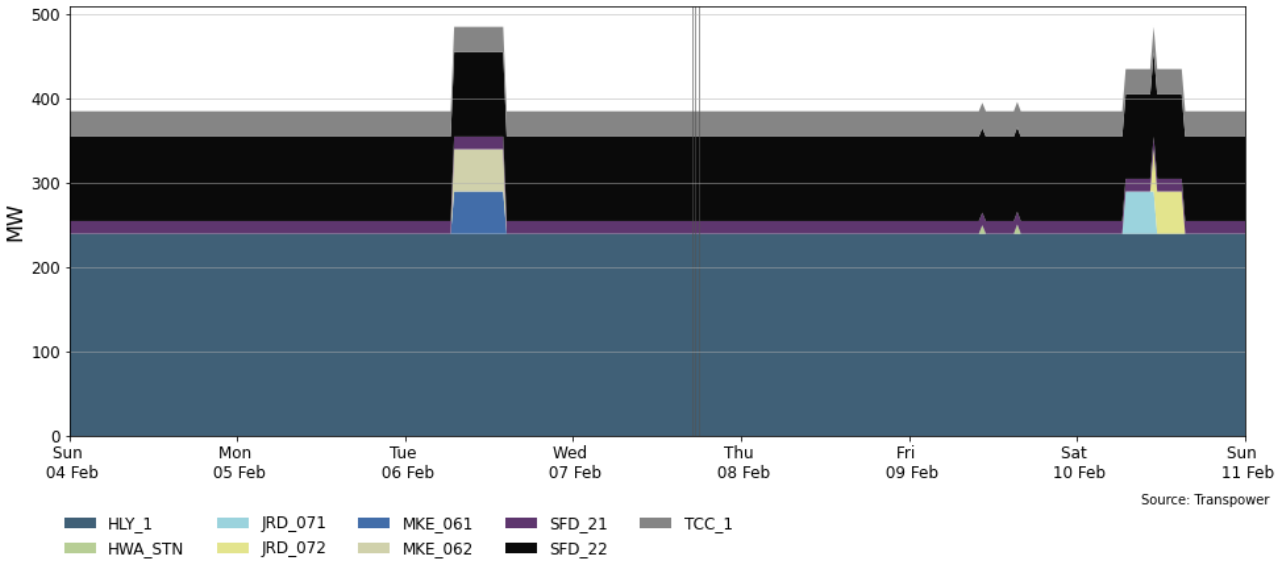


Figure 16: MW loss from thermal outages



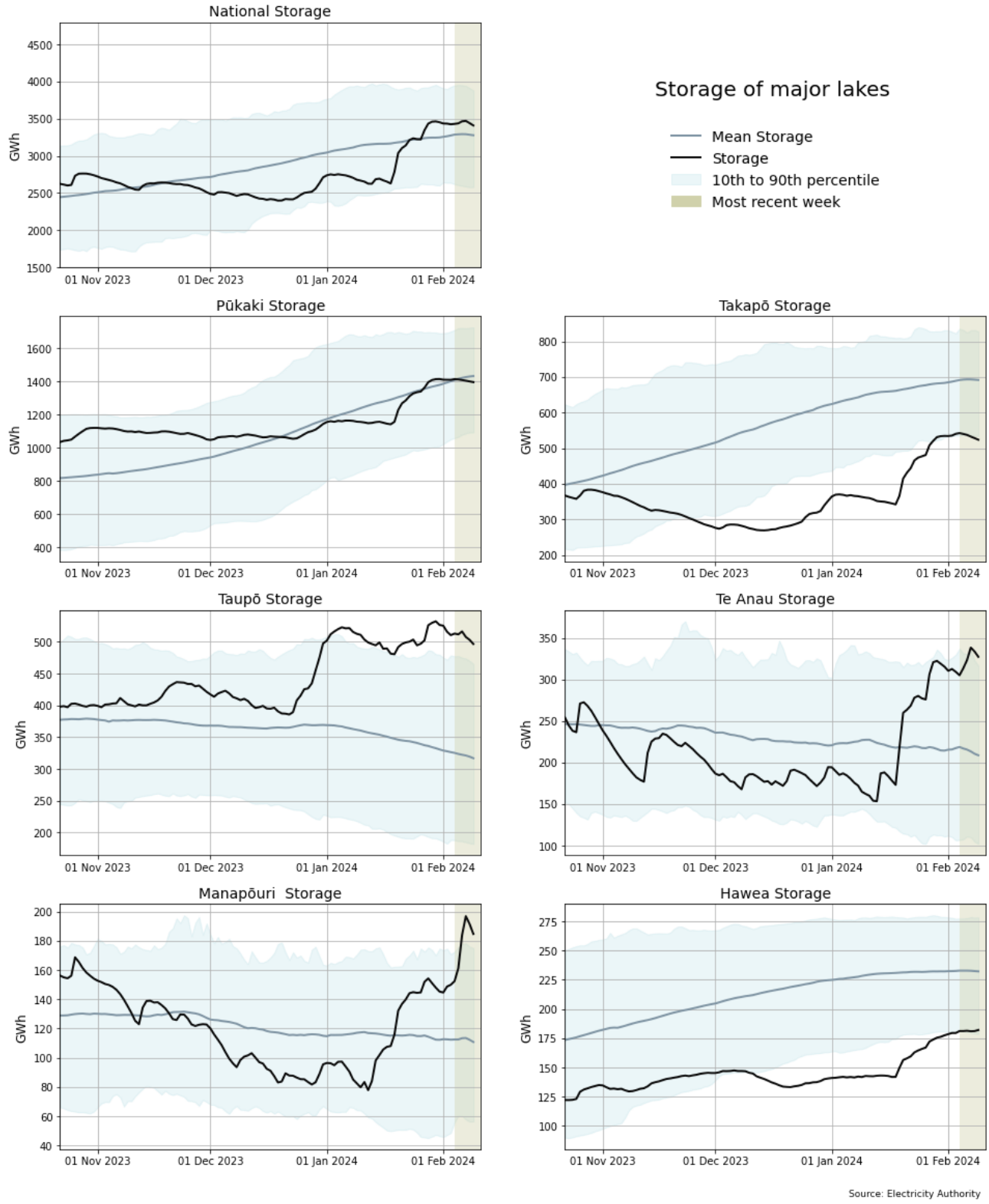
9. Storage/fuel supply

9.1. Figure 17 shows the 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 controlled storage decreased this week, but it is still above the average level, now sitting at 84% nominally full and ~103% of the historical average for this time of the year (as of 10 February).

9.3. Storage levels decreased over the week at all lakes except Hawea. Despite this, Taupō storage remains high at over 500GWh. Pūkaki storage decreased slightly and now sits just below its historical average for this time of the year. Takapō storage decreased and remains below its 10th percentile. Manapōuri and Te Anau are still above their 90th percentiles.

Figure 17: Hydro storage

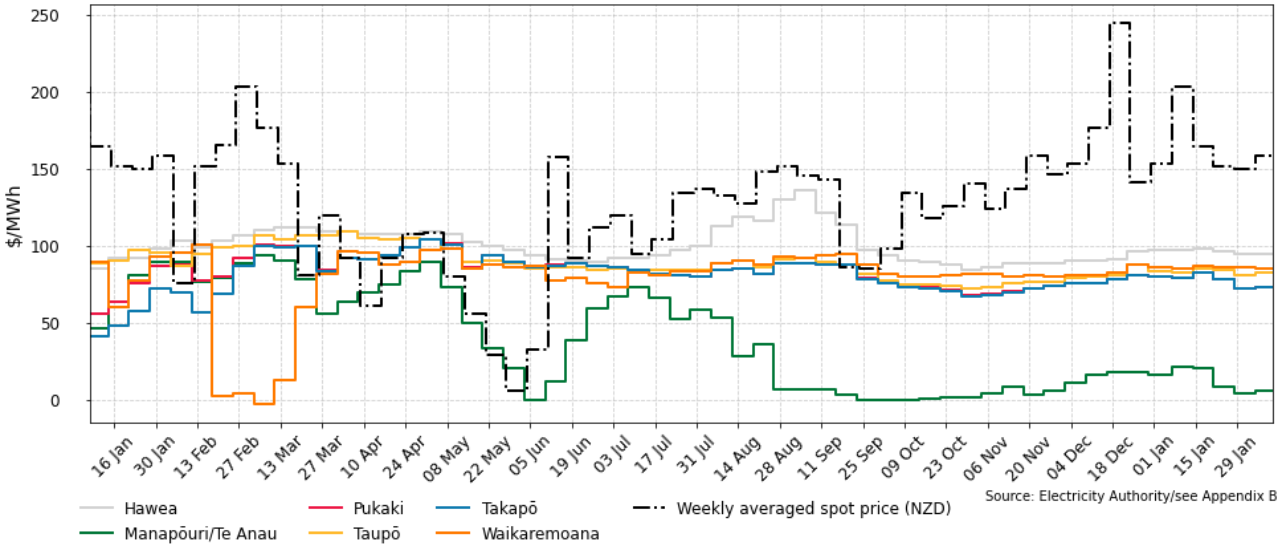


10. JADE water values

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. Figure 18 shows the national water values between 4-10 February 2024 obtained from JADE calculated as at the start of the week. 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 B.

10.2. There were small increases to water values across most lakes of around $1-$2/MWh.

Figure 18: JADE water values across various reservoirs between 8 January 2023 and 10 February 2024



11. Prices 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 19 shows an estimate of thermal SRMCs as a monthly average up 1 February 2024. The SRMC for coal and diesel have not seen much change from the previous month. The gas SRMC has seen some decreases although it remains relatively high.

11.4. The latest SRMC of coal-fueled Rankine generation is ~$159MWh. This is now similar to the cost of running the Rankines on gas at ~$156/MWh, whereas the coal SRMC was lower than gas the previous month.

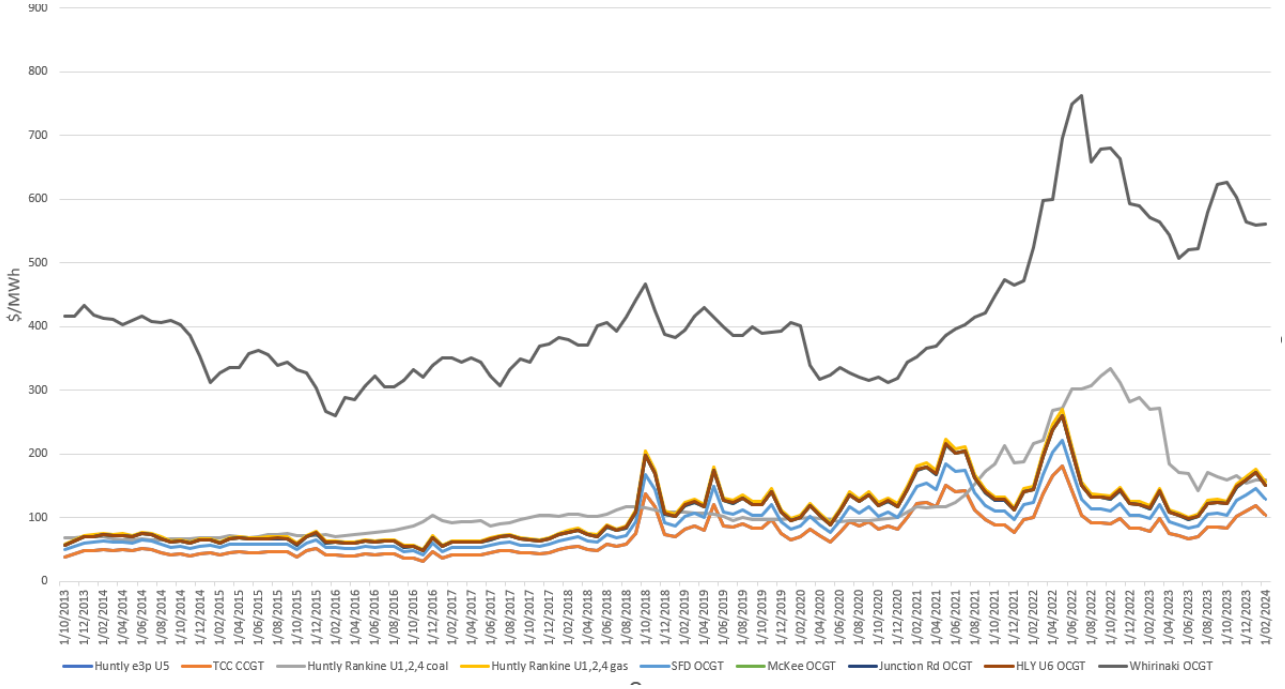
11.5. The SRMC of gas fueled thermal plants is currently between $105/MWh and $156/MWh.

11.6. The SRMC of Whirinaki is ~$560/MWh.

[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.

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

Figure 19: Estimated monthly SRMC for thermal fuels



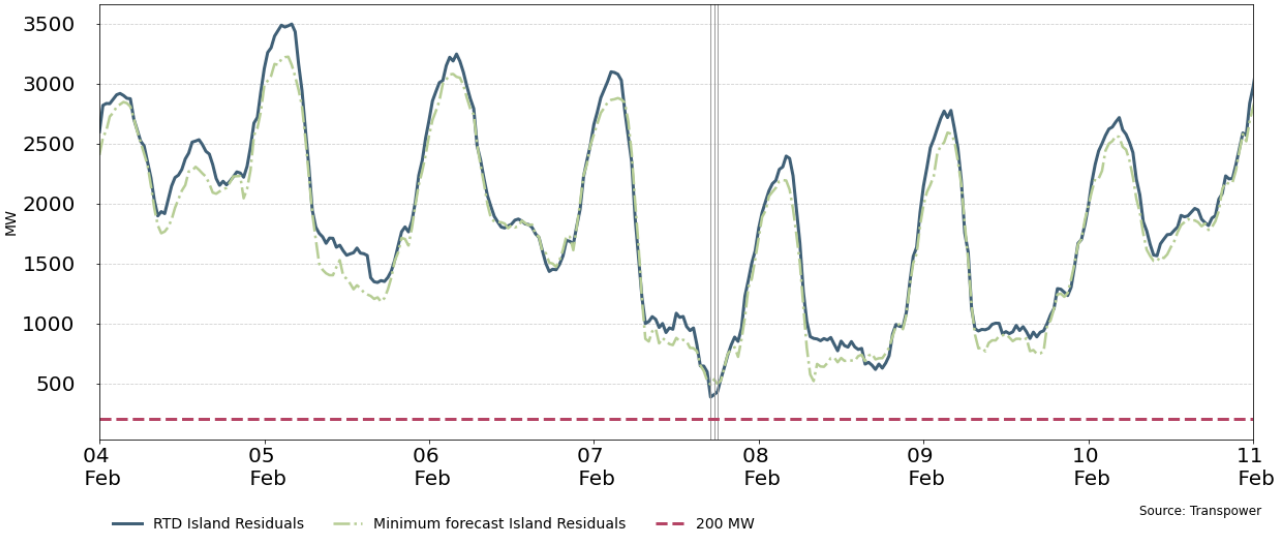
Source: Electricity Authority/see Appendix C

12. Generation balance residuals

12.1. Figure 20 shows the generation balance residuals between 4-10 February. The red dashed line represents the 200MW residual mark which is the threshold at which Transpower issues a customer advice notice (CAN) for a low residual situation. The green dashed line represents the forecast residuals and the blue the real time dispatch (RTD) residuals.

12.2. Generation residuals were mainly healthy during the week, reaching a minimum of 385MW during the price spike, above the 200MW residual mark.

Figure 20: Generation balance residuals 28 January - 3 February



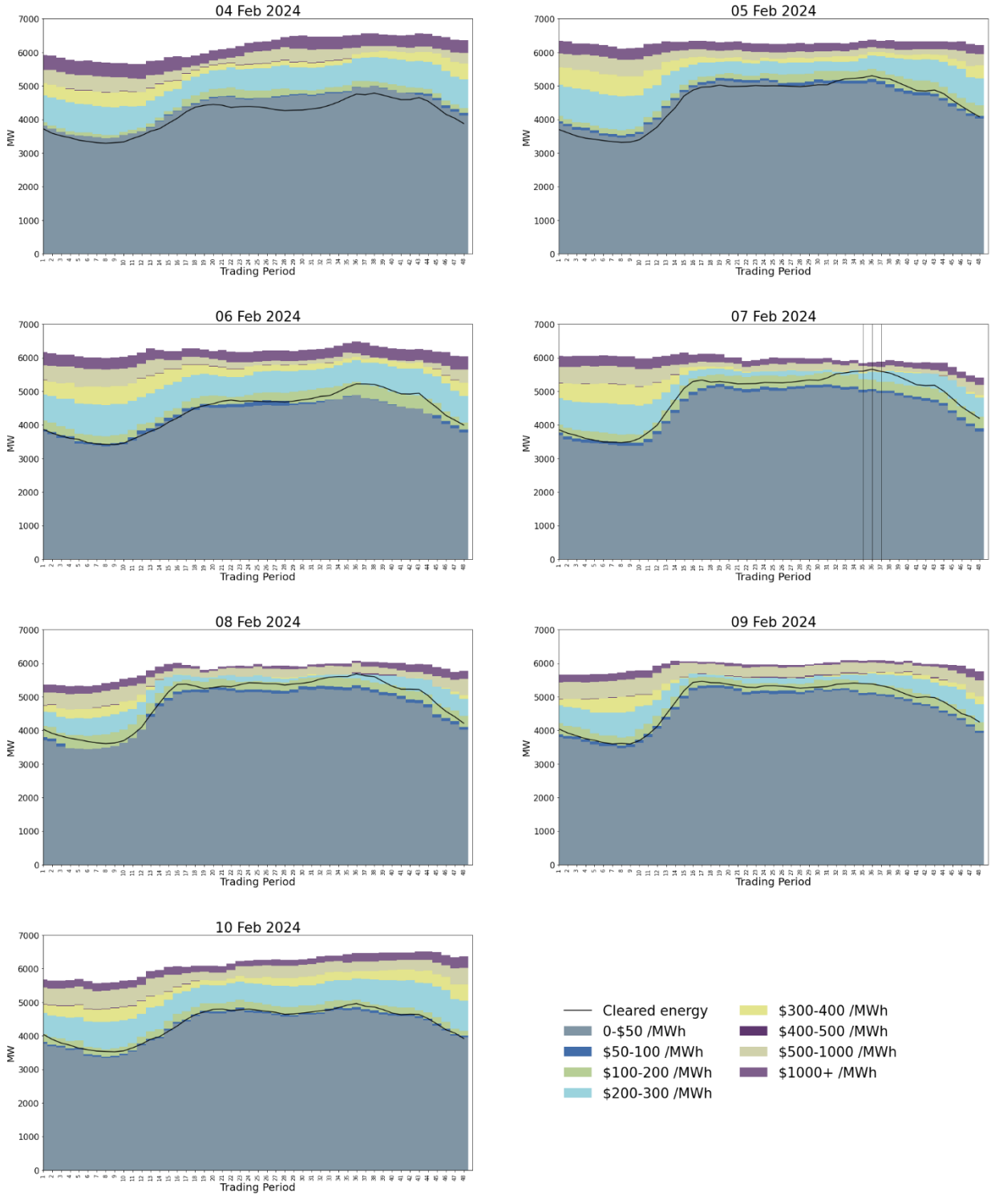
13. Offer behaviour

13.1. Figure 21 shows this week's national daily offer stacks. The black line shows cleared energy, indicating the range of the average final price.

13.2. At the beginning of the week lower demand and higher wind generation saw offers clear in the $0- $50/MWh range. The rest of the week saw offers clear in the $50- $200/MWh range.

13.3. On Wednesday when prices spiked the total offers were lower than other days likely due to an increase in generation outages on this day. Offers cleared in the $500-$1000/MWh band during these trading periods.

Figure 21: Daily Offer stacks[3]



Source: Electricity Authority

[3] PRSS data has been used for trading periods where RTD data was not available. These stacks will be highlighted within the offer stack and may be slightly higher than the adjusted offers.

14. Ongoing work in trading conduct

14.1. This week, prices generally appeared to be consistent with supply and demand conditions.

14.2. 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	Participant	Location	Enquiry topic
14/06/2023-15/06/2023	15-17/ 15-19	Passed to Compliance	Genesis	Multiple	High energy prices associated with high energy offers.
22/09/2023-30/09/2023	Several	Further analysis	Contact	Multiple	High hydro offers.
17/01/2024-19/01/2024	Several	Further analysis	Genesis, Contact	Multiple	High energy prices associated with high energy offers.
21/01/2024-27/01/2024	Several	Further analysis	Mercury	Waikato hydro dams	High hydro offers.
30/01/2024-01/02/2024	Several	Further analysis	Several	Multiple	High reserve prices related to reserve offers.