TRANSPOWER

MARKET 101 - PART 2

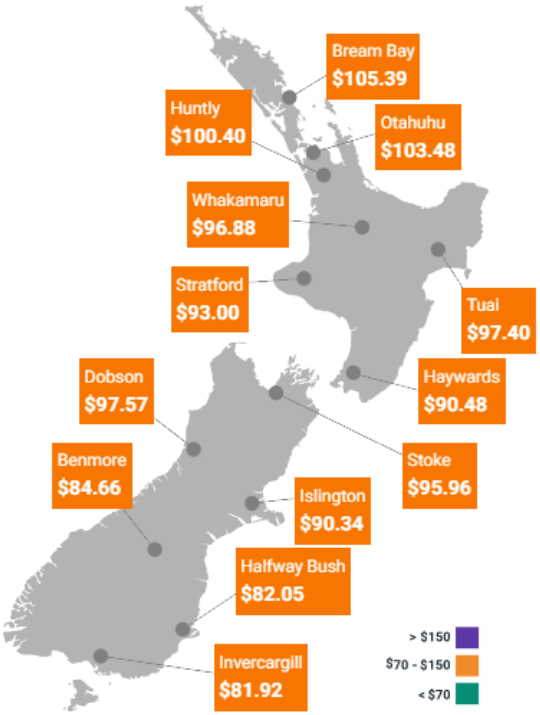
02 July 2018

Locational Marginal Pricing

Why are there different prices all over the grid

This, the second part in our Market 101 series follows on from our earlier article "The Market and the Spot Price". In this article we provide a simple explanation to answer the question "Why are there different prices all over the grid?"

In New Zealand wholesale electricity prices vary according to your location, these are known as locational marginal prices (LMP). These are the half-hour wholesale price of energy at a given location, referred to as a node.



Source: WITS

As the name (locational marginal pricing) suggests these prices are based on

- location (reflecting the cost of transport from generation to that node – including the costs of losses and of transmission constraints) and
- marginal pricing (reflecting the cost of generating and delivering an additional unit of energy to that location - or the amount a generator will be paid for an additional unit supplied at that location).

Let's break down those 2 components, starting with the marginal nature of pricing first.

The marginal aspect of the price

This means the price is set by the incremental cost of producing an additional unit of energy to meet an additional unit of demand. Even if a generator offers its generation at $0.01/MW it doesn't mean that generator will get paid $0.01/MWh for every MWh of electricity that they generate. They will be paid according to the marginal price at the node where they generated that electricity, which may differ from their offered price.

The locational aspect of the price

Within NZ there are some 200 nodes at which wholesale electricity is sold by generators and purchased by retailers on behalf of consumers. As we mentioned above, the price at each location reflects the transport costs from generation to that location. That is, the price includes the cost of electricity lost in transport to the node (called losses) and, if there is limited transmission capacity on the system, the cost of transporting electricity from elsewhere, to meet the load at a node (called constraints). Losses accrue due to heat losses on the lines, and constraints can arise due to congestion on the grid. Congestion may be increased due to outages (planned or unplanned).

For ease of explanation, it's easier to start with the concept of constraints first.

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Examples

For this example, illustrating the concept of constraints, we'll ignore the effect of losses.

In the example to the right, there is a generator at node A with an offer price of $20/MWh and a load at node B. The load at node B requires 50MW of load.

Line A-B has a constraint – a limit of 40MW. There is another generator at location C with an offer price of $100/MWh.

With the constraint on line A-B, only 40MW can come from generator A so the remaining 10MW supply must come from Generator C.

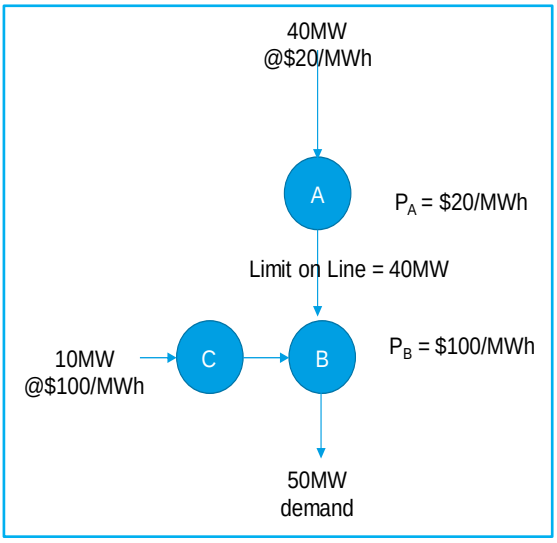
The price at node B will be set at the price of $100/MWh. This is the offer price of the Generator at C, required to supply the electricity that can't come from the Generator at A.

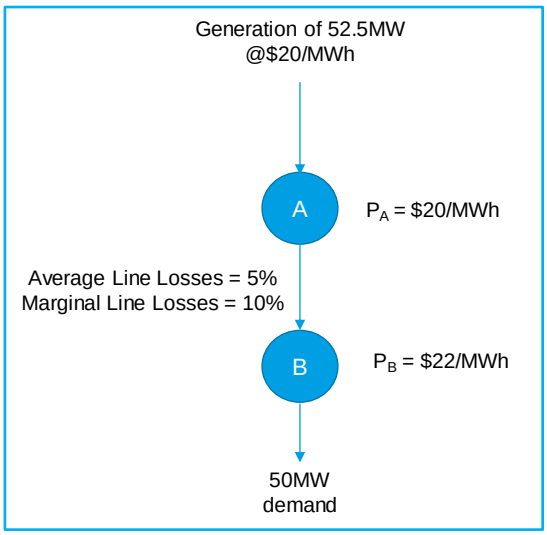
Now let's look at an example of how the price is affected by losses. To do this we'll ignore the concept of constraints.

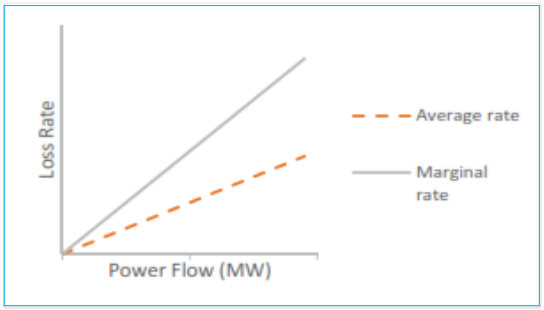
If there is no limit on line A-B then all generation can be met by Generator A. If there is an average loss rate of 5% on line A-B then the generator at node A has to supply 52.5MW, being the demand at Node B plus the losses incurred in transporting 50MW to node B. The generators cleared offer price is $20/MWh. Prices are determined by the marginal loss rate[1].

For an asset, such as lines, where the losses increase with power flow, marginal losses are approximately twice the average loss rate. Losses are a function of current and resistance.

With marginal losses of 10% over the line (and no constraints) the price at node B would be $22/MWh.







[1] The maths behind the relationship between average and marginal losses is excluded here. However, if you wish the loss and constraint excess payment document (https://www.transpower.co.nz/sites/default/files/uncontrolled_docs/Loss%20and%20Constraint%20Excess%20Booklet.pdf) on the Transpower website has a good explanation of the maths behind this.