ELECTRICITY AUTHORITY
TE MANA HIKO

Post implementation review of the trading conduct provisions

Executive summary

This Post Implementation Review (PIR) presents analysis aimed at assessing whether the new trading conduct provisions are having an impact on generator behaviour and market outcomes. To do this we have used the same framework as set out in the Market Monitoring Review of Structure Conduct and Performance in the Wholesale Electricity Market - Information Paper (WMR). That is, we use the Structure-Conduct-Performance (SCP) framework. The simple premise of the framework is that the structure of the market determines the conduct of its participants. The more competitive the structure, the more competitive the conduct of participants and the more efficient their performance.

The new trading conduct provisions came into effect on 30 June 2021. The new provisions require participants to ensure that their offers reflect the offers that would be made in a competitive market.

Based on our assessment of the conduct and performance indicators presented here and the findings in the Authority's proactive regular monitoring, the new provisions appear to be having an impact on generator behaviour. During the months analysed here, we found that prices tend to reflect underlying conditions. During some of these months, those conditions have resulted in prices which are higher than the historical average. Price separation has become more pronounced since the introduction of the provisions. There has been an increase in the frequency of very low prices. The percentage of high-priced offers has decreased, and offer prices appear to be reflecting underlying conditions and economic costs more closely. Of 22 issues identified for further analysis under the Authority's proactive regular monitoring, only three have been passed to the Compliance team (and a further three remain open with the Market Monitoring team).

Our analysis does not however provide a definitive conclusion on the impact of the new provisions. As discussed in the WMR, the results we have observed from these indicators do not tell us definitively whether prices have been competitively determined. However, while when viewed in isolation, any particular indicator may not be insightful, this analysis builds a picture of the market based on the set of indicators rather than focusing on any indicator individually.

We are also only examining a short time horizon (13 months), which may also contribute to the less definitive nature of the conclusions. It is also a short time period for any accumulation of case law to emerge. However, we felt it expedient to provide the results of our analysis now rather than later, as we develop our work plan based on the observations from the WMR. We plan to regularly update and release the type of analysis presented in this paper.

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1 Post implementation reviews assess the effectiveness of regulatory change

1.1 This report presents the Authority's post-implementation review of the trading conduct provisions that came into effect on 30 June 2021. The purpose of a post-implementation review is to evaluate an initiative against its expected outcomes. From the Authority's perspective, this enables learning about how regulatory decisions—or decisions not to regulate—are affecting the sector and whether further policy action is required.

1.2 The methodology we use is to assess conduct and market performance from the time the new provisions came into effect against conduct and market performance in previous years. To do this we use the conduct and performance indicators presented in the WMR, where data allows. These indicators were formed using a Structure-Conduct-Performance (SCP) framework. The simple premise of the framework is that the structure of the market determines the conduct of its participants. The more competitive the structure, the more competitive the conduct of participants and the more efficient their performance. As structure is not expected to have changed much since the WMR was published we do not revisit the structural indicators here.

2 Introduction

2.1 The new trading conduct provisions came into effect on 30 June 2021. The new provisions require participants to ensure that their offers reflect the offers that would be made in a competitive market.

2.2 The new rule replaced clauses 13.5A and 13.5B and the definition of "pivotal" in Part 1 of the Electricity Industry Participation Code 2010 (Code). The new rule, clause 13.5A, is as follows:

> (1) In the spot market –
>
> (a) it is expected that offers and reserve offers will generally be subject to competitive disciplines such that no party has significant market power;
>
> (b) however, there may be locations where, or periods when, one or more generators, or ancillary service agents, as the case may be, has significant market power.
>
> (2) Accordingly –
>
> (a) where a generator submits or revises an offer, that offer must be consistent with the offer that the generator, acting rationally, would have made if no generator could exercise significant market power at the point of connection to the grid and in the trading period to which the offer relates;
>
> (b) where an ancillary service agent submits or revises a reserve offer, that offer must be consistent with the reserve offer that the ancillary service agent, acting rationally, would have made if no ancillary service agent could exercise significant market power at the point of connection to the grid and in the trading period to which the reserve offer relates;
>
> (3) For the purposes of this clause –

(a) market power becomes significant when its exercise would have a net adverse impact on economic efficiency, which includes productive, allocative and dynamic efficiency;

(b) "spot market" has the same meaning as wholesale market except that it excludes the hedge market for electricity (including the market for FTRs).

2.3 This report assesses observed conduct and outcomes under the new provisions from 1 July 2021 to 31 July 2022, compared to previous years.

2.4 The method we have used for this review is to assess a range of indicators against expectations of competitive outcomes, as we did in the WMR. As in the WMR, we cannot definitively conclude using these indicators that the new rule is having an impact, or as much of an impact as we would like. While the new rule is designed to address both transitory and sustained exercises of market power, the very nature of any sustained exercise of market power alongside the data available for the wholesale market may mean that the only impact of the new rule may be to temper extreme behaviour. That is, the new rule may have no effect on the exercise of market power that occurs at the margin, as it is difficult to detect this. What we can observe however is general trends and assess whether these are consistent with competition. Combined with the Authority's regular monitoring this may be sufficient to ensure that no *significant* transitory or sustained exercise of market power is occurring.

3 The Market Monitoring team publishes weekly reports and has undertaken further analysis into some trading periods

3.1 The Authority's Market Monitoring team actively monitors trading conduct. Weekly reports are published which provide high level indicators of trading conduct and highlight trading periods for further analysis. These indicators include actual versus predicted prices, spot market supply curves, and the identification and further analysis of trading periods with high prices. We therefore do not replicate that analysis here.

3.2 In the WMR, we stated that we were "…concerned with the sustained exercise of market power. This review is not concerned with the occasional exercise of market power, although the Authority may allege a breach under the new trading conduct rules if it considers such an exercise of market power has occurred." Under the trading conduct provisions, we are interested in both transitory and sustained exercises of market power, if it is "significant". The weekly monitoring and frequent further analysis undertaken by the Authority's Market Monitoring team assesses potential transitory periods of the exercise of market power. The analysis presented here complements that analysis by presenting indicators over a longer time horizon that are more useful for assessing the sustained exercise of market power.

3.3 Since the new provisions were implemented, the Market Monitoring team has identified 22 issues for further analysis. An issue can be one or more trading periods with a high price (in either the energy or reserve markets) on a particular day or over several days during which similar behaviour from a generator was observed. These issues have covered around 1540 trading periods across 153 days between 1 July 2021 and 31 July 2022. Ten of these issues have had no further action taken, and 12 have involved the Market Monitoring team asking for further information from participants. Three of these issues have been passed to Compliance while three are still under investigation by the Market Monitoring team.

3.4 The further analysis the Market Monitoring team undertakes for these issues has included identifying offers and offer changes that caused the high prices, and how they compare to offers in similar circumstances. The further analysis has also investigated whether there were any supply or demand conditions not initially identified which impacted prices. This helps to identify offer behaviour that does not appear to be consistent with the offer that a generator or ancillary service agent, acting rationally, would have made if no one could exercise significant market power.

3.5 Trading periods have not been passed to the compliance team where offer behaviour appears to be consistent with a competitive market and other factors explain the observed outcomes. For example, in some trading periods we concluded that the co-optimization of the reserve and energy market caused higher reserve prices in order to prevent higher energy prices and reduce overall system costs, rather than any behaviour by generators causing these higher reserve prices.

3.6 When offers do not appear consistent with a competitive market, if relevant, the Market Monitoring team asks for an explanation of the offers from the generator or ancillary service agent. Usually, the generators have informed the Market Monitoring team of supply conditions which impacted their offers that the Market Monitoring team had been unaware of. Provided the additional information gives sufficient context to explain how their offers reflect what a rational participant would do in a competitive market, the cases have not been passed to compliance.

3.7 As an example, between 8 and 11 January 2022 Meridian moved a significant amount of its generation capacity at Manapouri from lower priced tranches to higher priced tranches even though there was no significant difference in its water storage, and this resulted in higher prices. On enquiry Meridian informed the Authority that it was required by its resource consent to provide a flushing flow down the Lower Waiau river to manage didymo. As lake levels were not sufficiently high to provide this flow, Meridian had to reduce its generation at Manapouri between 8 and 11 January. As a rational participant is expected to avoid breaching resource consent, this was considered a satisfactory explanation. This is discussed in more detail on the Authority's website.

4 Some issues have been passed to the Authority's Compliance team

4.1 Under the new Trading Conduct provisions, the Monitoring team conducts regular monitoring which identifies trading periods that appear inconsistent with competitive market conditions. These may be formally reported as an alleged breach to the Authority's Compliance Team. If this step is taken, the Authority will follow the compliance process in accordance with the Electricity Industry (Enforcement) Regulations 2010.

4.2 In addition, alleged breaches may be reported directly to the Authority's Compliance team, for example by another participant. These also follow the process as set out in the Regulations.

4.3 The Market Monitoring team have referred three potential cases of 13.5A breaches to the Compliance team for further consideration relating to:

(a) Withdrawn reserve offers

(b) High energy prices in shoulder periods

(c) Offer prices while spilling was occurring

4.4 The withdrawn reserve offers case was considered by the Compliance Committee on 9 May 2022. The case was alleged by the Authority, with Mercury alleged to have withdrawn reserve offers and/or increased offer prices for reserves on 5 July and 9 August 2021. Withdrawing reserve may increase the cost of both reserve and energy above what would be expected in a competitive market. This may potentially limit North Island reserves and/or reduce transfer across the high-voltage direct current (HVDC) transmission system. This behaviour may have been a breach of section 13.5A(2)(a) as the offers submitted or revised by Mercury in the relevant period may not have been consistent with the offers that a rational generator would have made in the absence of significant market power.

4.5 Mercury denied the allegations and provided information that:

(a) changes in reserves offered were impacted by availability of units at Maraetai power station and a need to conserve water in Lake Taupo;

(b) tranche three reserve prices reflect the cost of running units inefficiently; and

(c) the relationship between Mercury's expected energy dispatched and available reserve is non-linear, and therefore not adequately modelled by the system operator's Scheduling Pricing and Dispatch tool (SPD).

4.6 The Compliance Committee formed the view that a prima facie case had not been established and decided to decline to take action under regulation 11(1)(b) of the Electricity Industry (Enforcement) Regulations 2010.[1]

4.7 High energy prices in shoulder periods were assessed, but the cause was demand staying higher than anticipated by all generators.

4.8 The third instance is currently in the Compliance team's fact-finding stage.

4.9 Electric Kiwi Limited, Haast Energy Trading Limited, Flick Electric Limited and Switch Utilities Limited also alleged a breach of the new rule by Genesis and Contact for trading periods on 9 August 2021.

Contact

4.10 On 6 December 2021, the Authority's Compliance Committee considered the alleged breach of clause 13.5A of the Code by Contact. The Committee considered Contact did not breach clause 13.5A during 9 August 2021 because;

[1] Note this information is provided by consent.

(a) TCC is not a peaking generator, it is a baseload generator and as such requires between 36 and 72 hours to start up from cold. Therefore, to be operational for the evening peak on 9 August, Contact would have had to decide to turn the unit on before 10:00 pm Saturday 7 August 2021,

(b) At this time, the information available in the market would not have enabled a rational generator to predict the unusual tightening of supply and demand at the evening peak on 9 August 2021. Accordingly, there was no evidence to suggest that Contact's conduct was inconsistent with the way that a rational generator would act in a completive market.

(c) The Committee decided to take no further action on the breach allegation under regulation 11(1)(b) of the Electricity Industry (Enforcement) Regulations 2010 (Regulations) on the grounds that no prima facie case had been established.

Genesis

4.11 On 28 February 2022, the Authority's Compliance Committee received and considered a report and a recommendation from the investigator to discontinue the investigation into an alleged breach of clause 13.5A of the Code by Genesis. The Committee decided, under regulation 23(3)(a) of the Regulations to discontinue the investigation because:

(a) Genesis' behaviour to not offer HLY4 for the evening of 9 August was within the realm of behaviours consistent with that of a rational generator which does not hold significant market power.

(b) The investigator modelled HLY4 turning on at different times on the morning of 9 August, allowing for scenarios where it was operating at its full capacity by 6:00 pm, and where it had only partially ramped up by this time. In this case, the timing of available information during the morning was a key factor.

(c) The modelling found, for HLY4 to be at full capacity by 6:00 pm, price signals did not merit offering HLY4 generation.

(d) There was a small window from approximately 10:45 am when Genesis could have made a decision to offer generation from HLY4 and been profitable. HLY4 is not a peaking unit and was cold on the morning of 9 August, meaning it would need around 9 hours to ramp up to generate at full capacity. Making a decision at this time would have enabled HLY4 to reach its minimum load by 6:51 pm, after the peak demand had passed.

(e) This would have involved various risks, such as forecast prices changing, the start-up taking longer than expected, and running the unit in a way that creates extra physical risks to the unit. The investigator considered a rational generator may have weighed up the potential expected profit against the risks of running, and come to the same decision as Genesis not to run the unit.

(f) The possible market power Genesis may have expected to have through HLY4 for the evening of 9 August was not assessed to be significant.

5 Our indicators suggest that offers are following underlying conditions more closely than in the WMR period, but this is not definitive

5.1 As in the WMR, we present a range of indicators to build a picture of the market based on the set of indicators, rather than focussing on any indicator individually. The results we have observed from these indicators do not tell us definitively whether the new trading conduct rule has affected offering behaviour and outcomes. The results could be driven more by underlying conditions than any response to regulatory changes, especially since we are only examining just over one year of data. The changes could also have been influenced by the WMR rather than any impact of the new provisions. Additionally, average prices for January to May have been very high. The indicators can allow us to observe broad trends in the data but cannot determine definitively whether sustained market power is being exercised. The new trading conduct provisions may only temper transitory, extreme behaviour, due to the nature of the data available to monitor the new rule.

5.2 However, the overall picture presented by these indicators suggest the new trading conduct rule is having a positive impact on offer behaviour and prices. There continues to be an increase in the frequency of very low prices, price separation continues to be more pronounced, the percentage of high-priced offers has decreased since the WMR period and offers seem to be reflecting underlying conditions more closely.

Underlying conditions

5.3 Underlying conditions from July to December 2021 were conducive to lower priced offers – demand was lower due to some or all of the country being in level 4 lockdown for a large proportion of the time, and hydro storage was increasing, becoming higher than mean storage from 20 July and remaining above mean for the rest of the year. Wind generation was also generally high (making up 6.0 percent of total generation), so thermal generation (gas and coal) ran less during these months in 2021 compared to the same months in previous years (8.4 percent of total generation compared to 12.4 percent on average in the previous five years).

5.4 The January to July 2022 period saw large swings in hydro storage along with differing storage patterns for different lakes. There were also large increases in coal, diesel, and carbon prices. This saw the short-run marginal cost (SRMC) for the Huntly Rankine units running on coal increase from $200/MWh in January to $300/MWh in June. The SRMC for Whirinaki increased from $470/MWh in January to $750/MWh in June. After running less over July to December, thermal generation (gas and coal) increased from January to May, reaching 15.8 percent of total generation in April and 14.7 percent in May (higher than the same months in the previous five years, except for 2021 which had lower hydro storage in those months). Thermal generation then decreased again in June and July (to an average of 10.4 percent) as hydro storage improved. Whirinaki also ran more over January to May this year compared to the same months in 2017 to 2020 (1.7GWh compared to an average of 0.7GWh)[2], but less over June/July (0.3GWh compared to an average of 1.5GWh over the same months in 2017 to 2020).

[2] Whirinaki generation over the same months in 2021 was 12.8GWh.

5.5 These high thermal costs resulted in high average prices when hydro storage was decreasing. The average price over October to December (while hydro storage was healthy and generally increasing in most lakes) was $68/MWh. From January to May while hydro storage was decreasing, prices averaged $181/MWh. After May as hydro storage started increasing again, prices averaged $131/MWh.

5.6 Gas availability concerns lessened during this period with rising supply and falling demand. Maui supply has lifted, with Maui the largest producing gas field over some months in 2022. However, the decline at Pohokura continued over these months. While there was a recent uptick in production in mid-July following the drilling of a new production well, production levels have not returned to pre-2021 levels.

Hydro storage has been variable

5.7 Figure 1 shows national and individual reservoir storage from 1 July 2021 to 31 July 2022. National storage increased fairly consistently between July and December but has been quite variable in 2022. Dry weather in January – with record low inflows to Pukaki - lead to national storage decreasing by about 720 GWh. A period of heavy rain from 3 – 6 February in some catchments then increased national storage by about 700 GWh. Dry weather in the latter half of February to the end of May decreased national storage by about 1500 GWh. Increased rainfall in June and July with significant rainfall events in both islands in early July then increased national storage by about 900 GWh.

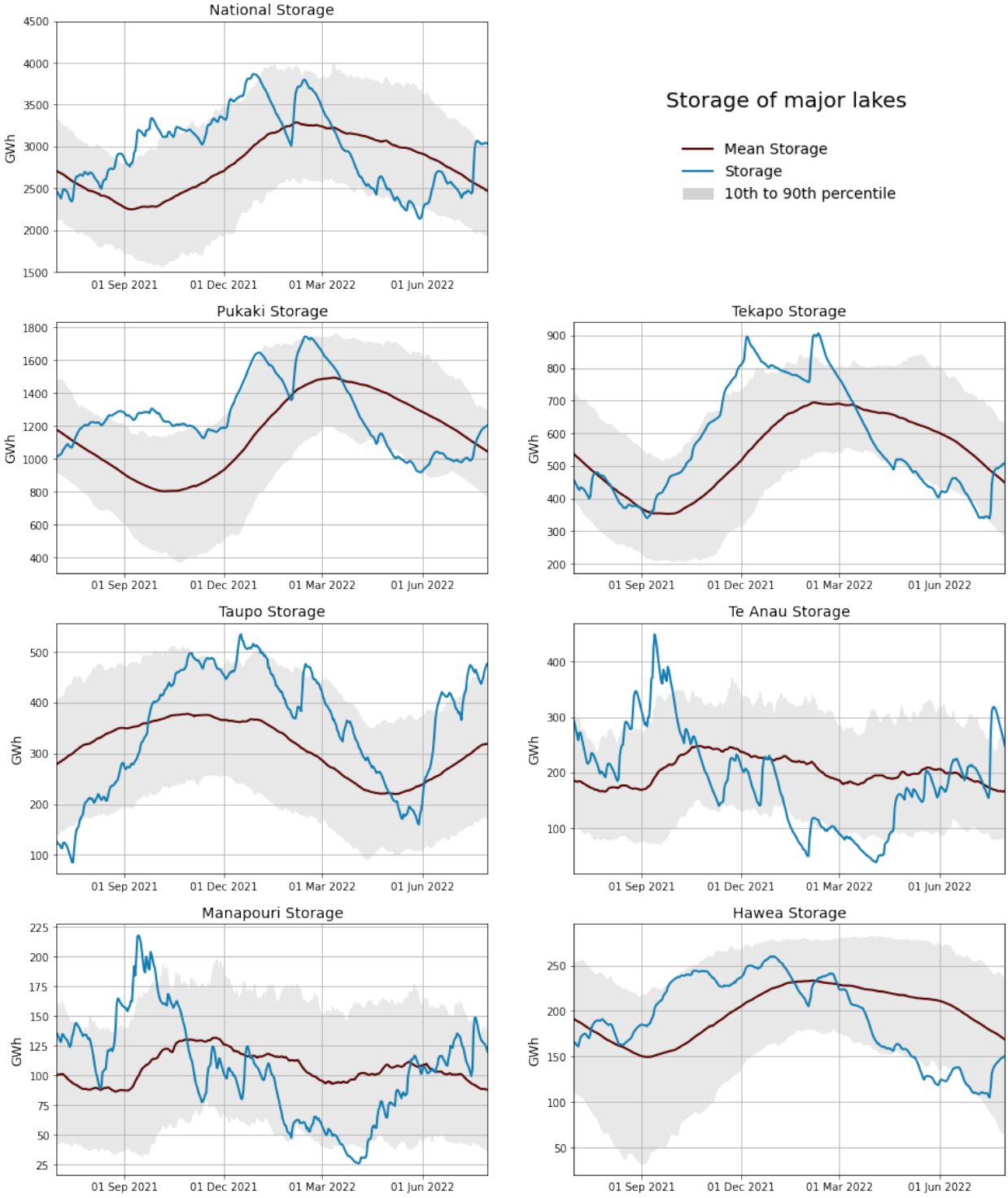
5.8 Storage also varied significantly across catchment areas. Manapouri and Te Anau did not receive the large inflows seen in Canterbury in early February. These lakes reached their low operating ranges in late January and remained around or below this low operating range until April. Wanaka and Wakatipu have also generally been low through-out the period. Hawea slipped below average in mid-January, rebounded slightly in early February, but then declined to reach lower than its 10th percentile in May and June.

5.9 Storage levels at Pukaki, Tekapo and Taupo were above their historical averages between November 2021 – February 2022. There was a significant rainfall event in all three lakes in early February, but all three lake levels then declined after mid-February. Pukaki and Tekapo storage declined below mean levels by mid-March, only rebounding above mean levels in early July. Taupo storage only briefly declined below mean levels in May before increasing above mean again at the start of June.

5.10 During February there was spill at Tekapo due to large inflows combined with an 80 MW outage at Tekapo B, which occurred from September 2021 – mid February 2022.

5.11 There was also spill at Lake Karapiro (the last dam of Mercury's Waikato river chain) in mid-July (from 13 July, continuing for about a week) and spill at Benmore and Aviemore for a couple of days a week later.

Figure 1: Hydro storage

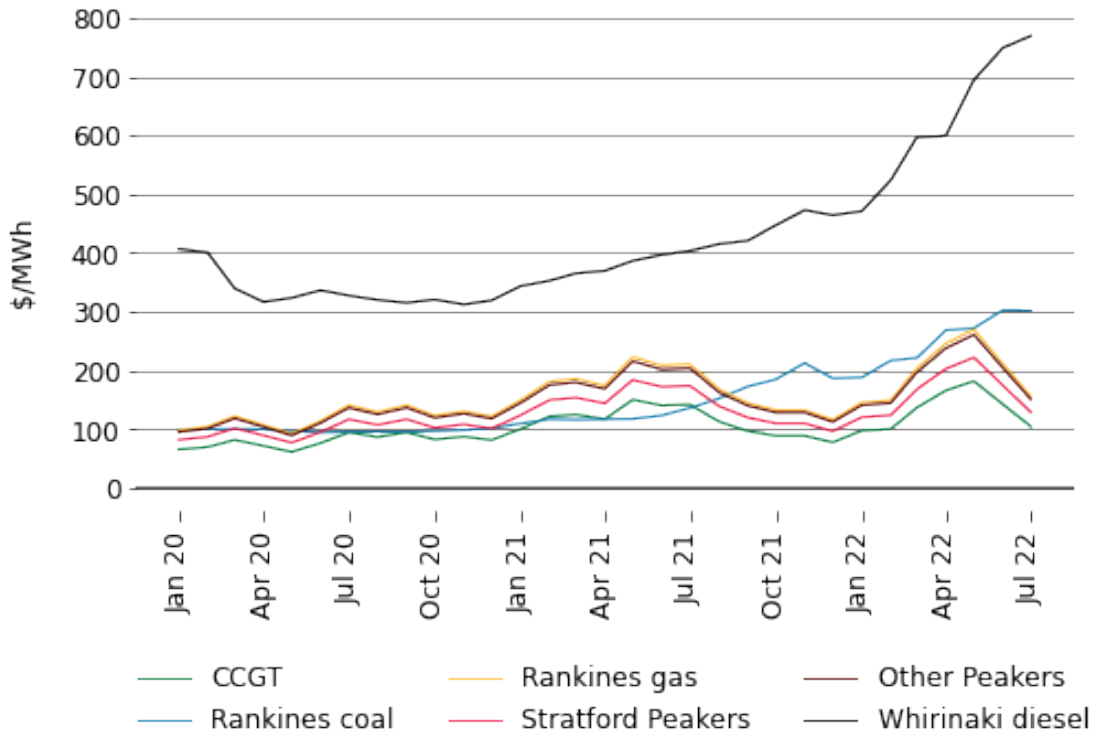


Thermal Fuel Costs decreased at the end of last year but have been increasing in 2022

5.12 The SRMC for thermal fuels can be estimated using gas and coal prices, and the average heat rates for each thermal unit. Figure 2 shows an estimate of thermal SRMCs as a monthly average. The thermal SRMC of gas increased in January to May compared to the last quarter of 2021, likely due to an increase in gas consumption. The gas SRMC reached a slightly higher level in April and May compared to last year. It then decreased in June and July to reach a slightly lower level than the same time last year, but was still higher than in previous years.

5.13 The SRMCs of coal and diesel both increased due to global supply and demand conditions and remain the highest they have ever been since at least 2009.[3] Note that the SRMC calculations include the carbon price, an estimate of operational and maintenance costs, and transport for coal. While Genesis contracted coal up until June this year at a lower price, the opportunity cost of that coal is the price it could get for alternative uses of that coal – ie, the international price of coal. The carbon price has significantly increased in the last year, reaching a high of $85/tonne in February before decreasing slightly to around $75/tonne for the rest of the year. This compares to a price of around $40-$50/tonne at the same time last year.

Figure 2: Estimated monthly SRMC for thermal fuels

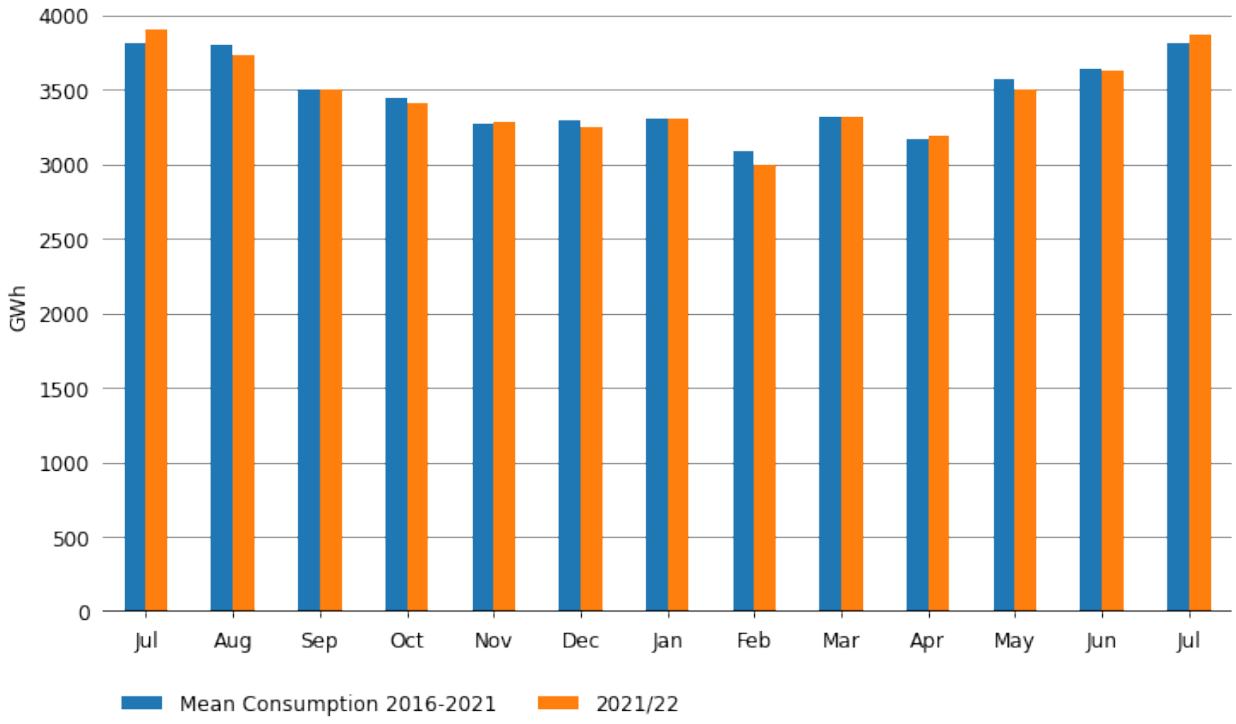


[3] We only have data back to 2009.

Demand has still been high despite covid restrictions

5.14 Figure 3 shows total monthly demand compared to the mean of the previous five years. Demand was higher in July 2021 compared to the previous five years, but lower in August 2021 due to the national level 4 lockdown (18 August – 31 August). It was slightly lower in September (Auckland was still in alert level 4 until 22 September), and lower in October (Auckland and Waikato in level 3, combined with warmer weather). Demand was similar in November, January and March compared to previous years, but lower in December and February. Irrigation load was high in January but lower in February following increased rain in the South Island. Additionally, the country entered the red traffic light setting on 23 January. Although industrials were not required to shut down in the red setting (as they were under alert level 4 restrictions), the move to red could have contributed to the lower demand in February. March and April then had the same or higher demand compared to previous years, but demand was slightly lower in May and June with warmer weather in these months compared to previous years. While July 2022 was the fourth warmest July on record, demand was still higher than the average demand for July over 2016-2020.

Figure 3: Monthly demand compared to previous years

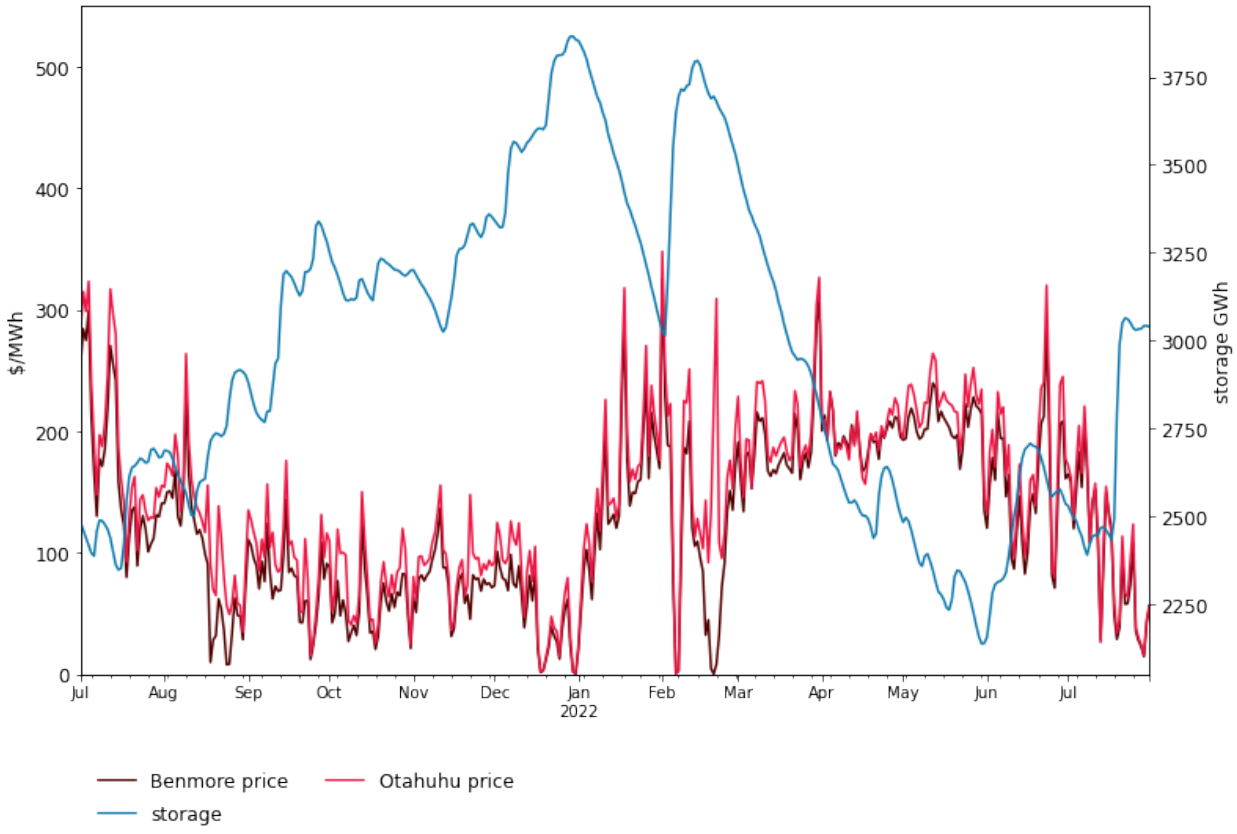


Source: Electricity Authority

Wholesale prices varied with hydro storage and wind

5.15 Figure 4 shows daily average prices and national hydro storage between 1 July 2021 and 31 July 2022. Between July and December, as hydro storage levels rose and the dry year risk faded, prices decreased. From mid-August onwards average daily prices were all below $200/MWh. After the Christmas holiday period, however, hydro storage began decreasing alongside NIWA reporting a strengthening of La Nina conditions,[4] and daily average prices rose. The daily average price reached above $200/MWh at the end of January and into early February. Large hydro inflows in early February saw prices fall close to $0/MWh over 6-7 February, as some lakes in the South Island spilled. An extended HVDC bipole outage led to price separation between 16 – 22 February, with daily average prices as low as $0.03/MWh in the South Island and as high as $347/MWh in the North Island. By the end of February daily average prices were again around $200/MWh everywhere. Prices then increased slowly until the end of May as hydro storage decreased, and then generally decreased following the increase in hydro storage in June and July. From 13 July (when spilling began in the North Island), prices averaged $67/MWh.

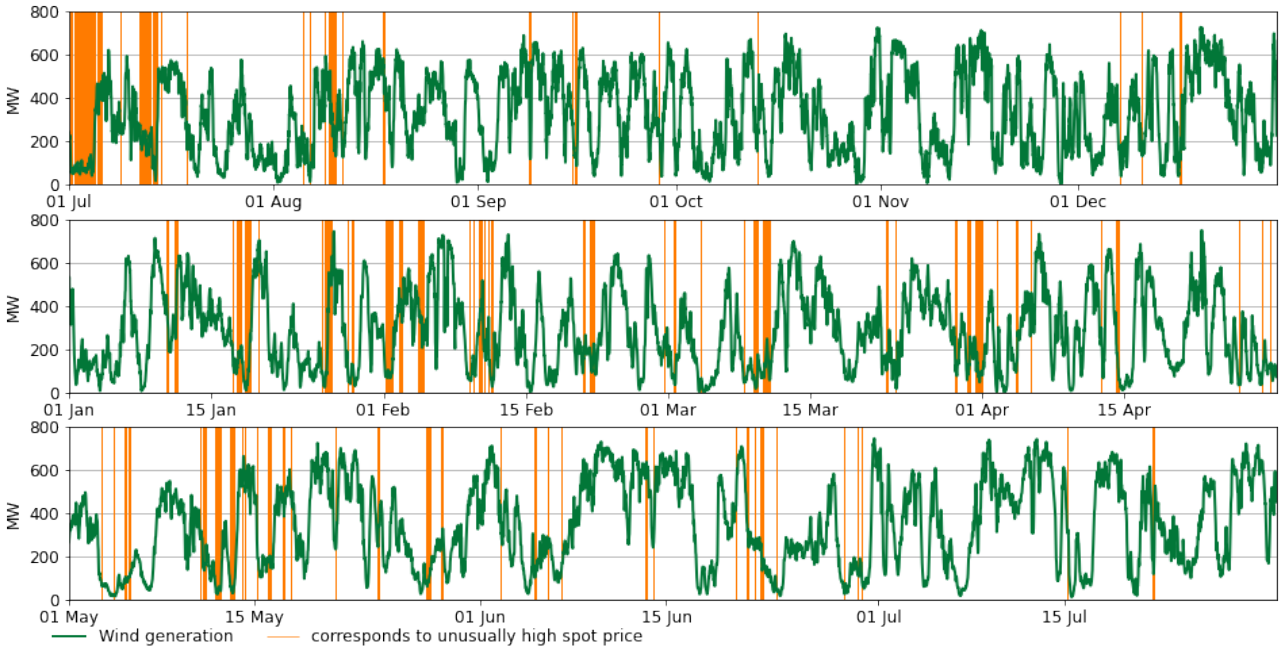
Figure 4: Daily average prices and hydro storage between 1 July 2021 and 31 July 2022



[4] https://niwa.co.nz/climate/seasonal-climate-outlook/seasonal-climate-outlook-january-2022-march-2022

5.16 Figure 5 shows wind generation by trading period between 1 July 2021 and 31 July 2022. Unusually high spot prices (above the 90th percentile based on historical data) are shown by the orange lines. The chart shows that these unusually high spot prices usually occur when wind is low. It also shows the intermittent nature of wind generation.

Figure 5: Wind generation and high prices



5.17 Overall, wind generation was high between July and December, low over January to May, and slightly higher again in June/July. From July to December wind contributed 6.0 percent of total generation, compared to 4.9 percent during January to May. In June/July it contributed 5.5 percent. The low wind generation over January to May, combined with decreasing hydro storage over most of these months, pushed thermal generation (gas and coal) up from 8.4 percent of total generation during July to December to 13.1 percent during January to May. Whirinaki also ran more than usual, generating 1.7GWh over January to May compared to an average of 0.7GWh over the same months in 2017 to 2020.[5]

Indicators used

5.18 The indicators we have used to assess competitive outcomes in the market are as follows:

(a) The frequency of **very low prices**. If prices are being determined in a competitive environment, we would expect very low prices in off-peak trading periods to occur more frequently. In the past, low prices have been avoided by generators by reducing the volume of low priced generation—economic withholding[6]. This type of offering would not be consistent with the new provisions.

[5] We have excluded 2021 for this comparison as it was an unusual year – hydro storage was very low during these months and gas supply was tight. Whirinaki generated 12.8GWh from January to May 2021.

[6] Economic withholding is defined here as in the WMR – that is, offering some quantity at higher prices with the intention that it not be dispatched, to reduce supply and increase the spot price.

(b) **Price separation**. If prices are being determined in a competitive environment, we would expect price separation to occur more frequently. In the past, price separation has been avoided by generators by reducing the volume of low priced generation—economic withholding. This type of offering would not be consistent with the new provisions.

(c) How generators are **offering into the market over time**. If offer prices are not related to underlying supply and demand conditions, this could suggest the exercise of market power. It is expected that offers diverging from underlying supply and demand conditions—of the sort that occurred in June 2016 and the 2019 UTS—would constitute breaches of the new provision.

(d) The **percent of offers above $300/MWh** and **above final price**. If these higher priced offers are not related to operational or underling supply and demand reasons, it could indicate economic withholding.

(e) The **percent of offers above cost**, using various estimates of cost. In a competitive market, offer prices should reflect economic costs, including opportunity costs.

(f) The **relationship of storage and offers to cost**. In a competitive market, we expect an inverse relationship of storage to cost, because the value of stored water for hydro generators increases when storage is low relative to what is expected. We expect a positive relationship between offers and cost, as we expect generators to increase their offer prices if their costs increase.

5.19 The frequency of very low prices is examined in section 6. Price separation analysis is shown in section 7. The historical comparison of offers, indicators (c) through (f), is presented in section 8.

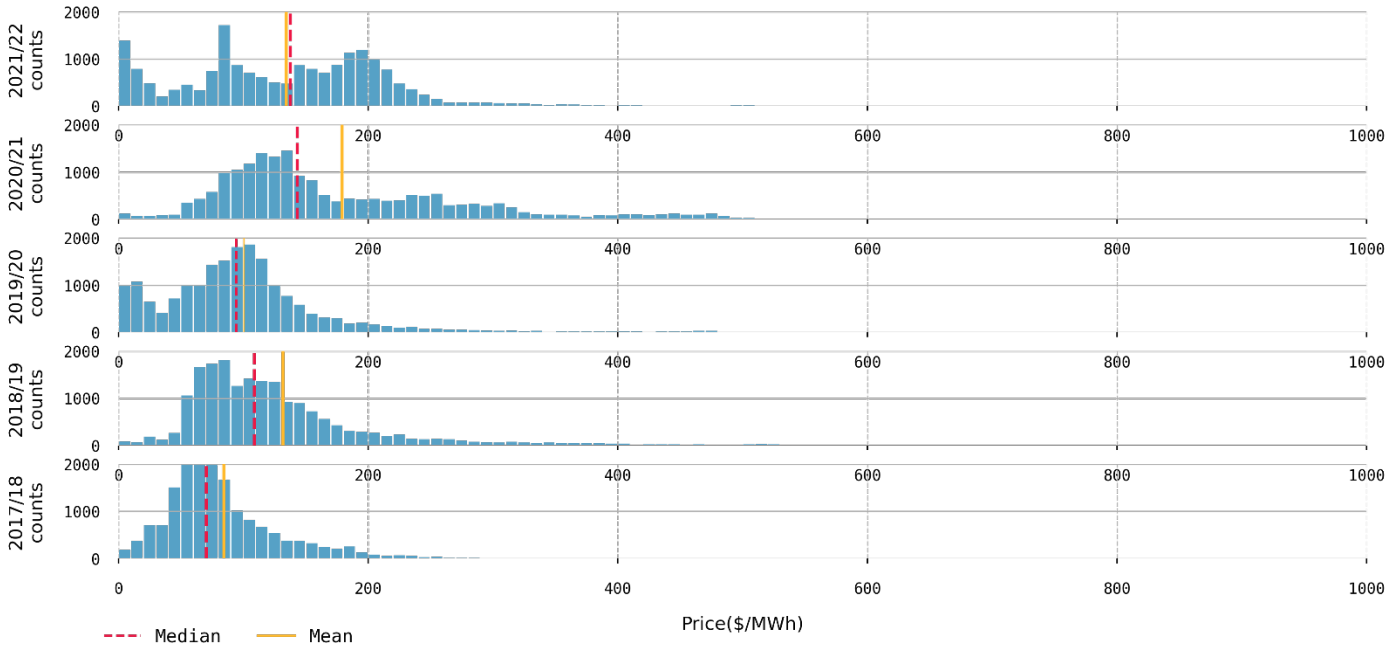
6 Very low prices are occurring more often

6.1 If prices are being determined in a competitive environment, we would expect very low prices in off-peak trading periods to occur more frequently than in a market where participants are exercising market power. If participants are economically withholding generation (in a manner that is consistent with the exercise of significant market power), very low prices would be less likely to occur. It is important to note this is an indicator only, as fewer low prices could also arise from prudent hydro storage management.

6.2 We have observed an increase in the frequency of very low prices for July 2021 to July 2022 compared to the same months in previous years. There has been an increase in the proportion of these very low prices occurring in off-peak times during the day, rather than just occurring overnight. These observations suggest that prices - and therefore offering behaviour - are following underlying conditions more closely than in previous years, which is indicative of competitive behaviour.

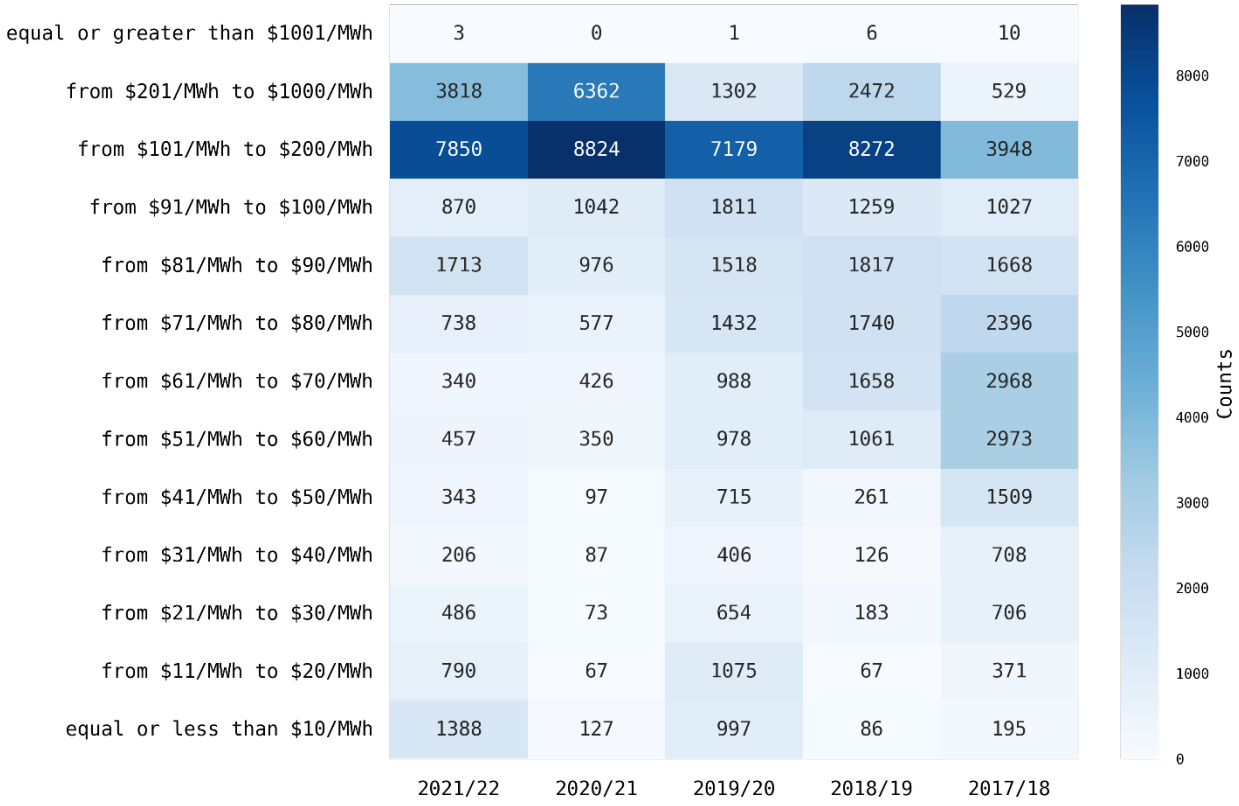
6.3 Figure 6 shows the distribution of prices for each year from 1 July to 31 July (13 months). Each bar represents a $10/MWh interval. It shows that there was a much more pronounced tail at the lower end of the distribution in 2021/22 compared to other years (except for 2019/20 when spilling occurred from November to January and a UTS was found between 3 to 27 December 2019).

Figure 6: Histogram of spot prices from 1 July to 31 July (13 months), by year



6.4 We also looked at a heatmap of the half-hourly spot prices in the different pricing bands. Figure 7 shows that 1388 trading periods – or 7 percent of all trading periods - in 2021/22 were less than or equal to $10/MWh. 2019/20 - when spilling occurred from November to January and a UTS was found – had a smaller percentage of prices less than $10/MWh but a higher percentage between $11/MWh and $20/MWh. The other three years examined had a much lower percentage of low prices – all three years had less than 1 percent of all trading periods priced at less than or equal to $10/MWh.

Figure 7: Heatmap of spot prices from 1 July to 31 July (13 months), by year



6.5 Table 1 shows the percent of these very low prices (less than or equal to $10/MWh) that occurred in off-peak trading periods during the day, and the median price of these very low prices. 46 percent of these very low prices occurred in off-peak trading periods during the day in 2021/22. This is a higher percentage compared to previous years (including 2019/20 when significant spill occurred between November to January and a UTS was found).

6.6 About 50 percent of these very low prices in 2021/22 were less than $0.31/MWh, which is a lower median than in previous years. So not only are very low prices occurring more often, and more often during the day, but also these very low prices are – on average - lower than in previous years. All of this taken together suggests more competitive offering behaviour.

Table 1: Very low prices

Year	Percent of very low prices that occurred in off-peak times during the day (9am to 4.30pm)	Median price of the very low prices (all trading periods)
2014 to September 2018	25	5.19
2019 to June 2021	38*	2.02
July 2021 to July 2022	46	0.31

*excluding November 2019 to January 2020 when spilling occurred this decreases to 29 percent.

7 Price separation has been more pronounced

7.1 An indication of economic withholding (consistent with the exercise of significant market power) would be subdued price separation, although subdued price separation can also result from hydro generators trying to conserve water in periods of low hydro storage or for other reasons. Large price differences, or price separation, indicate where transmission is constrained. These prices are important investment signals. When large amounts of South Island generation are exported north, we would expect transmission to become constrained. This should lead to lower prices in the South Island than in the North Island

7.2 In the WMR, we found that differences in price between the North Island and South Island were subdued over the review period when hydro storage was high. This suggests some generators may have been economically withholding so the price they pay to cover their retail books in one island is not much higher than the price they receive for their generation in the other.

7.3 Price separation has been more pronounced since the new trading conduct provisions came into effect, suggesting that economic withholding may no longer be occurring (or occurring less frequently) (see Table 2). Price separation between Benmore and Haywards, and between Manapouri and Benmore, has been more pronounced in July 2021 to July 2022 than in previous years.

7.4 The median price separation is a lot lower than the mean price separation in 2021/22, which results from a few periods of extreme price differences, where the price was 1 or 2 cents at Manapouri (most of which occurred prior to Manapouri lake levels beginning to decline in mid-January). Because we are using a ratio, these extremely low prices can result in a very large ratio (eg, one dollar at Benmore and 1 cent at Manapouri would equal a ratio of 100). The much lower median in 2021/22 (compared to the mean) is consistent with the very low prices discussed in the previous section which skew the distribution.[7] We are interested in both measures as this gives us the full picture of what is happening.

Table 2: Price separation, for periods of high hydro storage

Year	Ratio of Haywards to Benmore price		Ratio of Benmore to Manapouri price	
	Mean	Median	Mean	Median
2014 to September 2018	1.68	1.06	31.38	1.09
2019 to June 2021	1.12	1.06	8.48	1.07
July 2021 to July 2022	15.52	1.04	96.02	1.08

Note: this only includes trading periods when hydro storage is high (ie, where total New Zealand storage is greater than or equal to 100 percent of mean). This is because there were not many trading periods where total New Zealand storage was low (ie, less than 80 percent of mean) in these months for July 2021-July 2022 (8 percent of trading periods had storage less than 80 percent of mean). We have also excluded periods for the Haywards/ Benmore ratio where one or more of the HVDC poles has been on outage, and periods for the Benmore/Manapouri ratio where there was an outage for the CUWLP (ie, the Naseby to Livingston line or the Naseby to Roxburgh line was on outage).

[7] The median can be defined as the number that is found in the middle of the set of data, so is not affected as much as the mean is by some very large values in the data.

8 Offers have been more consistent with underlying conditions than they were during the WMR period

8.1 In the WMR, we discussed how we were interested in the quantities of electricity offered at high prices. If these higher priced offers are not related to operational or underlying supply and demand reasons, it could indicate economic withholding (ie, offering some quantity at higher prices for the express purpose of reducing supply and increasing the spot price). The review observed that there seemed to be a significant quantity of high offers for some generators that are not always related to underlying supply and demand conditions, including hydro storage and thermal fuel costs, during the review period.

8.2 In this section we look at some of the same indicators of offer behaviour as presented in the WMR. The hydro plant offer tranches, with reservoir storage overlayed, from July 2021 – July 2022, are shown in Figure 8 to Figure 12. Offers, from various plants, are compared to those over previous years (split into the review period of January 2019 to June 2021, and years prior to the October 2018 Pohokura outage, as shown in the WMR). These are shown in Table 4 to Table 8.

8.3 It appears that since the new trading conduct provisions came into effect, generator offers are more closely related to underlying supply and demand conditions, with low percentages of high-priced offers and offers above estimates of cost for all hydro generators, except Mercury's Waikato offers.

8.4 Meridian's Waitaki offers appear to follow storage quite closely (see Figure 8). From September to December, Meridian had near to 100 percent of offers priced below $100/MWh. As the storage situation deteriorated in January it increased its offers priced between $100-$300/MWh, but returned to near 100 percent of offers under $50/MWh following the rain event in early February. Since September last year it has very rarely had any offers on the Waitaki priced at over $300/MWh. Since late January, Meridian has needed to generate more from the Waitaki to cover its contracted amount since Manapouri has been constrained by low storage. This can be seen in an increased amount of offers priced over $300/MWh as storage decreased at Manapouri in Figure 9 below. As storage began increasing again at Manapouri from May, Meridian decreased its offer prices for Manapouri.

Figure 8: Meridian Waitaki plant offers

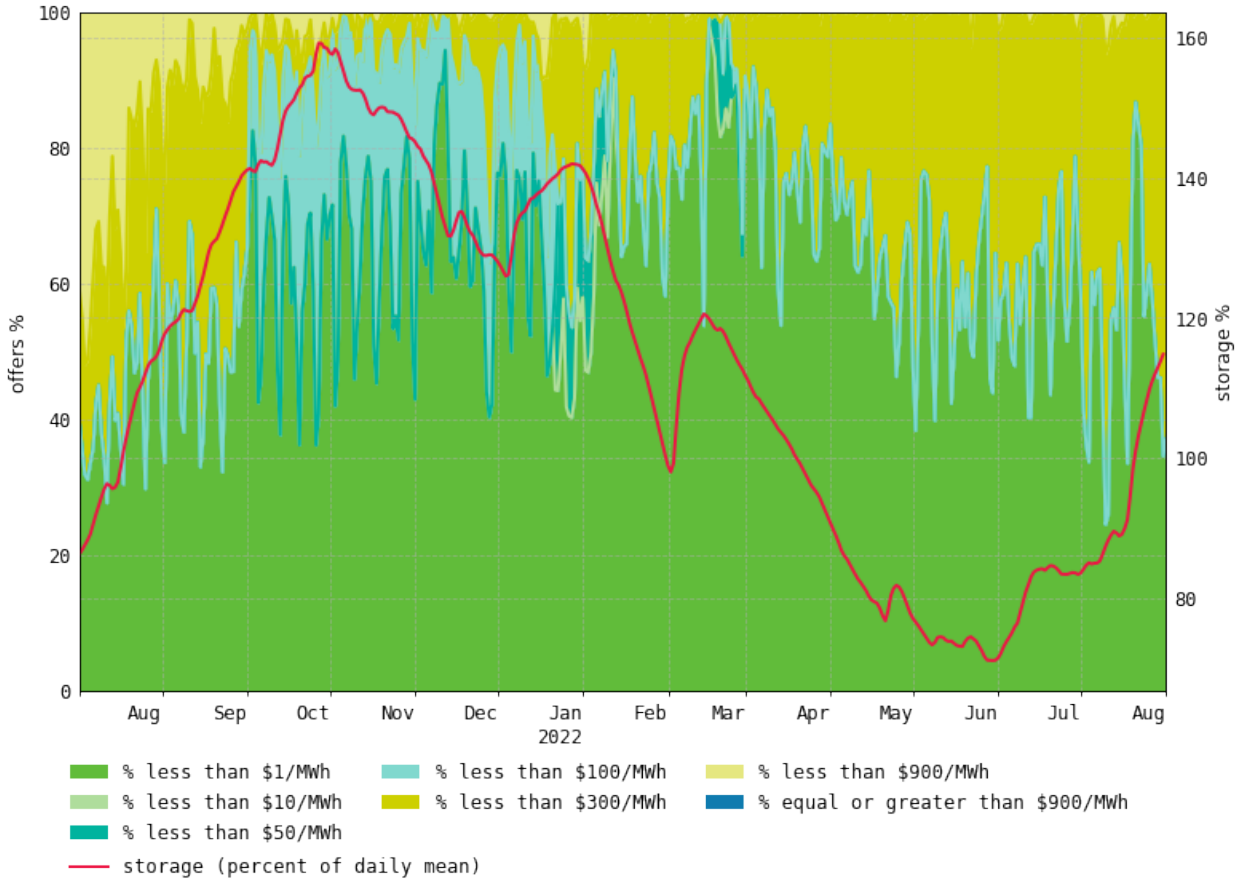
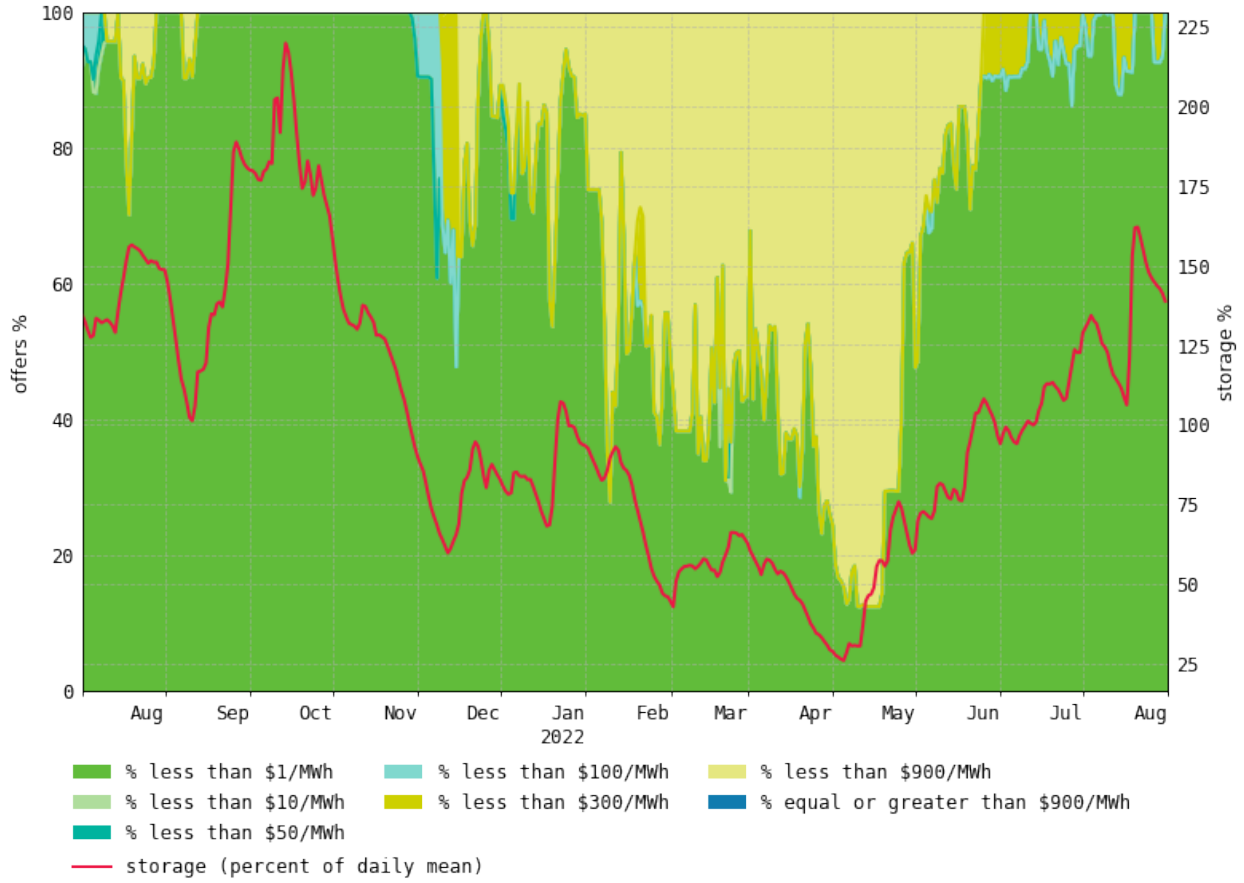


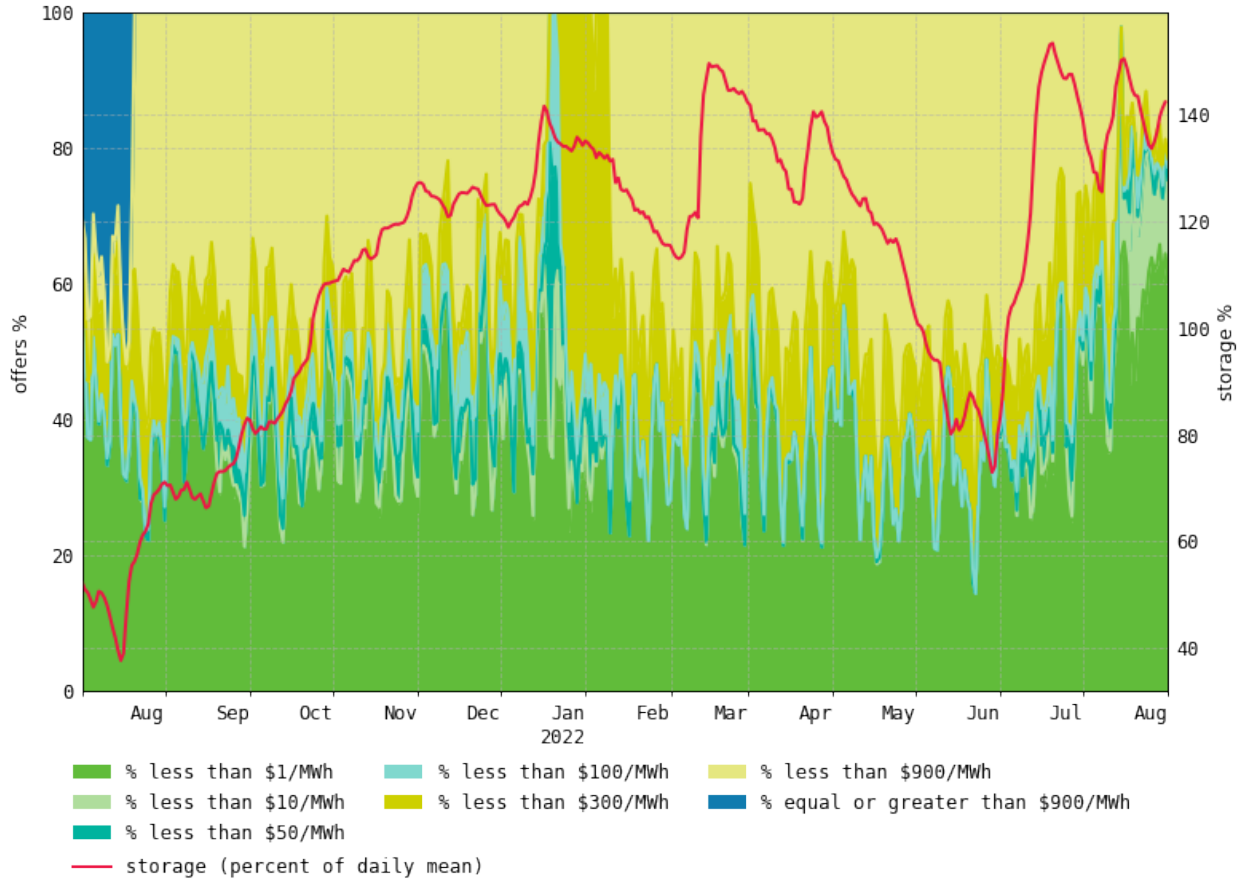
Figure 9: Meridian Manapouri offers



8.5 Prior to June, Mercury did not change its offers much for the Waikato except for the holiday period during December-January when Taupo storage was relatively high and demand was low (see Figure 10). There was a slight increase in lower priced offers at the same time as strong inflows in early February 2022. The lack of change in offers despite an increase in storage from July 2021 to October 2021 may have been because storage did not rebound to the same extent as in the South Island. North Island inflows were below average for that time of year and Taupo storage did not exceed the mean until the end of September. This is consistent with the decrease in offers at the end of December when storage increased to around 140 percent of mean. However, storage increased more (to near 150 percent of mean) at the start of February without much of a decrease in offer prices. Trading periods in February were flagged for further analysis by the Authority's Market Monitoring team in our weekly trading conduct reports as national storage had increased without a fall in prices. However, upon further inspection it was found that prices fell after higher inflows into Taupo. [8] The HVDC bipole outage also coincided with this period. As storage began increasing at Taupo in June, Mercury began decreasing its offer prices for its Waikato plants. By early July it had around 80 percent of offers priced at less than $10/MWh. For peak trading periods (chart not shown) Mercury had almost 100 percent of offers priced at less than $10/MWh by early July.

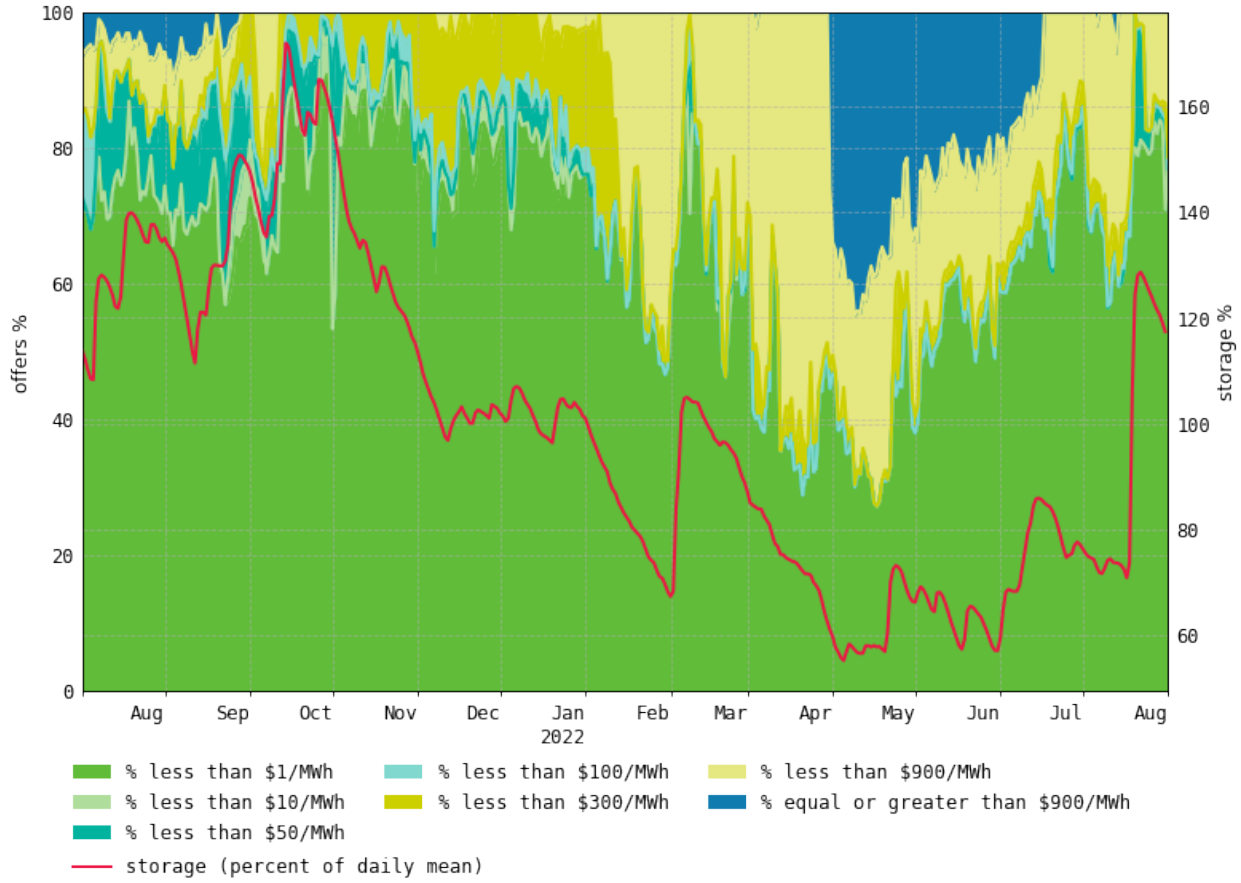
[8] Monitoring trading conduct — Electricity Authority (ea.govt.nz)

Figure 10: Mercury Waikato plant offers



8.6 Contact's offers on the Clutha have followed lake levels quite closely over the period examined (see Figure 11). From the end of September to the beginning of January, offers at Clutha remained relatively constant while lake levels were high and demand was low, with close to 100 percent of offers priced below $300/MWh. As lake levels decreased in January, the top offer tranche was increased to above $300/MWh, but the rainfall event in early February saw close to 100 percent of offers priced below $100/MWh for a brief period before lake levels began declining again. Similarly for the rain event in July, almost 100 percent of Contact's offers were priced at less than $50/MWh briefly and 80 percent of offers were priced at less than $1/MWh for the rest of July.

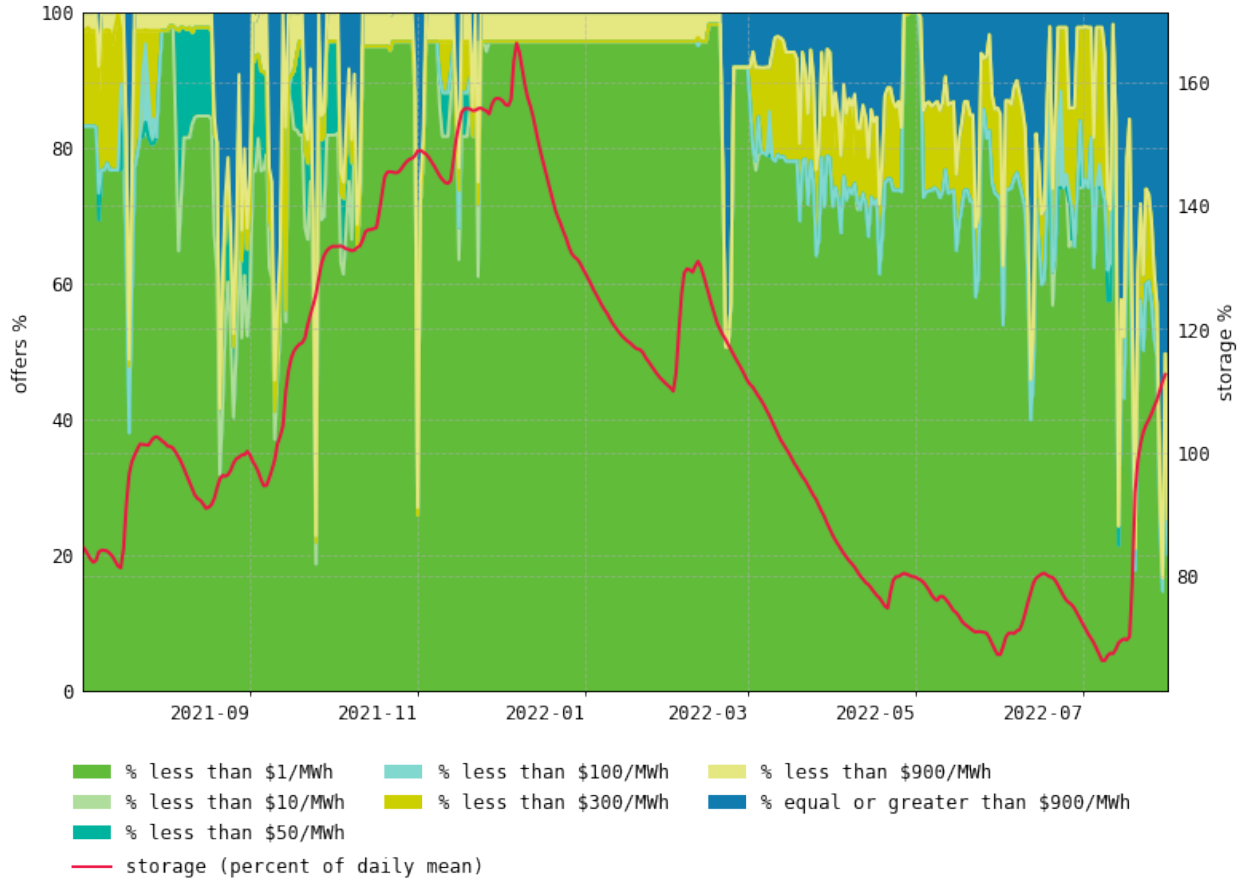
Figure 11: Contact Clutha plant offers



8.7 Tekapo operated at reduced capacity for a lot of the period, due to an 80 MW unit outage from 13 September 2021 until 19 February 2022. The offers shown in Figure 12, with ~90 percent of energy offered at under $1/MWh, reflect the decreased capacity of the generator whilst storage has also been as high as 160 percent of mean. However, when Tekapo B returned from outage on 19 February, the additional 80MW was offered at over $1500/MWh. Offers for this 80MW remained at $1500/MWh until the HVDC outage ended near the end of the day on 22 February. 65MW was then offered at $0.01/MWh but Genesis continued to offer 15MW at $1500/MWh during February and March. The reasons for these higher priced offers are not immediately obvious and this issue is being analysed further by the Authority's Compliance team.[9]

[9] Monitoring trading conduct — Electricity Authority (ea.govt.nz)

Figure 12: Genesis Tekapo plant offers



8.8 Table 3 to Table 7 show the percent of offers above $300/MWh, final price, and various measures of cost, for July 2021 to July 2022 compared to previous years, when hydro storage was high.[10] These tables show that Meridian (Waitaki) had a lower percent of high priced offers in 2021/22 compared with previous years (although its percent of offers above the average New Zealand water value remains higher than for Genesis (Tekapo) and Contact (Clutha)).[11] However, Mercury (Waikato) still has a high percent of high priced offers. This is despite controlling for storage levels – that is, we are only comparing periods of high hydro storage (storage greater than or equal to mean storage). This is a similar finding to during the WMR period. Genesis (Tekapo) and Contact (Clutha) continue to have low percentages of high-priced offers.

8.9 Contact still has a large percentage of higher priced offers at Stratford, which appears to be mainly driven by offers for the Stratford peakers. The percentage of offers above SRMC for Contact's Stratford peakers are comparable with the percentages above

[10] Only trading periods when hydro storage was high are included for each table – ie, where total New Zealand storage or storage for the relevant catchment is greater than or equal to 100 percent of mean. This is to control for storage. Only periods of high storage are included because there were very few trading periods where total New Zealand, Pukaki, Tekapo or Clutha storage were low (ie, less than 80 percent of mean) in these months for 2021/22.

[11] Water values for previous years have been calculated using DOASA (Dynamic Outer Approximation Sampling Algorithm), which is an optimization methodology for hydro thermal scheduling and water valuation. JADE ((Just Another DOASA environment) has been used for the 2021/22 water values. In both instances we have used actual fuel input costs, actual plant and HVDC outages, and reconciled load data to calculate historical water values. For details of the DOASA average water value refer to Market Monitoring Review of Structure, Conduct and Performance in the wholesale electricity market - Information Paper. For details of the JADE average water value refer to Appendix B JADE water value model.

SRMC (or the average forward price) for both McKee and the Huntly OCGT (both also peakers), and all are at similar (or lower) levels than all previous years examined. As mentioned in the WMR, we would expect the peakers (compared to the essentially baseload plants e3p and TCC) to have a higher percentage of higher priced offers. This is because peakers, which cannot easily run continuously, incur costs associated with being idle for longer periods. From the end of October one of the Stratford peakers has been on outage, with the other peaker also on outage from 24 February. TCC was also on outage from 22 January to 28 February, and again from 25 March to 3 April. After the latter outage, it returned to service with some limitations on its combined cycle operation.[12]

Table 3: Percent of offers above $300/MWh

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)	Stratford	Huntly
2014 to September 2018	6	23	2	0	1	4
2019 to June 2021	41	25	4	10	37	13
July 2021 to July 2022	39	3	10	6	58	18

Table 4: Percent of offers above final price

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)	Stratford	Huntly
2014 to September 2018	39	38	15	11	63	20
2019 to June 2021	51	33	5	30	60	22
July 2021 to July 2022	52	28	12	18	74	29

[12] https://contact.co.nz/aboutus/media-centre/2022/04/04/tcc-power-station-returns-to-limited-service.

Table 5: Percent of offers above the average forward price

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)	McKee	Huntly OCGT	Stratford peakers	Rankines (coal)	E3P	TCC
2014 to Sept 2018	23	21	9	3	55	60	45	18	4	12
2019 to June 2021	32	21	3	15	31	54	59	22	7	16
July 2021 to July 2022	33	11	8	8	53	52	59	23	12	25

Table 6: Percent of offers above thermal SRMCs

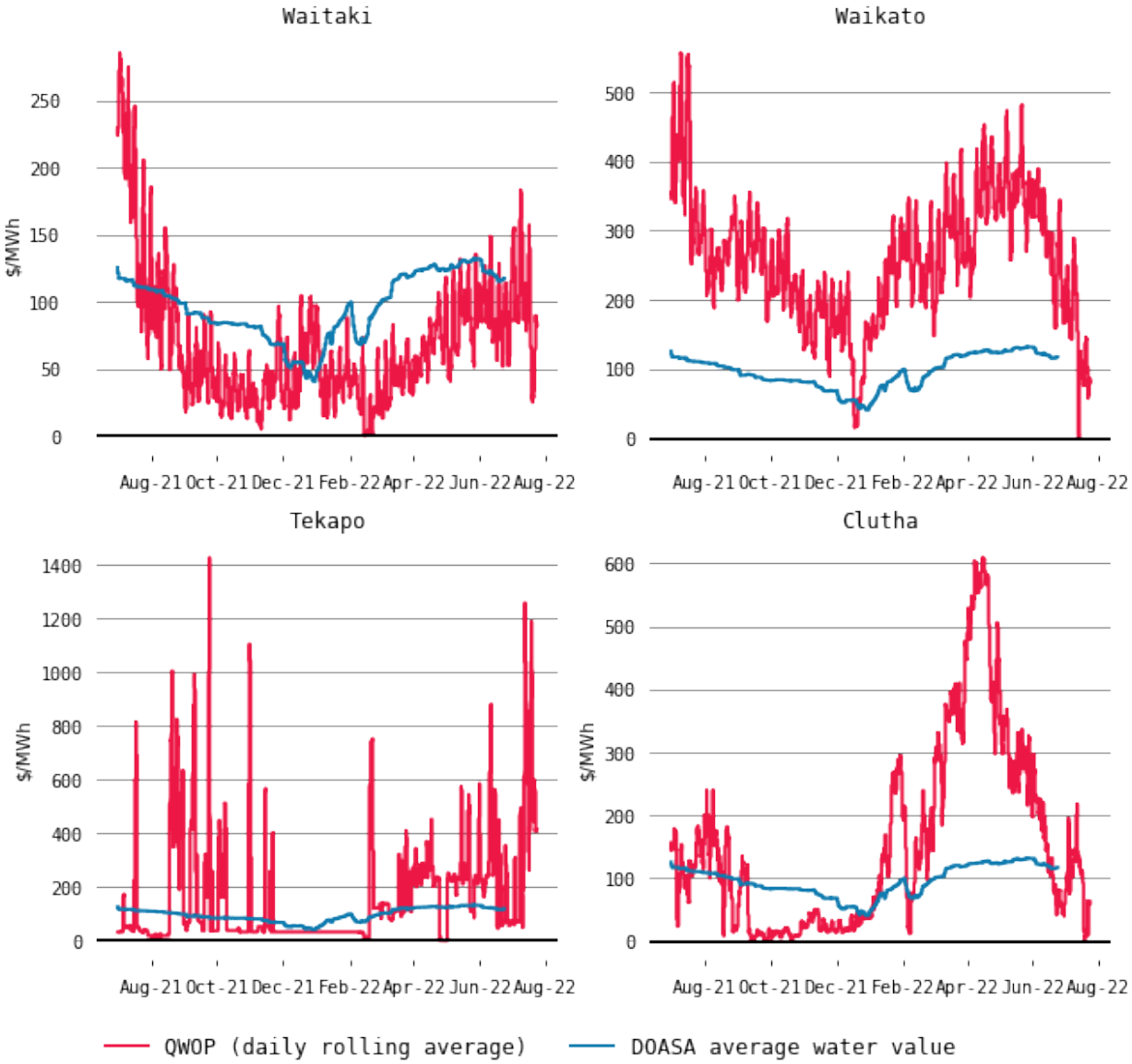
Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)	McKee	Huntly OCGT	Stratford peakers	Rankines (coal)	E3P	TCC
2014 to Sept 2018	23	34	14	4	84	23	49	20	15	19
2019 to June 2021	31	28	4	18	52	29	61	27	11	15
July 2021 to July 2022	27	7	10	7	78	53	42	25	18	22

Note: the maximum gas SRMC is used for hydro plants.

Table 7: Percent of offers above DOASA water values

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)
2016 to September 2018	37	38	16	17
2019 to June 2021	55	35	5	29
July 2021 to July 2022	58	25	10	14

Figure 13: QWOPs and DOASA average water value



8.10 Table 8 to Table 11 show the relationships between the average DOASA water value and hydro storage and offers. They show that in 2021/22 the average DOASA water value was strongly negatively correlated with storage for the Waitaki and Tekapo schemes, and less strongly correlated with storage for the Waikato and Clutha schemes.[13]

8.11 The correlations of the average DOASA water values with offers confirm the conclusion above that offers now appear to be reflecting underlying conditions and costs more closely. Most correlations in 2021/22 were positive.

[13] As noted in the WMR, "…Contact does not use water values for the majority of generation from the Clutha scheme. Contact has advised the Clutha is essentially a run-of-river scheme with very low storage. Generation attributable to stored water in Hawea accounts for only 10 percent to 15 percent of total generation volumes. We have used DOASA water values for Contact, to paint a complete picture, but note that any analysis for Contact based on DOASA water values is unlikely to be particularly meaningful."

Table 8: Correlations of DOASA water values with hydro storage

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)
2016 to September 2018	0.08	-0.68	-0.12	-0.41
2019 to March 2021	-0.66	-0.73	-0.35	-0.33
July 2021 to July 2022	-0.39	-0.80	-0.93	-0.48

Table 9: Correlations of DOASA water values with percent of offers above $300/MWh

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)
2016 to September 2018	0.44	0.18	0.20	0.68
2019 to March 2021	0.11	-0.01	0.06	0.33
July 2021 to July 2022	0.28	-0.07	-0.23	0.60

Table 10: Correlations of DOASA water values with QWOP

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)
2016 to September 2018	0.32	0.19	-0.22	0.58
2019 to March 2021	0.14	-0.22	0.09	0.27
July 2021 to July 2022	0.50	0.39	0.51	0.57

Table 11: Correlations of DOASA water values with QWOP excluding offers priced over $300/MWh

Period	Mercury (Waikato)	Meridian (Waitaki)	Genesis (Tekapo)	Contact (Clutha)
2016 to September 2018	-0.11	0.09	-0.31	-0.13
2019 to March 2021	0.09	0.23	0.34	-0.07
July 2021 to July 2022	0.30	0.42	0.79	-0.12

9 Our indicators suggest the new provisions are having an impact, but this is not definitive

9.1 The overall picture presented by these indicators suggests that the new trading conduct rule is having a positive impact on offer behaviour and prices. There continues to be an increase in the frequency of very low prices, price separation continues to be more pronounced, the percentage of high-priced offers has decreased since the WMR period, and offers seem to be reflecting underlying conditions more closely.

9.2 The Authority continues to monitor trading conduct proactively. We publish weekly monitoring reports, that assess market data and update on progress made to review trading periods that we have identified as requiring further analysis. These can be viewed at Monitoring trading conduct — Electricity Authority (ea.govt.nz). We also plan to regularly update and release the type of analysis presented in this paper.