Trading Conduct Report

Market Monitoring Weekly Report

1. Overview for the week of 3 to 9 April

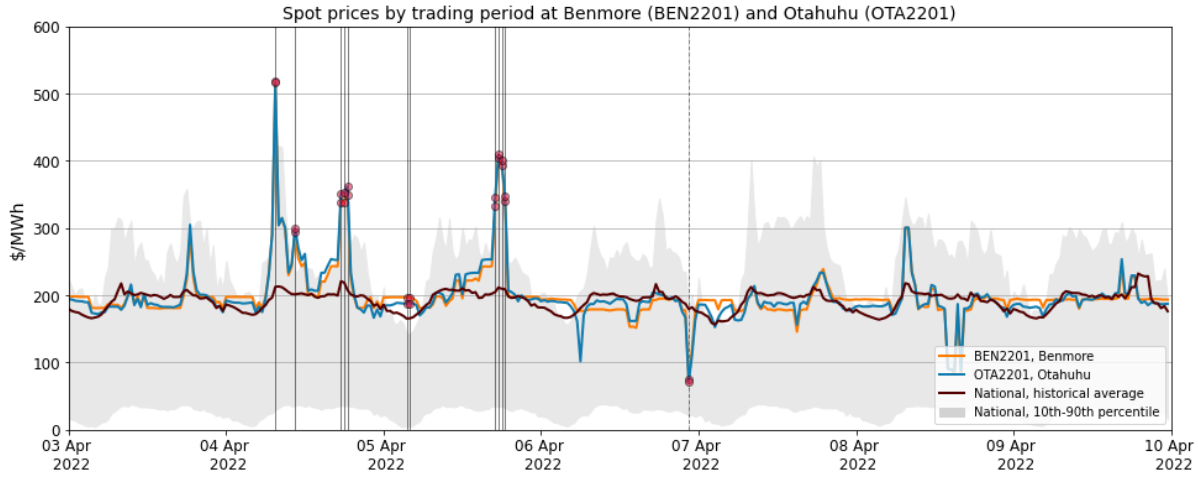
1.1. Wholesale spot prices this week appear to be consistent with supply and demand conditions.

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 marked out by vertical lines. Prices at all nodes for this period averaged $333.09/MWh.

2.2. Prices in the past week were influenced by slightly higher peak demand, periods of low wind generation which caused extra hydro generation to be dispatched, and a 100 MW outage at Kawarau.

Figure 1: Wholesale Spot Prices



2.3. The highest (when Benmore or Otahuhu exceeds their historical 90th percentile) priced trading periods for this week are listed below in Table 1.

Table 1: High Priced Periods

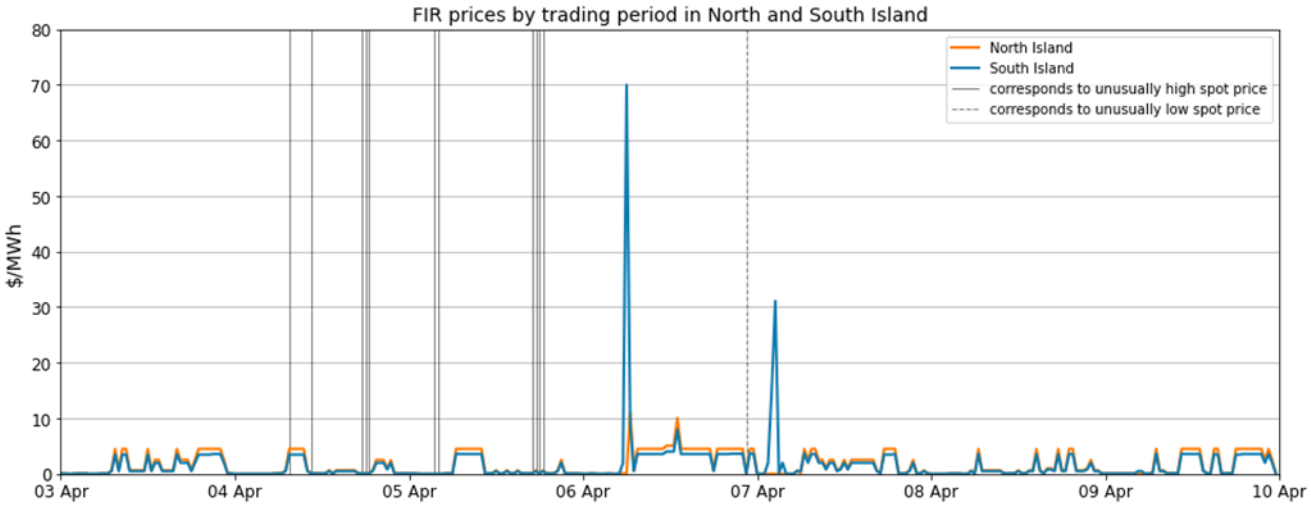
Datetime	Hist. Mean	10th percentile	90th percentile	Benmore	Otahuhu
4/04/2022 7:30	212.55	30.28	420.18	517.85	517.14
4/04/2022 10:30	201.44	35.73	234.11	294.06	300.06
4/04/2022 17:30	220.79	36.54	345.63	338.35	351.47
4/04/2022 18:00	218.78	35.24	360.58	338.23	352.02
4/04/2022 18:30	207.63	36.20	342.91	348.37	362.23
5/04/2022 3:30	165.36	4.41	143.69	197.01	187.82
5/04/2022 4:00	165.69	4.93	143.00	197.05	187.14
5/04/2022 17:00	204.75	33.93	322.14	332.99	345.89
5/04/2022 17:30	211.59	34.43	344.60	404.51	409.70
5/04/2022 18:00	209.67	35.06	343.88	392.40	400.50
5/04/2022 18:30	209.01	32.99	352.93	340.45	347.60

2.4. The highest price for the week at Benmore was $517.85/MWh on trading period 16, 4 April. The highest price for the week at Otahuhu was $517.14/MWh on trading period 16, 4 April.

3. Reserve Prices

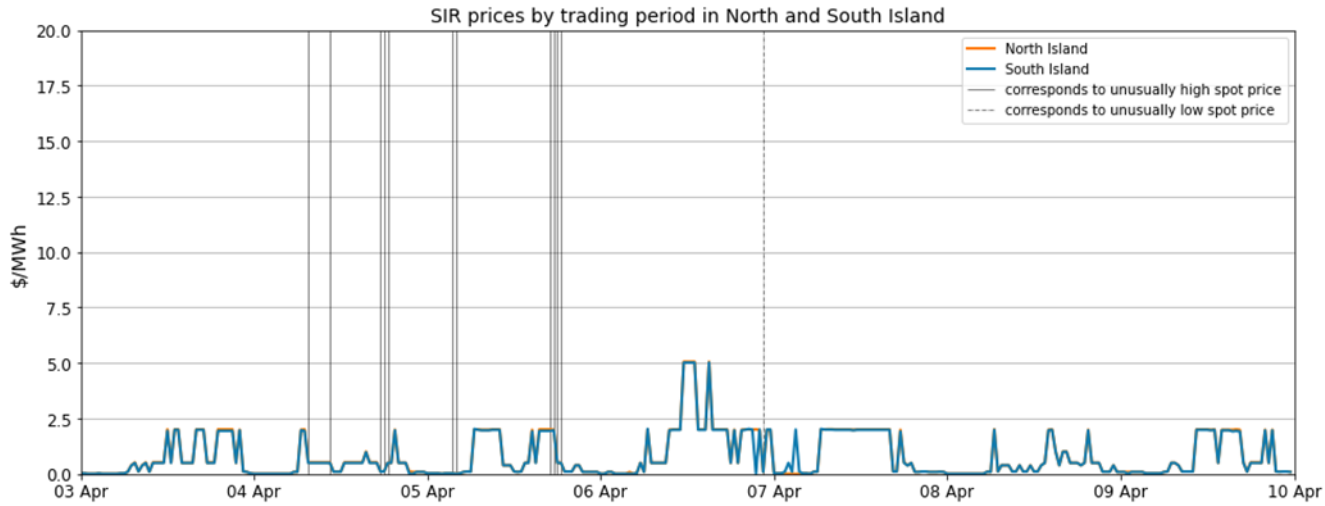
3.1. Fast instantaneous reserves (FIR) prices this week as seen in Figure 2, similarly to the previous week, tended to remain below $20/MWh, with occasional price spikes to around ~$70/MWh.

Figure 2: FIR prices by trading period and Island



3.2. Sustained instantaneous reserves (SIR) prices this week as seen in Figure 3, similarly to the previous week, tended to remain below $10/MWh.

Figure 3: SIR prices by trading period and Island

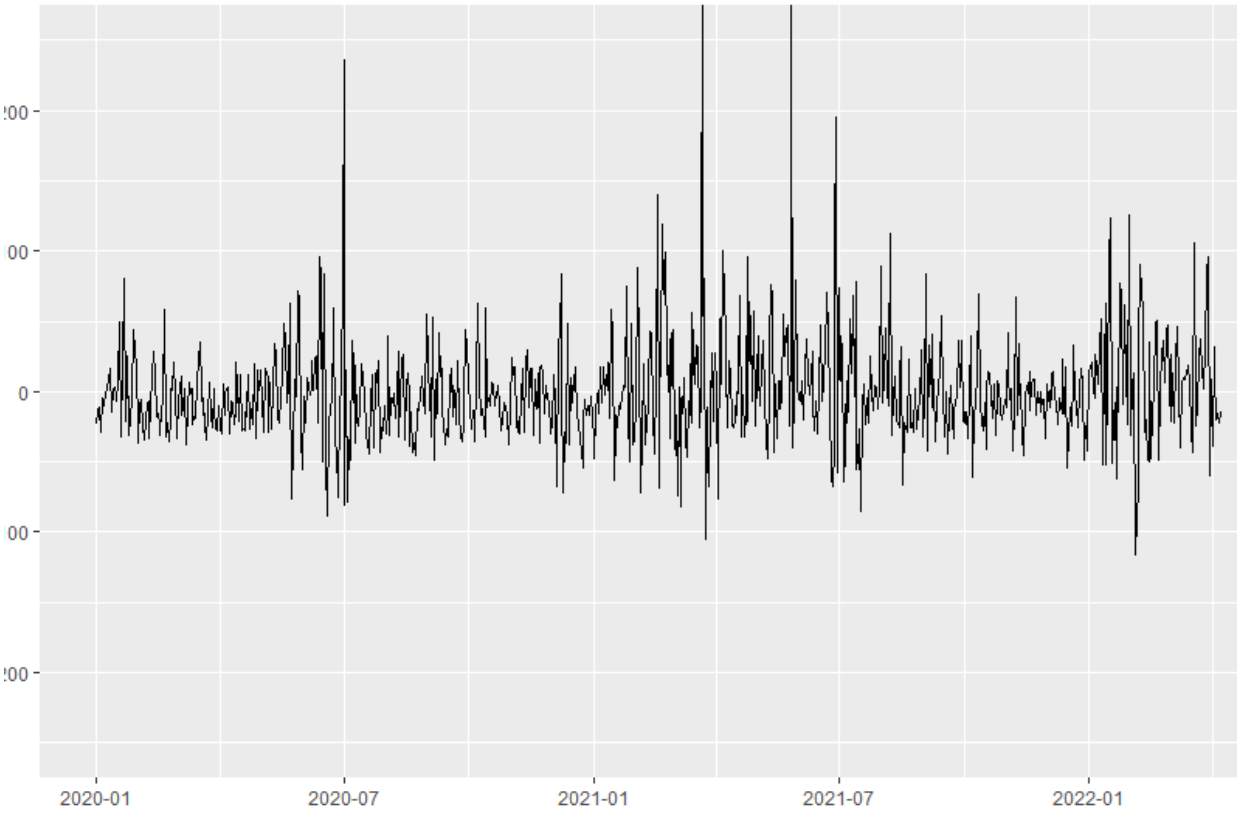


4. Regression Residuals

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 were relatively stable this week. On 4 April, the highest residual correlated with the highest spot price of the week.

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

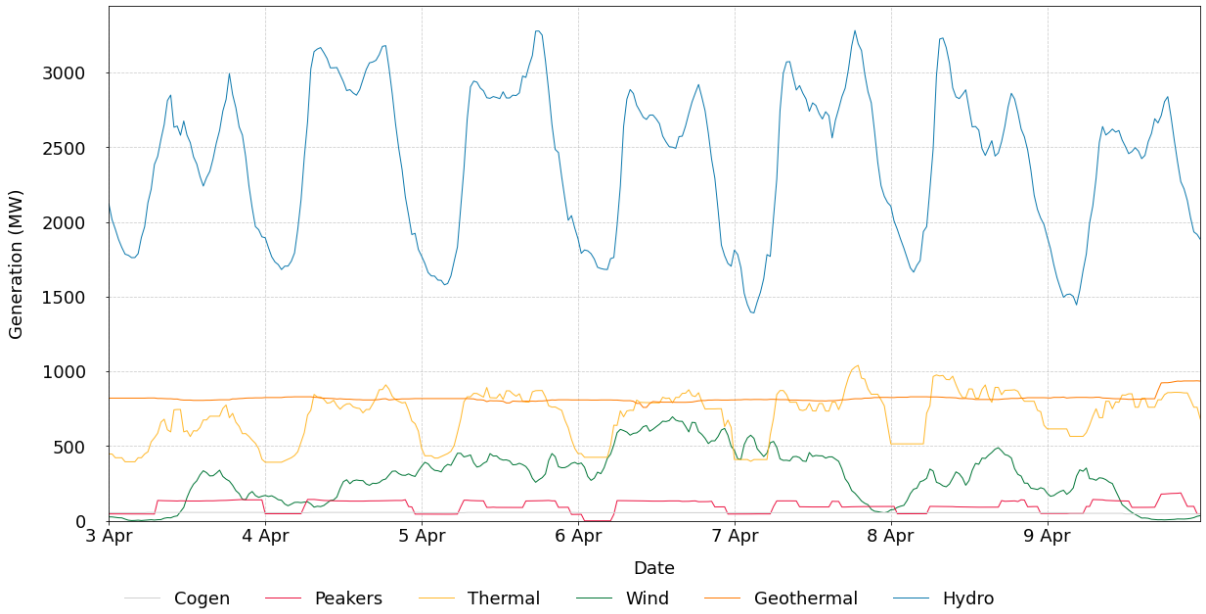


5. High Prices

5.1. Price separation occurred twice on Monday evening and on Thursday morning in the lower South Island, most likely due to work on CUWLP.

5.2. High prices, which were above $550/MWh, on Monday morning, occurred during a period of low wind, peak demand, decreased thermal output from TCC still being on outage and decreased geothermal output, due to a 100 MW outage at Kawerau as seen in Figure 5 which shows generation by fuel.

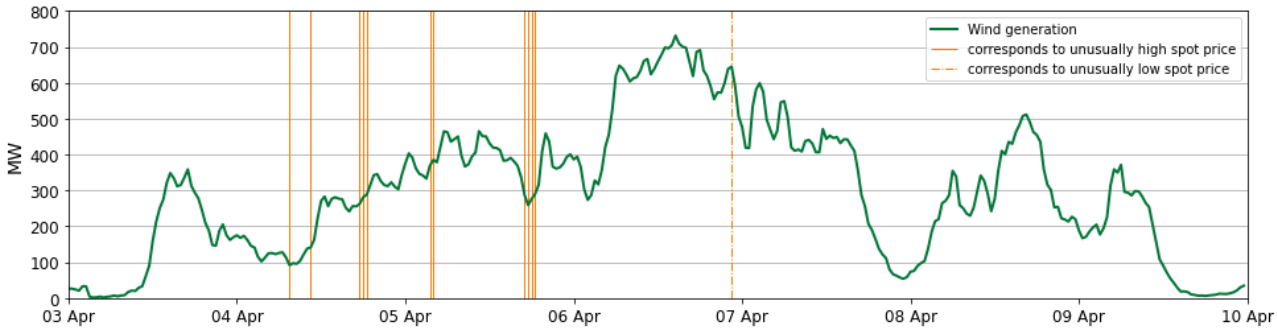
Figure 5: Generation by Fuel



5.3. High prices, above $400/MWh, on Tuesday evening occurred during peak demand as North Island wind generation dipped, after generating above 300 MW at 3pm, down to 221 at 6pm. To compensate North Island hydro generation – currently priced highly due to low hydro storage - increased its output from 1,075 MW at 4:30 pm to 1,264 MW at 5:45 pm. Thermal peakers also stepped up from 90 MW to 135 MW.

5.4. Prices above $300/MWh, occurred on Friday morning, during peak demand, which coincided with lower North Island wind generation (220 MW at 7am) as seen in Figure 6 which shows wind generation. This caused North Island hydro to ramp up from 900 MW at 7am to 1,200 MW at 8am.

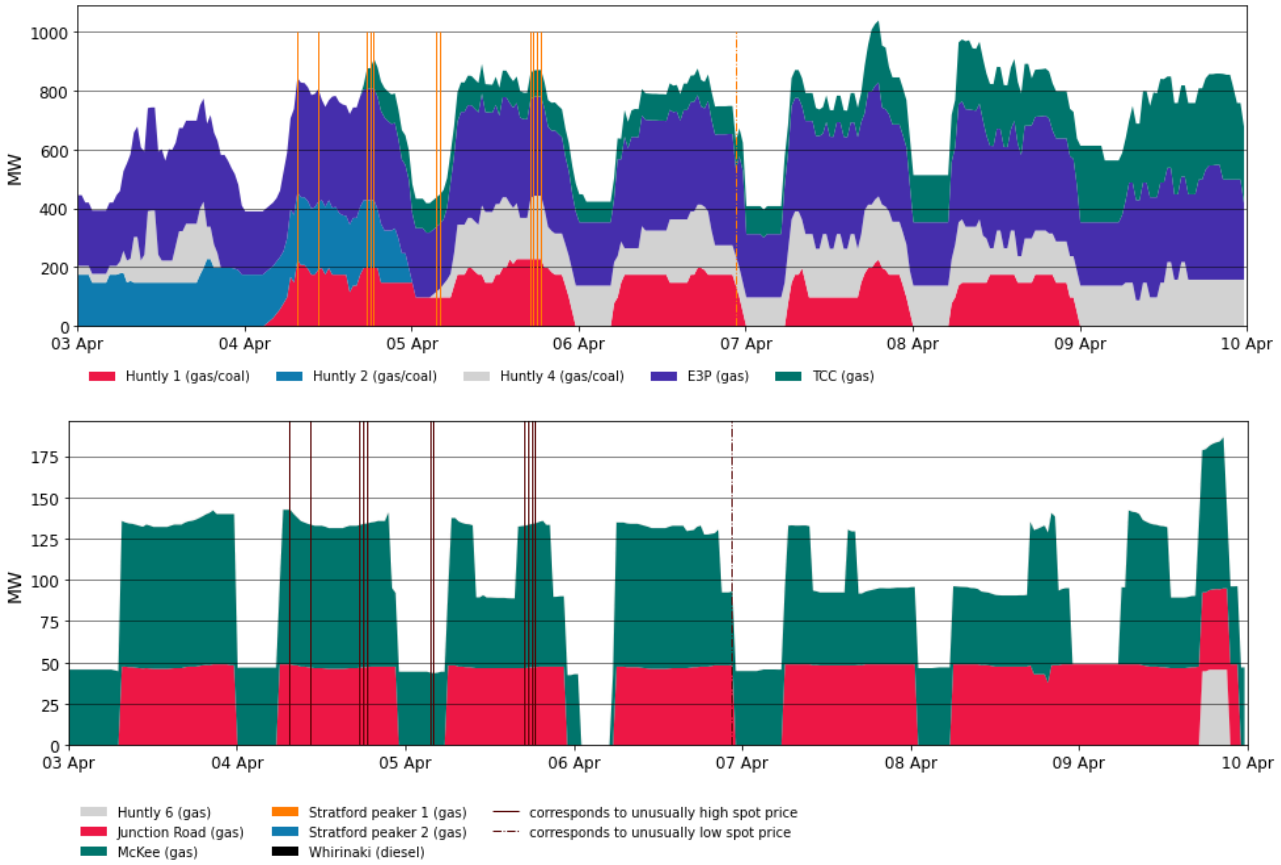
Figure 6: Wind Generation



5.5. Figure 5 shows thermal generation between 3 to 9 April 2022. Peaker usage was relatively constant on Monday and Wednesday at roughly 130 MW. Whilst on Tuesday, Thursday and

Friday peakers ran at roughly 90 MW, with higher use during morning or evening peak demand. Saturday saw Huntly 6 dispatched during evening peak demand.

Figure 5: Thermal Peaker Usage



5.6. Figure 7 shows national grid demand between 3 to 9 April 2022, compared to the previous week. Daytime demand was relatively similar to the previous week, however, the evening peaks were generally higher. The morning peak on Friday was also higher. This is likely due to the cooler temperatures as indicated in Figure 8, and decreased evening sunlight hours from daylight savings.

Figure 7: Daily Grid Demand

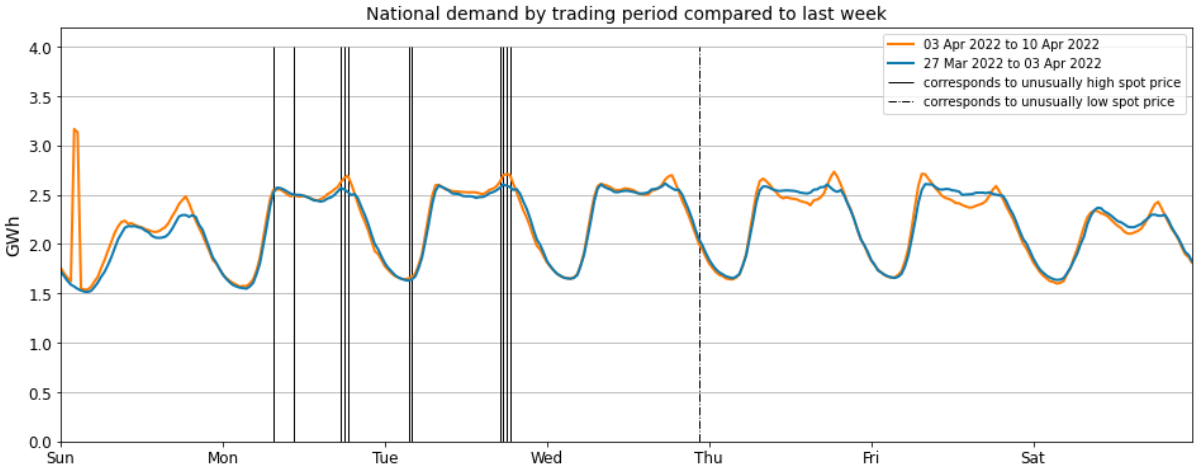
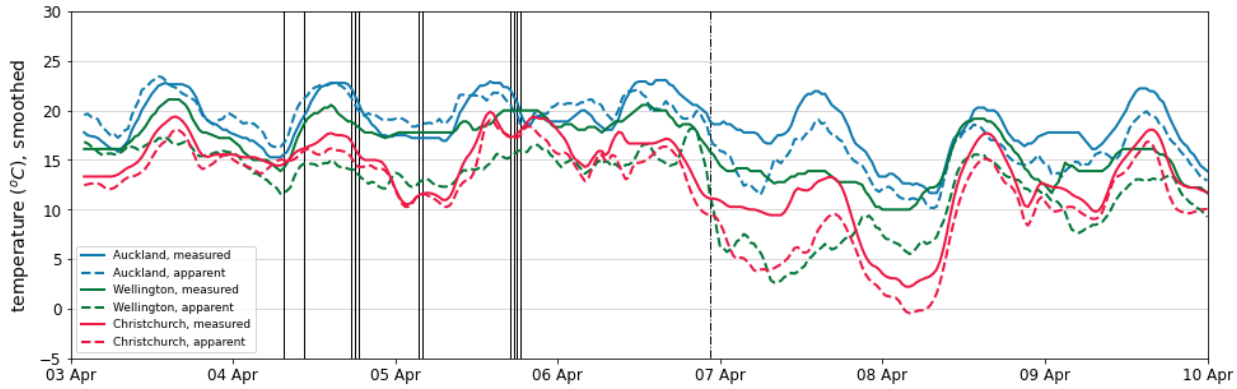


Figure 8: Temperature



5.7. Figure 9 shows generation capacity lost due to outages between 3 to 9 April by fuel type. Geothermal outages have increased from Kawerau. Thermal outages have decreased.

5.8. Figure 10 shows the decrease comes from the return of TCC. TCC returned from outage on mid-4 April though Contact has advised of an operational issue with the heat recovery unit which may limit its ability to generate in combined cycle mode. TCC can operate for 2000 hours on combined cycle operation (360MW) and then can run on open cycle (100MW). TCC can operate continuous at 360MW from the 4 April until 16 July. However, from 17 July to 21 August it will not generate at all.

Figure 9: Generation Outages

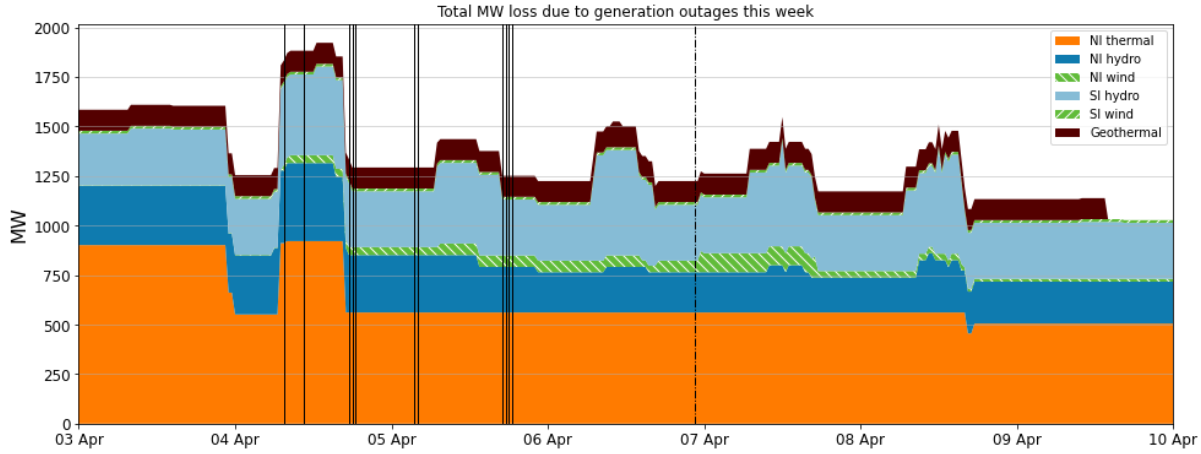
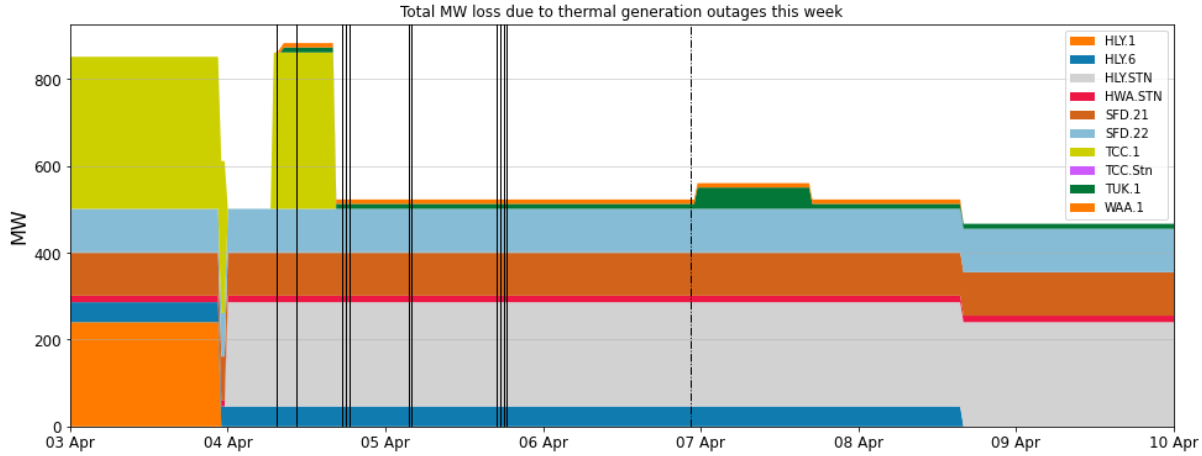


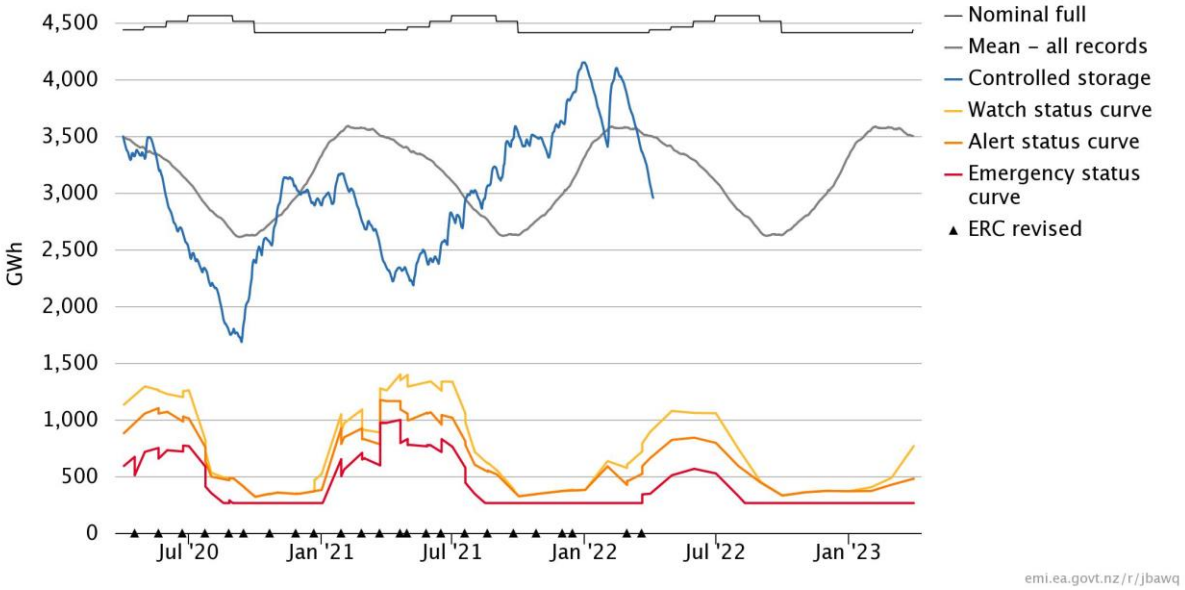
Figure 10: Thermal Outages



6. Storage/Fuel Supply

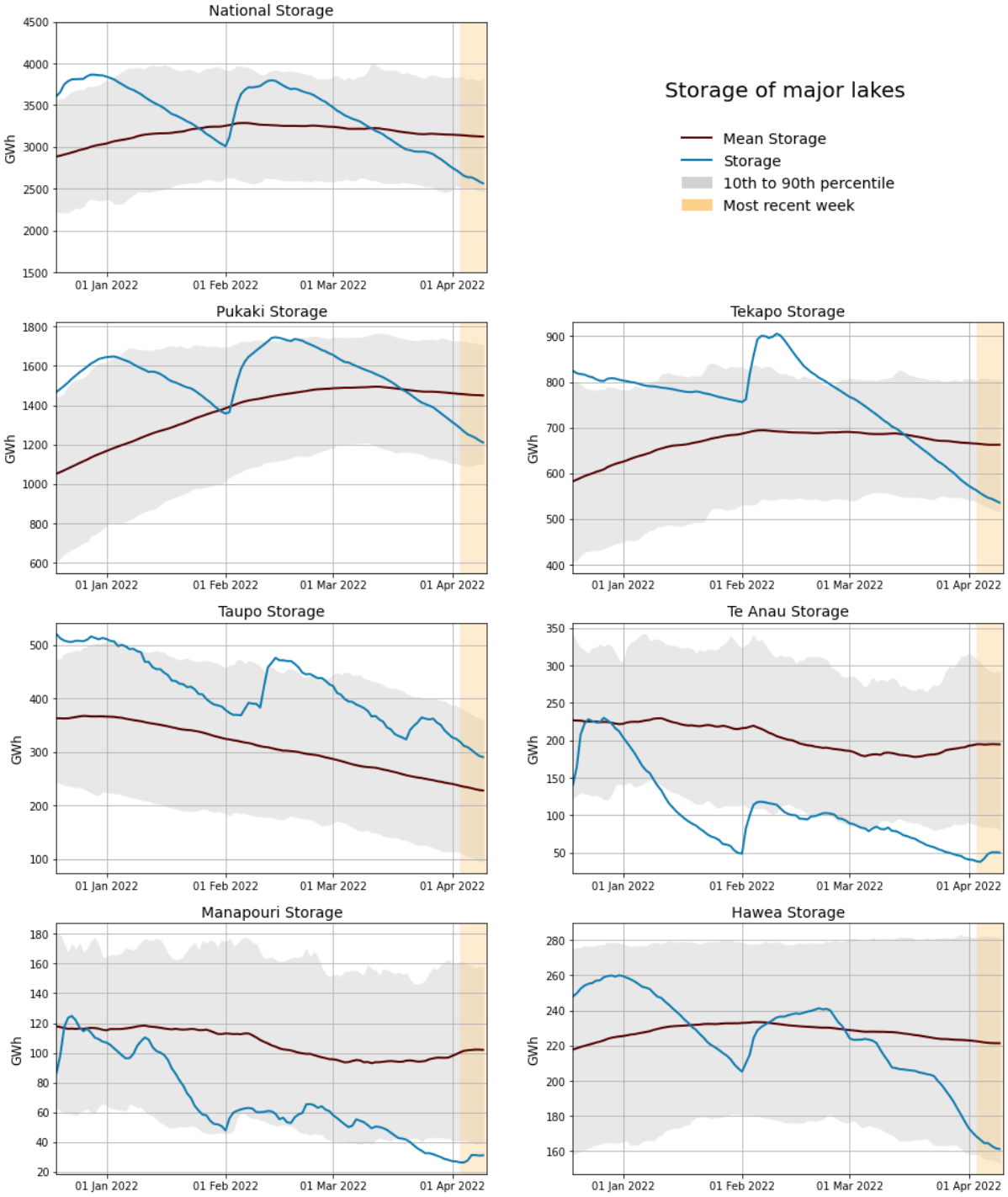
6.1. Total national controlled hydro storage shown in Figure 11 was 2,956 GWh on 5 April 2022. This is 84 per cent of the all-time mean (3,493 GWh) and 67 per cent of nominal full (4,437 GWh).

Figure 11: Total Controlled Hydro Storage



6.2. Figure 12 shows the individual level of the major lakes for the year to date. Below average inflows across the country have contributed to hydro storage dropping. All lakes shown here are below their historical average, bar Taupo. Manapouri and Te Anau are below their 10 per cent percentile. Pukaki and Tekapo are close to their 10th per cent percentile.

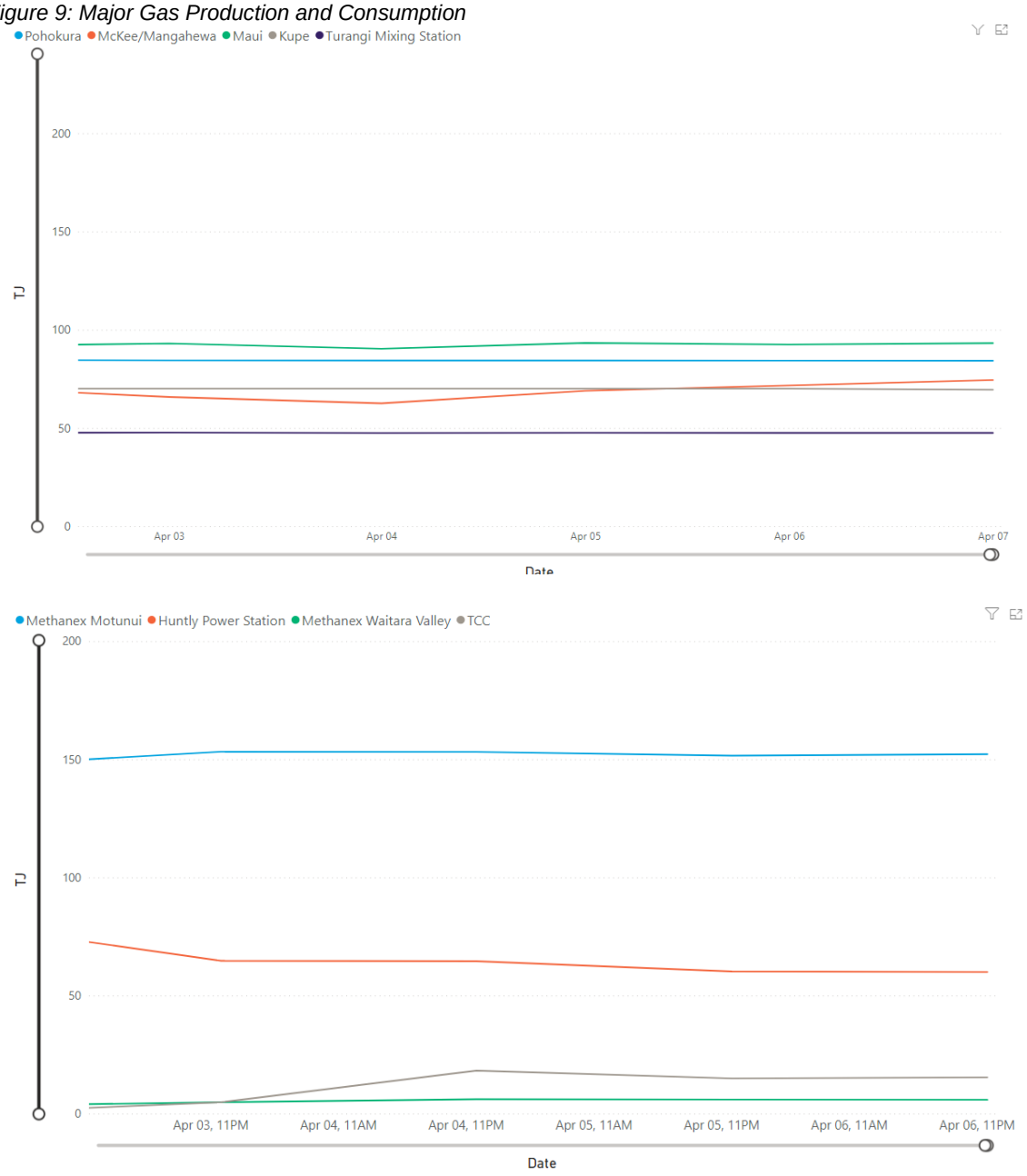
Figure 12: Individual Lake Storage



6.3. Gas production and consumption from 3 to 9 April is shown in Figure 9. Total gas production from major fields was steady at ~ 360 TJ/day. This is roughly 20 TJ/day less than in late March.

6.4. Methanex had steady consumption at roughly ~150 TJ/ day. Huntly reduced its consumption by 20 TJ/ day between April 3 to 7. TCC returned from outage on Tuesday and began using between 15- 20 TJ/ day.

Figure 9: Major Gas Production and Consumption



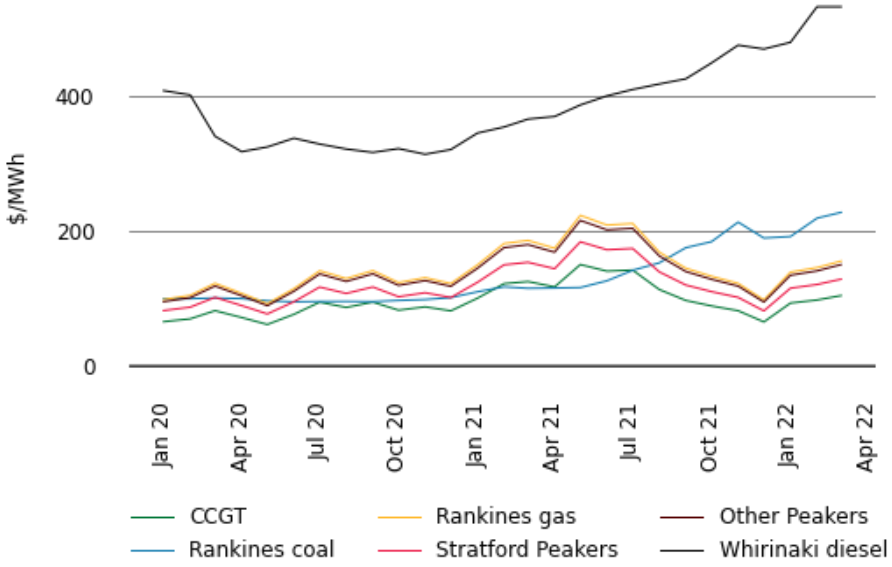
7. Price versus estimated costs

7.1. 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).

7.2. 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. Figure 13 shows an estimate of thermal SRMCs as a monthly average. The thermal SRMC of gas increased in January and February, likely due to the increase in gas consumption.

7.3. The SRMC of coal and diesel both increased due to global supply and demand conditions and remain high. Note that the SRMC calculations include the carbon price, an estimate of operational and maintenance costs, and transport for coal. Indonesian coal prices are currently around US$200/tonne and carbon prices on the secondary market are currently averaging ~$75/tonne.

Figure 13: Estimated monthly SRMC for thermal fuels



8. JADE Water values

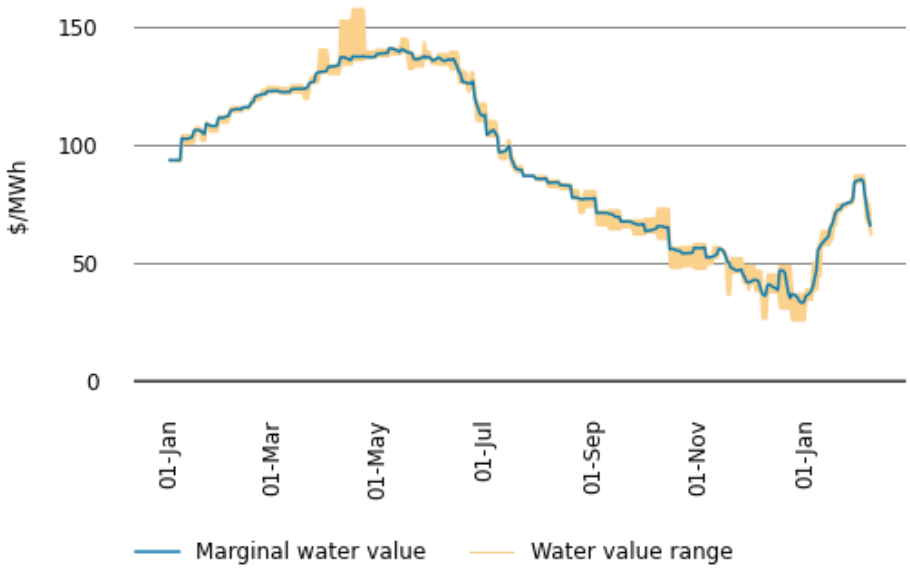
8.1. The JADE[1] model gives a consistent measure of the opportunity cost of water, by seeking to minimise the expected fuel cost of thermal generation and the value of lost load and provides an estimate of water values at a range of storage levels. Figure 14 shows the national water values[2] to 20 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.

8.2. 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



9. Offer Behaviour

9.1. Figure 15 shows this week's high priced period offer stacks. High thermal costs and increased hydro costs have created steep offer curves.

9.2. Factors contributing to high prices on 4 April for trading periods 16 and 22 were low wind generation, peak daily demand and thermal and geothermal outages.

9.3. Factors contributing to high prices on 4 April for trading periods 36 to 38 were decreasing wind generation and peak daily demand. Prices were also fairly close to the normal 90th percentile price range.

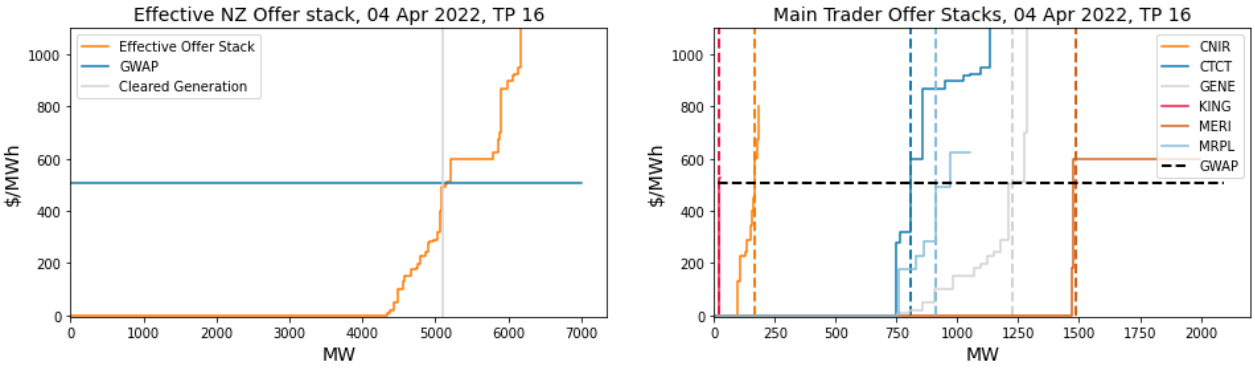
9.4. Prices on April 5 for trading periods 8 and 9 though above the historical 90th percentile were in line with prices that morning and so were not unusually high in the context of prices that day.

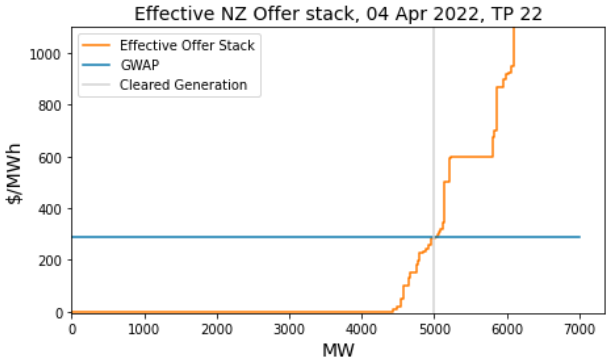
9.5. Factors contributing to high prices on 5 April for trading periods 35 to 38 were decreasing wind generation and peak daily demand.

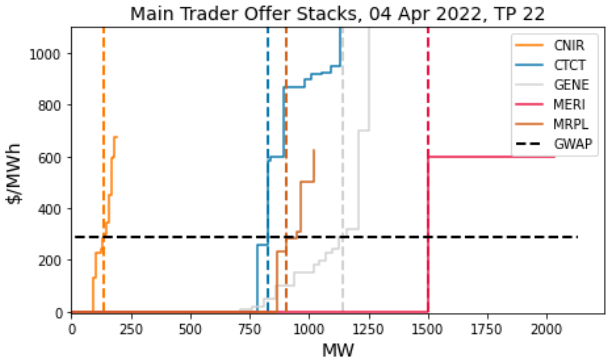
9.6. The pre-dispatch offers in the short term lead up to high prices showed no changes that would suggest generators were trying to take advantage of market conditions.

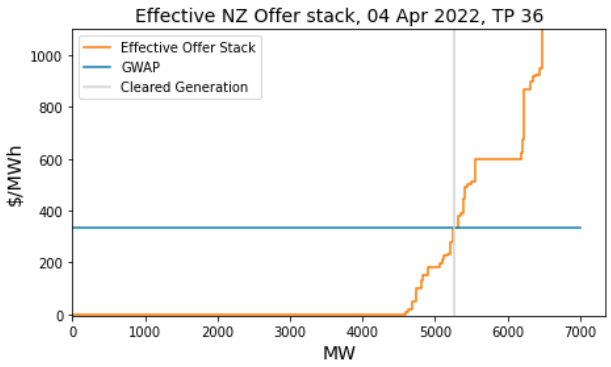
9.7. Overall high priced periods appear to be consistent with market conditions.

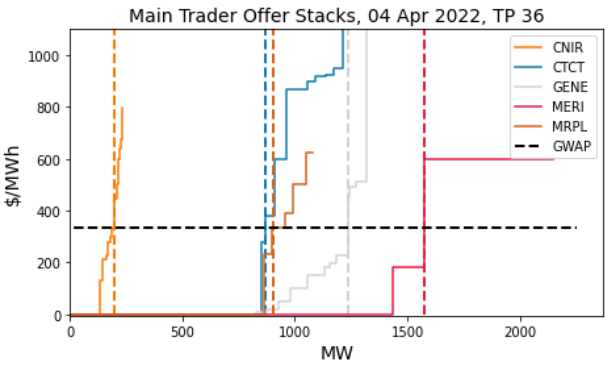
Figure 15: Offer Stacks

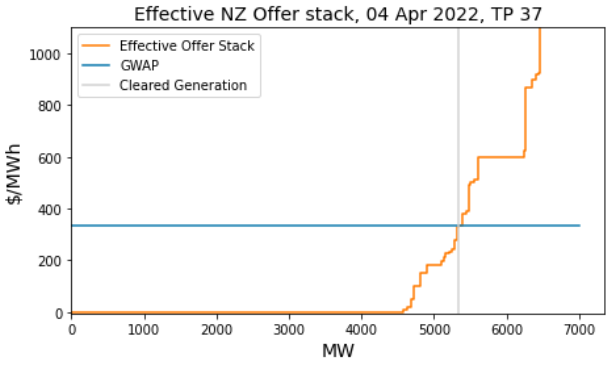


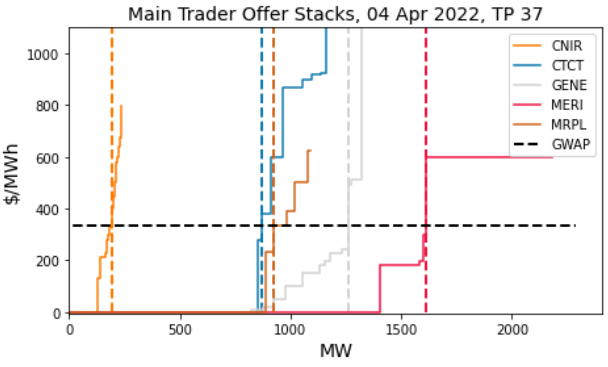

Effective NZ Offer stack, 04 Apr 2022, TP 22
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW

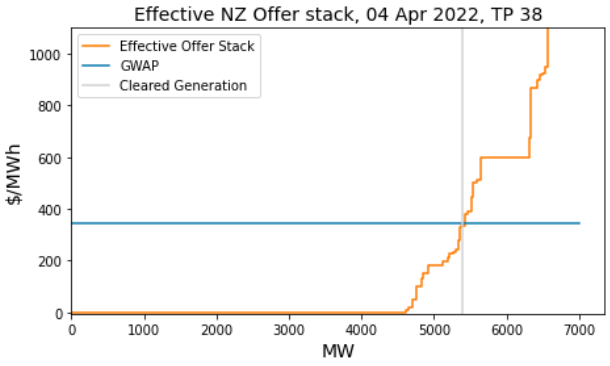

Main Trader Offer Stacks, 04 Apr 2022, TP 22
CNIR
CTCT
GENE
MERI
MRPL
GWAP
$/MWh
MW

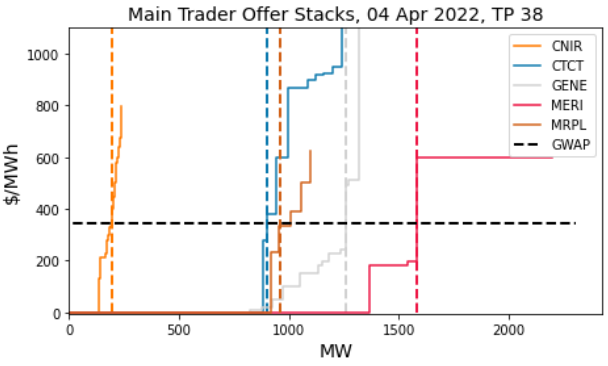

Effective NZ Offer stack, 04 Apr 2022, TP 36
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW

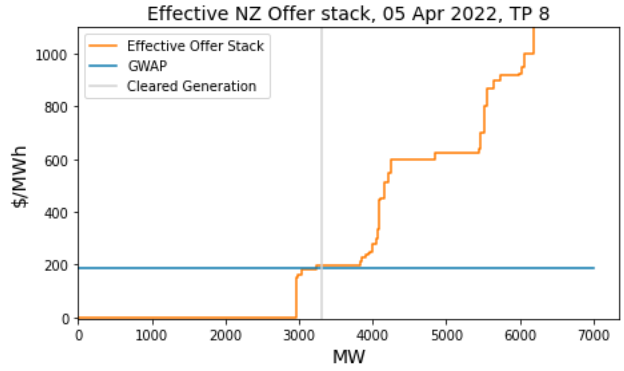

Main Trader Offer Stacks, 04 Apr 2022, TP 36
CNIR
CTCT
GENE
MERI
MRPL
GWAP
$/MWh
MW

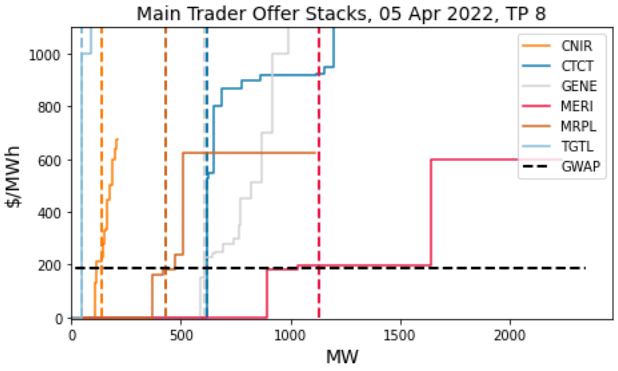

Effective NZ Offer stack, 04 Apr 2022, TP 37
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW


Main Trader Offer Stacks, 04 Apr 2022, TP 37
CNIR
CTCT
GENE
MERI
MRPL
GWAP
$/MWh
MW


Effective NZ Offer stack, 04 Apr 2022, TP 38
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW


Main Trader Offer Stacks, 04 Apr 2022, TP 38
CNIR
CTCT
GENE
MERI
MRPL
GWAP
$/MWh
MW


Effective NZ Offer stack, 05 Apr 2022, TP 8
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW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CNIR
CTCT
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MERI
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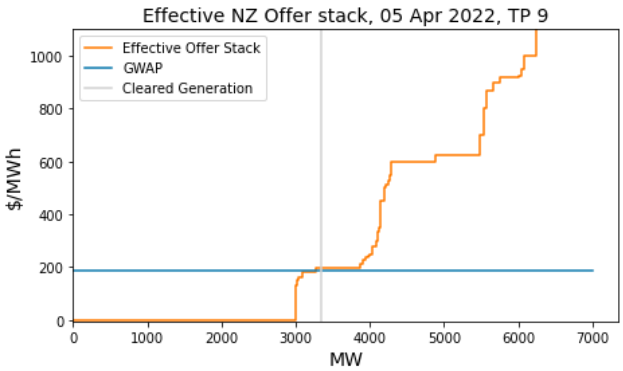
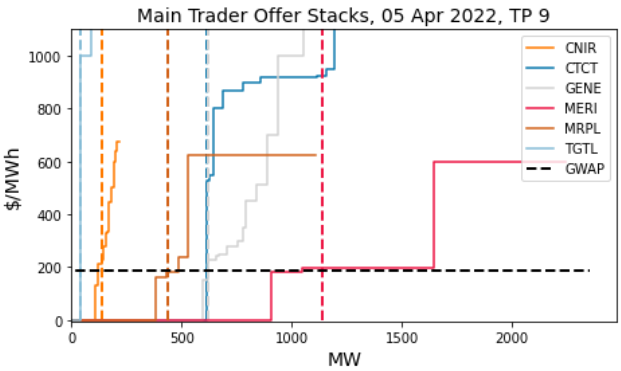
TGTL
GWAP
$/MWh
MW


Effective NZ Offer stack, 05 Apr 2022, TP 9
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW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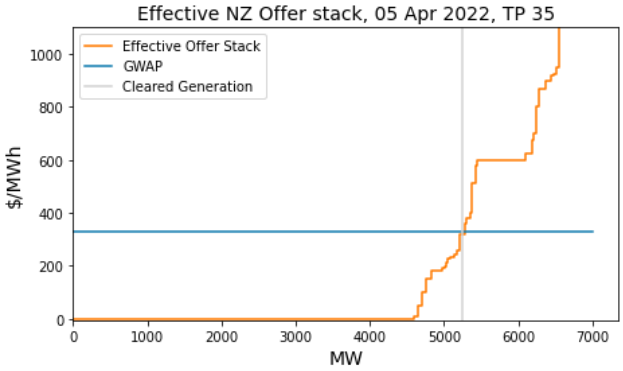
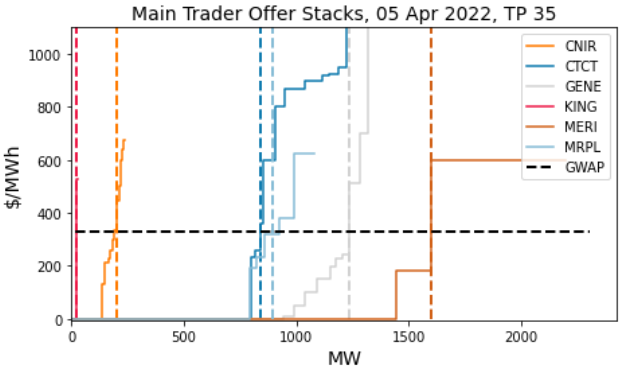
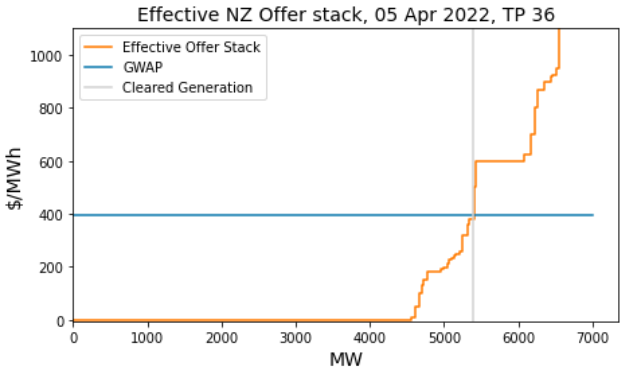
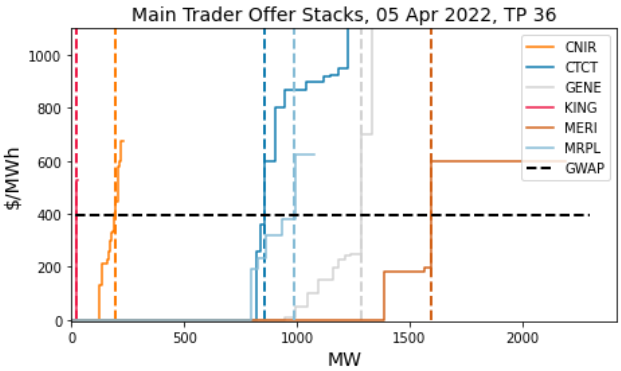
TGTL
GWAP
$/MWh
MW


Effective NZ Offer stack, 05 Apr 2022, TP 35
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW


Main Trader Offer Stacks, 05 Apr 2022, TP 35
CNIR
CTCT
GENE
KING
MERI
MRPL
GWAP
$/MWh
MW


Effective NZ Offer stack, 05 Apr 2022, TP 36
Effective Offer Stack
GWAP
Cleared Generation
$/MWh
MW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CNIR
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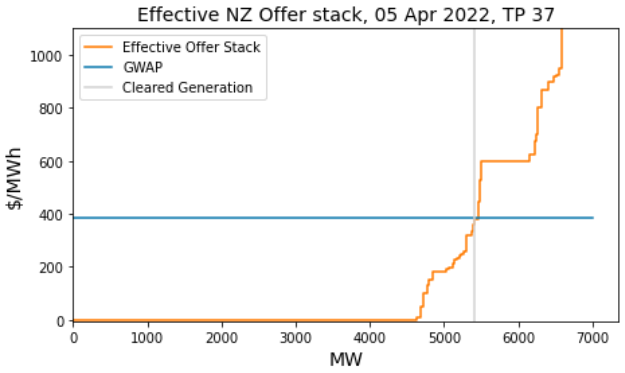

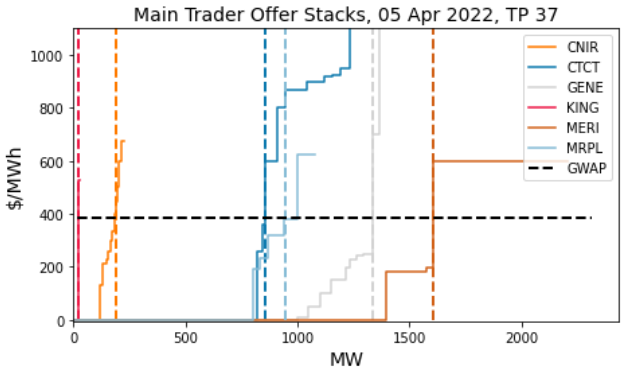

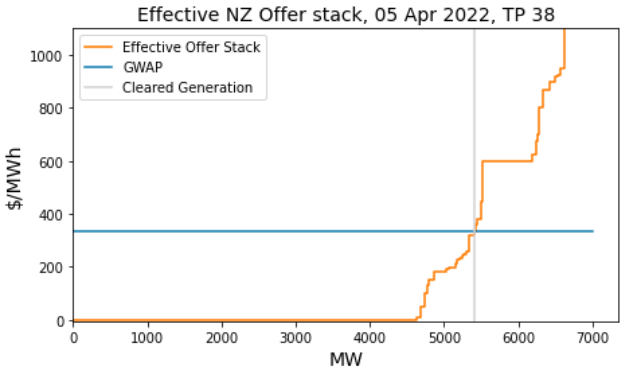

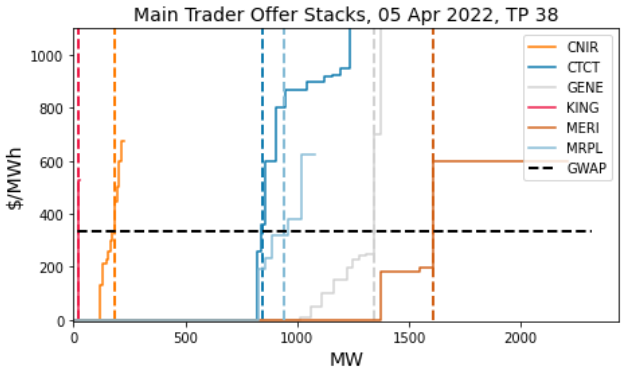

10. Ongoing Work in Trading Conduct

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

10.2. New information has been obtained regarding apparent unusual activity at Huntly between 29 March and 2 April and resolved without need for further action.

10.3. Further information has also been received regarding trading period 6 on 3 March, trading period 5 on 4 March and trading period 7 on 5 March and has been resolved.

Table 2: Trading periods identified for further analysis

Date	TP	Status	Notes
29/03-02/04	14-37	Resolved	Observed fluctuations were due to tuning and optimisation testing as part of the unit 4 test program. https://www.genesisenergy.co.nz/about/media/news/statement-rankine-unit-4-test-programme
03/03-05/03	4-10	Further analysis	Branch constraint, high prices in lower South Island
03/03-05/03	6,5,7	Resolved	The high prices in the lower South Island were caused by an import stability branch constraint while LIV_NSY_1 circuit was on outage. Low lake levels caused lower generation in lower South Island while consumption at Tiwai remained relatively constant. This increased level of imported generation from North of the outage and has caused voltage stability issues. Generation offered at low prices in the impacted area was low, but further analysis has found no indication that this was intentional to increase prices, pre-dispatch prices were much lower than final prices and quantity offered was not changed. Instead, it is likely that the lower quantity offered at low prices in the early morning

			was due to low national demand and to conserve water for later in the day when demand was higher. The branch constraint caused an increase if generation dispatched in the lower South Island, which was priced high due to low lake levels, causing high prices.
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.
30/06/21-21/08/21	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.