Energy Link decision power

Hedging Fundamentals Part 2

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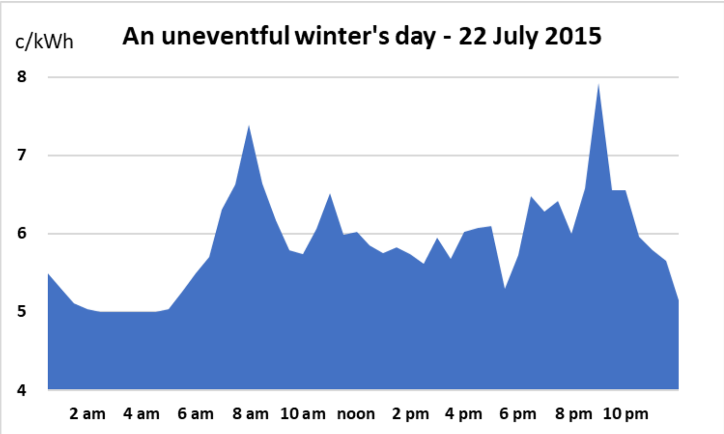
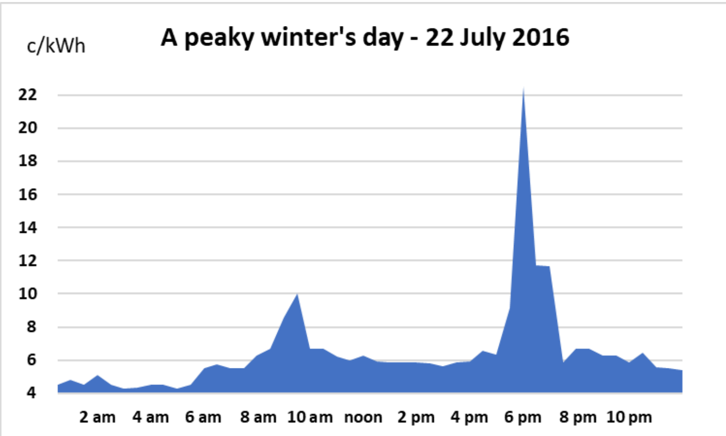
"Why are spot prices in the NZ wholesale electricity market so volatile?"

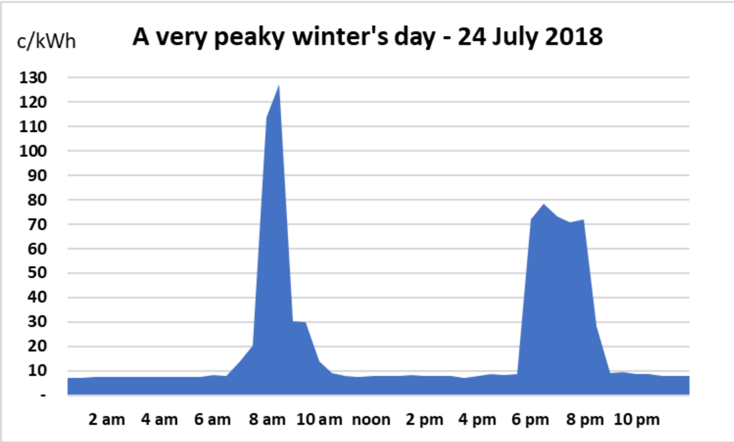
Before answering this question, we first need to define what we mean by "volatile" in this context. The wholesale electricity market is overlaid on the national grid which is the network of high voltage lines carrying electricity to over 200 off-take and injection locations around the country usually called nodes. While most generation is injected directly into the grid, the vast majority of consumers are indirectly connected to the grid through local area networks which do not play a part in the wholesale market.



A separate wholesale electricity spot price is set every half hour at every node on the grid. The price given location and time is the result of a calculation that balances the quantity of electricity demanded with the price offered into the market by generators, after accounting for the cost of transmitting power to the node, and the cost of maintaining a secure supply of electricity.



Clearly the demand for electricity is central to determining its cost. As you might expect, demand varies across the day with peaks typically in the morning and evening and also across the year with demand being on average roughly 7% higher in the six months from April to September than in the corresponding Summer months.

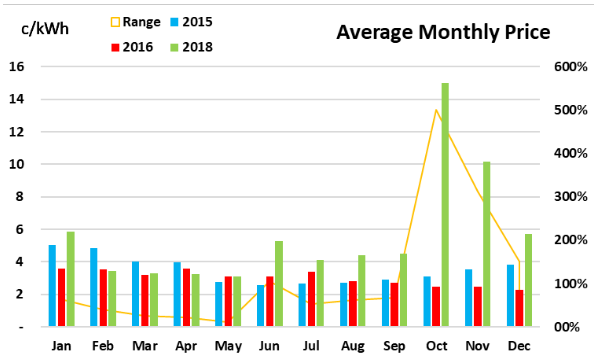


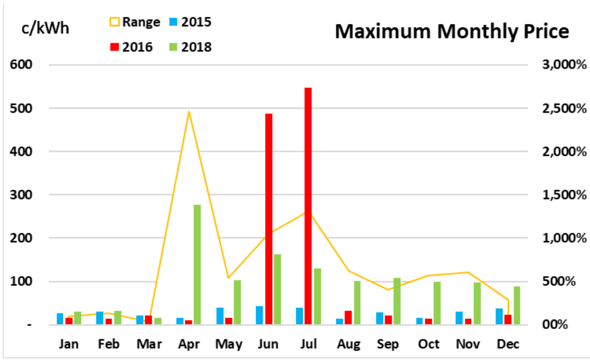
The first three charts show the price at a central Auckland node across a July business day in three separate years.

The overall shape is similar in that the price peaks in the morning an evening when demand also peaks, but the magnitude of the peaks varies significantly: with maximum prices at 7.92 c/kWh at 9 pm in 2015 rising to $1.27 /kWh at 8:30 am in 2019 that's a 1,600% increase!

The dates for these charts were chosen at random from all recent winter business days. Maybe it was just sheer chance that the selection contains such a dramatic price range and averaging of prices would reveal a more stable price pattern?

The next two charts show the average and maximum prices for each month in the three years charted above which reveal some interesting things.

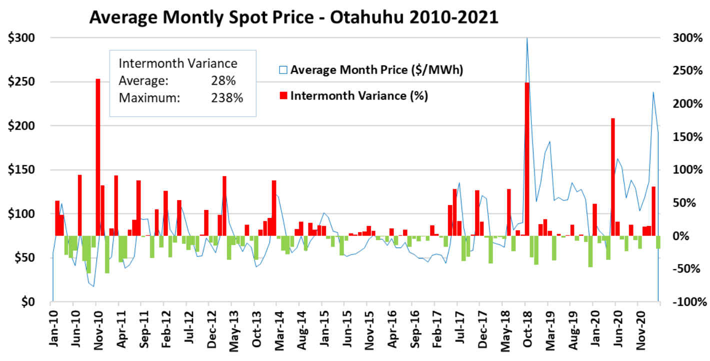


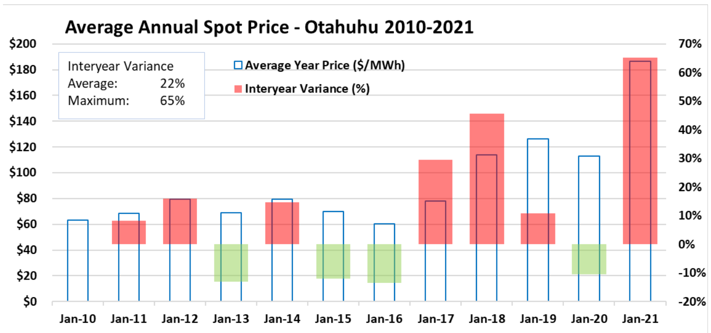


Firstly, averaging the price across the month does flatten the price volatility. For example, taking the July months in the daily charts above, 2018 has an average monthly price 52% higher than 2015, as opposed to the 1,600% daily difference above.

Secondly, looking at the daily and maximum monthly charts above you might have guessed that July 2018 would have the highest half-hourly price but, no, that occurred in July 2016 at $5.46/kWh.

Thirdly, you might have looked for higher winter demand to be reflected in higher winter prices, but the highest average monthly prices in each year appear in January in 2015, April in 2016 and October in 2018.





For a more comprehensive view, let's look at the next two charts which show the average monthly and annual variance in spot price at Otahuhu in Auckland since January 2010.

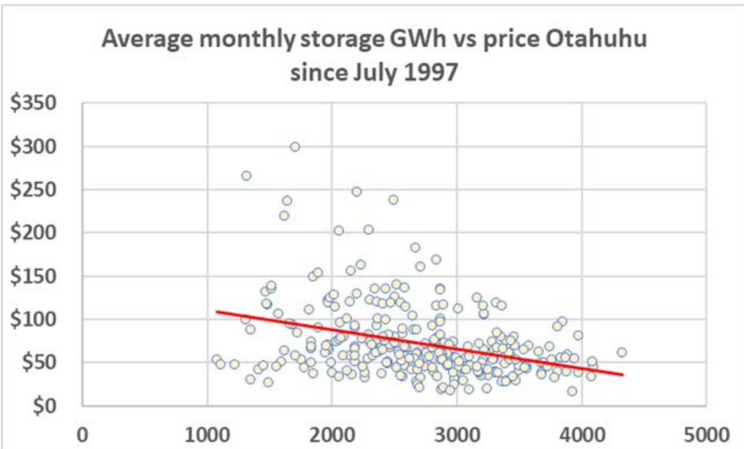
Here we can see the average variance in price from one month to another is 28%, and 22% from one year to the next. So, ignoring 2021 (which at time of writing was incomplete) over the past decade the average price in any one year could be anywhere between 14% lower to 46% higher than the previous year.

Wow – that's quite a challenge for budgeting if you are a buyer or a seller on the spot market!

Clearly demand patterns alone can't fully explain the wide range we see in spot prices. So, what else is going on?

Unfortunately, there is more than one answer. Some of the most dramatic price changes are short lived spikes caused by specific conditions on the grid. For example, the $5.46/kWh price mentioned above occurred during a 2-hour period on the 26th July 2016 and was triggered by a technical fault at the Haywards substation near Wellington that disrupted the conversion of direct current on the inter-island 'HVDC' link, into alternating current on the North Is AC grid.

More sustained periods of high prices can often be traced back to storage levels in the hydro lakes. The scatter graph shows the relationship between the average monthly storage in GWh and the average monthly spot price at Otahuhu since July 1997. When storage levels are high, prices are on average lower. Typically, low storage levels going into winter correlate strongly with higher spot prices.



Other supply-related factors also feed into price volatility. Fossil fuels, mostly natural gas from the Taranaki gas fields, have long been used to maintain supply when generation from the main hydro and geothermal renewable sources cannot meet demand. Any disruption to the supply of thermal generation, such as the issues around supply from the Pohokura gas field since 2018, will put pressure on spot prices, particularly when falling storage levels force hydro generators to be conservative with their water releases for generation.

We should also include in our analysis the contribution to price volatility from intermittent energy sources. Wind generation currently accounts for around 6% of total generation, but only on average. On a good day, when supply from other sources is constrained, wind generation has a strong moderating effect on spot prices. On a bad day, the lack of wind leaves the market exposed to more highly priced generation. The tighter the supply constraint the more pronounced the impact of low wind on price. National efforts to become less reliant on fossil fuels includes the construction of new large-scale windfarms, so we can expect the proportion of total generation coming from wind to increase over the next decade and with it the possibility of ever more short-term price volatility.

Finally, to round out the picture, we should return to demand. While there are growing efforts to provide consumers with technology and incentives to reduce consumption during high price periods, demand remains mostly inelastic in the short-term, especially within a day. The slow and relatively insubstantial response to short-term price signals means that when a spike occurs it is likely to go higher and stay longer than would be the case with more flexible demand response. Contrast this with airline loadings: airliners, like generators, are very expensive, long-term investments, but loadings are very sensitive to ticket prices, which means that hikes in ticket prices are quickly moderated. Unlike air travel, electricity is an essential service, with quite different demand characteristics.

Faced with such price uncertainty, how can buyers and sellers on the wholesale market manage cash flow risk? One widely used approach is to use hedge contracts to lock in future prices regardless of wholesale market movements. Next time we'll take a look at the mechanism underlying the most commonly used contract form: the swap (a.k.a. contract for differences or simply CFD).

Key takeaways:

1. The wholesale price of electricity is unpredictably volatile.
2. The deviation in price from the mean hour by hour, month by month and year by year is considerable.

In the next blog we answer the question: "How does a Contract for Difference work?"

