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CC: MDAG members, James Stevenson-Wallace, Matt Rowe

Critique of Concept's report "Review of impact of trading conduct enforcement action on spot prices"

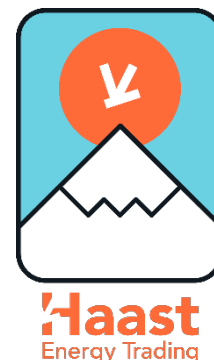
Haast Energy Trading (Haast) has reviewed Concept's report "Review of impact of trading conduct enforcement action on spot prices" (the Concept Report), August 2019, to test the validity of the report, including the extent to which it helps inform whether there has been a structural or behavioural shift in the wholesale electricity market and in wholesale electricity pricing. Our finding is that, once corrected for modelling issues, the Concept Report does not support the hypothesis that there has been no structural shift from May 2017. We also note Concept's finding that there may have been a structural shift or "breakpoint" in February 2017.¹

Summary of Haast's views

- A substantive problem with the Concept Report, or at least the Terms of Reference (ToR) for the Report, is that, as its title suggests, it narrowly focussed on "Review of impact of trading conduct enforcement action on spot prices". This failed to recognise the central hypothesis of Matt Rowe's article² was that there had been a structural shift in wholesale electricity price formation, and "there could be many reasons for this change in offer behaviour". The Concept Report instead exclusively focussed on Matt Rowe's question whether "the fact that the Electricity Authority had on the 8th May 2017 issued one of the generators, Meridian Energy, with a warning for their offer behaviour ... had the unintended consequence of ongoing higher prices due to a change to defensible market behaviour?"
- The question of whether there has been a significant structural shift in electricity spot prices that is not explained by changes in market fundamentals is important. If confirmed it would suggest some generators are significantly altering wholesale prices in a way that benefits themselves, to the long-term detriment of consumers, by changing how they offer their plant. This would highlight that inadequate competition exists, price formation is not efficient, and better regulation and/or structural change is needed to address it.
- We consider that the evidence suggests Matt Rowe was right. Since May 2017, "[wholesale electricity] prices have been consistently higher than the average for the last few years, seemingly independent (and outside) of events that would have historically led to higher prices".
- We also consider Matt Rowe is correct that "It would appear that our electricity market price has somewhat disconnected from our hydro storage situation – it used to be when the southern lakes were at mean levels, water flowed through the turbines, and that electricity flowed into our market, resulting in what most of us deemed fair and reasonable prices".

¹ The Concept Report noted: "Off-peak offered quantity dropped dramatically in February, despite above average storage levels and a normally benign time of year. A Chow test for February 2017 returned an F-statistic of 3.6 and a p-value of 0.3%."

² <https://www.energynews.co.nz/column/wholesale-prices/43428/lakes-are-near-full-gas-fields-are-back-operating-so-why-are-new>



- A significant contributor to why Concept didn't find a shift from May 2017 was that their modelling inappropriately included gas prices. A Granger Causality test indicates electricity price affects gas price suggesting gas prices should have been omitted from Concept's analysis, or replaced with an independent variable that captured the gas market dynamics but was not significantly determined by the electricity price.
- We repeated Concept's regression analysis with gas price removed. This resulted in an average price increase of \$30 since May 2017 after controlling for hydrology. The increase was statistically significant.
- We also repeated the regression after replacing gas price with gas gross production, a variable derived from the publicly available MBIE gas statistics. Further – and unlike gas price – a Granger Causality test shows no evidence that this variable is affected by electricity prices. Our model using this improved gas variable replacing gas price in Concept's data set estimates that there has been a statistically significant price increase of \$22.6 since May 2017. This is after controlling for the effects of hydrology and gas. This result should lead the Authority to ask serious questions about what is changing in the market beyond gas and hydrology.
- If the Concept Report was to be useful it needed to take an inquisitive approach to whether there had been any structural or behavioural changes in the wholesale electricity market. The Concept Report indicated there was a shift in February 2017 supporting Matt Rowe's central hypothesis that "New Zealand has seen what many are calling a 'structural shift' in our pricing in the last couple of years, not dissimilar to what was seen in Australia a couple of years earlier". The February shift Concept identified should have been explored further.

MDAG should thoroughly test the Concept Report

The Concept Report should be thoroughly tested before MDAG draws firm conclusions from the findings of the report.

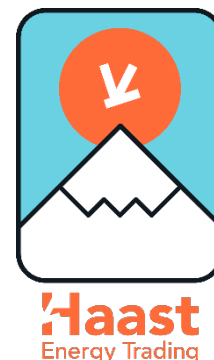
The Authority reminded MDAG, in the firmest terms, that "thorough testing" of "an issue squarely under consideration by the group" is necessary to ensure "analytically robust answers" and MDAG members are expected to "take an open minded approach". The Authority has warned this is essential to ensure "the robustness of the advice MDAG will ultimately provide to the Authority Board".³

This warning is particularly salient, in relation to the Concept Report, as Haast considers the ToR for the report was inappropriately narrow and focussed predominantly on discrediting Matt Rowe's article on high wholesale electricity prices.⁴ Consistent with the Authority's desire for "analytically robust answers", it would have been more appropriate if the ToR had sought an inquisitive testing of whether there has been a structural or behavioural shift (including the question of when) in the wholesale electricity market and in wholesale electricity pricing.

The limitations of the ToR has severely limited the potential usefulness of the Concept Report and creates an apparent evidential bias that there isn't a problem with changes in market conduct and behaviour.

³ Undated and untitled letter from Iana Miller (the Acting General Manager, Market Design) to Tony Baldwin (Chair, MDAG): <https://www.ea.govt.nz/dmsdocument/25596-letter-from-acting-gm-market-design-ilana-miller-to-mdag-chair-tony-baldwin>

⁴ <https://www.energynews.co.nz/column/wholesale-prices/43428/lakes-are-near-full-gas-fields-are-back-operating-so-why-are-new>



Concept should not have included gas prices in its statistical tests

Concept found that electricity prices were structurally higher after May 2017 but attributed this to changing in gas prices and hydro storage rather than, say, trading behaviour. This conclusion was based upon the finding that the wholesale electricity price increase was not statistically significant after 'controlling' for these physical factors.

While controlling for external factors is common, it is not appropriate if the factors are affected by the variable under assessment i.e. wholesale electricity prices. A Granger Causality test⁵ indicates electricity price indeed affects gas price,⁶ suggesting gas prices should have been omitted from Concept's analysis:

Results of the Granger Causality test: are 1 day VWAP gas prices granger-caused by Benmore electricity prices? The small p-value indicates yes.

```
> grangertest(x = granger$ben, y = granger$gas_vwap_1day, order = 6)
Granger causality test

Model 1: granger$gas_vwap_1day ~ Lags(granger$gas_vwap_1day, 1:6) + Lags(granger$ben, 1:6)
Model 2: granger$gas_vwap_1day ~ Lags(granger$gas_vwap_1day, 1:6)
      Res.Df Df    F    Pr(>F)
1      1765
2      1771 -6  7.0736 1.85e-07 ***
```

In contrast, there is no evidence that hydro storage anomaly, Concept's other key explanatory variable, is affected by electricity price:

Results of the Granger causality test: is storage anomaly granger-caused by Benmore electricity prices? The large p-value indicates 'no'.

```
> grangertest(x = granger$ben, y = granger$storage_NZ_anom, order = 6) |
Granger causality test

Model 1: granger$storage_NZ_anom ~ Lags(granger$storage_NZ_anom, 1:6) + Lags(granger$ben, 1:6)
Model 2: granger$storage_NZ_anom ~ Lags(granger$storage_NZ_anom, 1:6)
      Res.Df Df    F    Pr(>F)
1      870
2      876 -6  1.4702 0.1846
```

Given the results of the Granger test, we repeated Concept's regression analysis with gas price removed. This resulted in an average price increase of \$30 since May 2017 after controlling for hydrology. The increase was statistically significant:

⁵ Granger causality tests whether previous values of a given variable x (e.g. electricity price) help to predict future values of another variable y (e.g. gas price) after controlling for any predictive power in the past values of y . In practice, this is done by assessing whether a regression of y as a function of its own lagged values is improved by adding lagged values of x . Our Granger tests have been applied to daily rather than monthly data, because we considered the latter sample size too small to demonstrate (Granger) cause and effect. This is evidenced by the fact that storage anomaly does not granger-cause electricity price if assessed on a monthly basis with the accompanied small sample size over the period, despite being widely recognised as being causal.

⁶ We have not explored the reasons for this relationship in detail, but from a high level we think it is fairly intuitive that the NZ gas and electricity markets are heavily interconnected and a significant amount of the time gas fired power stations are the marginal price setter in both markets.

Reanalysis of Concept's regression model after removing gas price. Note the \$30 price increase after May 2017.

```
> f = lm(elec_price ~ rStor + after_may17, data = price)
> coeftest(f, vcov. = NeweyWest) #adjust for autocorrelation

t test of coefficients:

              Estimate Std. Error t value Pr(>|t|)
(Intercept) 74.1958722  4.9643126 14.9459 < 2.2e-16 ***
rStor        -0.0566489  0.0088749 -6.3831 7.902e-09 ***
after_may17  30.4517695  9.2257100  3.3008 0.001394 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

We investigated alternative options for including gas in the modelling

We acknowledge the gas market is an important driver of electricity price, however, it would have been more robust to model its effect using an independent variable which reflects the underlying drivers in the gas market but which is not significantly driven by electricity prices. We suggest gross gas production as provided by MBIE⁷ is an appropriate measure which captures the key dynamics of the gas market over this period. We believe supply shocks in the gas market have been the dominant feature of recent years and have therefore focussed on the supply side of the gas market. Gas production is not affected by electricity price, as indicated by the following Granger test:

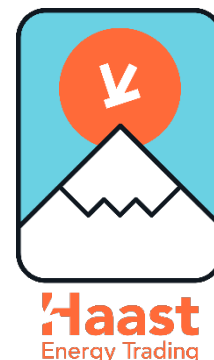
Results of the Granger causality test: is gross gas production granger-caused by Benmore electricity prices? The large p-value indicates 'no'.

```
> grangertest(x = granger$ben, y = log(granger$gas_prod), order = 6) |
Granger causality test

Model 1: log(granger$gas_prod) ~ Lags(log(granger$gas_prod), 1:6) + Lags(granger$ben, 1:6)
Model 2: log(granger$gas_prod) ~ Lags(log(granger$gas_prod), 1:6)
      Res.Df Df    F Pr(>F)
1       870
2       876 -6 0.2036 0.9757
```

When repeating Concept's regression analysis using gas production in place of gas price, the model estimates that prices have increased by \$22.6 since May 2017, after controlling for the effects of hydrology and gas. Further, the price increase is statistically significant as indicated by the small p-value.

⁷ Gross gas production was obtained from MBIE's gas statistics, published here: <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/gas-statistics/#data-tables-for-gas>. We believe this is an appropriate variable which captures supply available to the price sensitive consumption part of the gas market. Because MBIE's and Concept's data are quarterly and monthly, respectively, we imputed the gas data by dividing each quarter by three.



Output of the regression analysis

```
> f = lm(elec_price ~ gas_prod + rstor + after_may17, data = dat2)
> coeftest(f, vcov. = NeweyWest) #adjust for autocorrelation
```

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	157.4025622	40.0601538	3.9292	0.0001717	***
gas_prod	-4.6609955	2.1681472	-2.1498	0.0343824	*
rstor	-0.0579458	0.0085428	-6.7830	1.416e-09	***
after_may17	22.6612436	8.2462275	2.7481	0.0073030	**

In the light of the results of this reanalysis, we believe Concept's work indicates that electricity prices have risen since May 2017 for reasons which are not explained by the obvious fundamental drivers.

The Terms of Reference for the Concept were inappropriate and too narrowly focussed

It appears, based on material released under the OIA, that the purpose of the Concept Report was that the Authority wanted to discredit the Matt Rowe article. The Authority had already formed the view, before the Concept Report was commissioned, that "the prices in spring 2017 ie several months after the May letter was issued were very normal for this time of year and this does not square with Matt's structural change hypothesis" and "the periods of water and gas supply risks were much more extended and extensive than Matt's article says and we should call him out on this more than we do".^{8,9}

Whether for this reason, or other reasons that aren't so apparent, the ToR, consequently, focussed narrowly on whether "trading conduct enforcement action by the Electricity Authority in May 2017 cause[d] a structural increase in electricity spot prices since May 2017", and "To what extent can changes in spot prices since May 2017 be explained by other factors, such as demand, fuel costs or hydrology" [emphasis added]. The narrow focus of the Concept Report meant that, at best, it served to defend the Authority from suggestions "the change in behaviour is a tit-for-tat from Meridian" or "An "up-you" response to its regulator".¹⁰

The inappropriate restrictions on the Concept Report are highlighted by the fact Concept identified off-peak offer volumes below \$100/MWh had declined from February 2017, for reasons not explained by gas price/hydro storage, but this result was dismissed on the grounds it could not have been caused by the May 2017 enforcement letter. While this may be true, it disregards the more pertinent questions of whether prices have structurally increased; and whether trading conduct has been inappropriate (as may be suggested by a decrease in offer volumes unrelated to the physical market). If there was a structural change it should have been neither here nor there whether this was from February or May 2017.

It is also noteworthy that our internal analyses indicate that offer volumes <\$100/MWh have decreased by 4% since May 2017 after controlling for gas price and hydro storage:

⁸ E-mail from Brent Layton to James Stevenson-Wallace Subject: Re: Media - Matt Rowe commentary piece on LinkedIn, 2 July 2019 5:02 PM.

⁹ See also: Q&A to guide the response to the Matt Rowe commentary piece, July 2019.

¹⁰ E-mail from Brent Layton to James Stevenson-Wallace Subject: Re: Media - Matt Rowe commentary piece on LinkedIn, 2 July 2019 5:02 PM.



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Output of the regression model testing whether the volume of offers <\$100 decreased after May 2017. Note that the 'after_may17' coefficient is 0.96 after exponentiation. This is the source of the 4% reduction quoted in the text.

```
Call:
lm(formula = log(offers_lt_100) ~ storage_NZ_anom + gas_vwap_20days +
    after_may17, data = offers)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.239870	-0.051191	-0.004262	0.061411	0.208276

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	4.844e+00	4.624e-03	1047.555	<2e-16	***
storage_NZ_anom	6.345e-05	4.559e-06	13.918	<2e-16	***
gas_vwap_20days	-8.052e-03	7.491e-04	-10.749	<2e-16	***
after_may17	-3.983e-02	4.777e-03	-8.339	<2e-16	***

Concluding remarks

Matt Rowe's article is a constructive and useful contribution to the debate about whether there are structural problems in the wholesale electricity market. The article demonstrated Matt Rowe's ability to think and contribute independently and his desire to seek analytically robust solutions to general market issues.

Concept has failed to demonstrate Matt Rowe's central hypothesis that there has been "a 'structural shift' in our pricing in the last couple of years" is incorrect. The findings of Concept's Report were contingent upon controlling for a variable which we believe should have been omitted (gas price). Our own analysis indicates wholesale electricity prices have increased for reasons other than gas price and hydrology.

After improving Concept's use of conventional statistical tests, we believe their analyses also support the view that prices have materially increased for reasons unrelated to the physical market.

All of the data used in this analysis is either publicly available or available from the NZX or EMS for a fee. We are happy to assist any interested parties who wish to recreate these results.

Yours sincerely,

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