THE NZ ELECTRICITY MARKET: TEETERING ON THE EDGE OF TRANSFORMATION?
In a sleepy corner of the South Pacific
Consumption

Almost
39,000 GWh
of electricity was consumed in 2014

- Residential consumers: 1,700,000
- Commercial consumers: 166,000
- Industrial consumers: 115,000

Source: Ministry of Business, Innovation and Employment, Energy in New Zealand 2015
Hydro dominated

Figure F.4: Electricity generation by fuel

Renewable electricity generation rose to 85%, a 35 year high
NZ electricity demand peak is winter

Figure 2.6: Intra-week mean system load, summer and winter, 2004-07

Source: Centralised Data Set
ON AVERAGE, WHERE DOES EACH DOLLAR FROM YOUR POWER BILL GO?

90%
- 30.5% GENERATION
  - This money goes towards the cost of generating the electricity you use.

70%
- 9.9% TRANSMISSION
  - This money goes towards the cost of building and maintaining the national grid.

60%
- 26.2% DISTRIBUTION
  - This money goes towards the cost of building and maintaining the power lines that transport electricity from the national grid to your home.

50%
- 16.2% RETAIL
  - This money goes towards the operating costs of the retailer that you bought electricity from.

40%
- 11.0% GST*
  - 3.4% METERING
    - This money goes towards the cost of metering and maintaining your electricity meter.
  - 0.4% MARKET GOVERNANCE
    - This money goes towards energy efficiency programmes and the costs of running the organisations that regulate the electricity industry, including us.
  - 0.4% MARKET SERVICES
    - This money goes towards the operating costs of the organisations that manage the day-to-day running of the electricity market.

10%
- This money goes towards the goods and services that we all pay.

0%
- Source: Electricity Authority

*GST is 15% of the pre-GST cost. Therefore it is 15% of the GST inclusive amount.
### TYPICAL HOUSEHOLD ELECTRICITY USAGE

- **Water Heating**: 30%
- **Electronics and Other Electrical Uses**: 22%
- **Refrigeration**: 16%
- **Space Heating**: 14%
- **Lighting**: 12%
- **Cooking**: 6%

*EECA - Energy End Use Database (calendar year 2013)*
Transmission
It’s just clearing supply and demand?

- Forecast demand
- Generators make capacity available at a price that reflects their willingness to generate
- Clear the market!
Electricity markets are the most “designed” market in the world

- A vital, ubiquitous service for society with few substitutes (heat)
- Need almost absolute assurance that supply and demand balances in real time
- If it doesn’t, blackouts occur
- Historically (and today) storage isn’t economic
- The consumers have been disengaged (technology limitations, but also time)
- The “transportation” problem is driven by hard physical laws

An enormous, complex optimisation problem with extremely little room for error

New Zealand – globally isolated, with a weather-driven system in the Roaring 40s...with a world leading market design
Market is “cleared” every half hour (solved 5 minutes).

At ~250 locations to optimise transmission losses and recognising transmission limitations.

Simultaneously optimising supply of electricity with two types of standby reserves.

Produces market clearing prices at every location, for three products.
A volatile price series

Wholesale Price (c/kWh)


0c/kWh 10c/kWh 20c/kWh 30c/kWh 40c/kWh 50c/kWh 60c/kWh 70c/kWh
Questions

• What sorts of long-term decisions are emerging from this market?

• How will it handle increasing renewables?

• Electricity Price Review

• What about the changes on the demand side?
Questions

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Reliable growth....
Demand 2007-2016
And we built…

(mostly) low SRMC renewables
Wholesale market

Renewable vs Demand Against % Renewable
Then we un-built

(mostly) low SRMC renewables

(exclusively) moderate SRMC thermal
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Can the market handle low emission electricity?
Renewable bid into market at a price of zero

Figure 15: Scatter plot of renewable share and prices for high and very high renewable scenarios.
How do we know if we have adequate energy resources?

Resource Adequacy is the ability to reliably meet demand at every point in time.

The system must have enough reliable capacity to meet the system peak.

The system must have enough available fuel (wind, rain, geo fluids, coal, gas etc) to meet total demand over any period and under different fuel scenarios.
NZ hydro – an unfortunate correlation

Average National Inflows vs National Electricity Demand

- **National Demand**
- **National Inflows**

Annual Expected Solar Profile

- Batteries?
- Demand Response?
Hydro uncertainty
Managing between years

- The concept of “shifting” power through time (flexibility) is relevant to every system.
- But in a hydro dominated system happens over long periods.
- Currently done through fuel contracts + storage.
- With a high renewables future, flexibility will be the “coin of the realm.”
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Figure 5: Average electricity prices between 1990 and 2018

Source: Concept Consulting analysis of data from Ministry of Business, Innovation and Employment. All prices are adjusted for inflation and expressed in 2018 dollars using the CPI index for residential prices and the PPI index for commercial and industrial prices. Residential prices alone include GST.
Composition of Price increases

Figure 6: Changes in composition of residential prices
Breakdown by consumer type

Figure 8: Estimated breakdown of charges by consumer type
International comparison

Figure 9: Residential electricity prices in OECD countries
Switching and new retailers

Number of Retailers

National Switching Statistics

Switches per month
Figure 16: Retailer price variations in individual areas

$ per customer per year
February 2000 to February 2014

- Blue line: Difference between incumbent and lowest cost supplier
- Orange line: Difference between highest and lowest cost supplier
Wholesale market: EPR sees no market power

“Using the LRMC benchmark, there is no clear evidence of the sustained or long term exercise of market power”
However recent work (Poletti, 2018) suggests otherwise

“Our view, and that of most economists, is that market power is being exercised whenever prices are consistently above marginal cost, which may well be below the LRMC for many years - since the investment costs are sunk.”

This is the standard approach taken by regulatory authority’s worldwide. For example the Great Britain Office of Fair Trading (2004) states that market power is

“…the ability profitably to sustain prices above competitive levels [p.2]” whilst the

PJM (2007) discussion document defines market power in electricity markets as the “ability to increase/decrease market clearing price above/below competitive price level [p1.]”
Model competitive prices using a simplified model of the NZ electricity market….

- Need to estimate the water value which looks like a fuel cost and compare to actual prices.
- Competitive offer stack is when all generators offer into market at their marginal cost. Example of 2013 below…
Between 2010-2016 market power rents are **$6 billion (39% of revenue)**!

<table>
<thead>
<tr>
<th>Year</th>
<th>Simulated Competitive Benchmark Revenue ($million)</th>
<th>ACTUAL Market rents ($ million)</th>
<th>% of total</th>
<th>ACTUAL Wholesale Revenue ($million)</th>
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<tr>
<td>2010</td>
<td>1861</td>
<td>333</td>
<td>15%</td>
<td>2194</td>
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<tr>
<td>2011</td>
<td>1668</td>
<td>393</td>
<td>19%</td>
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<td>1569</td>
<td>1077</td>
<td>41%</td>
<td>2646</td>
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<tr>
<td>2013</td>
<td>1146</td>
<td>1003</td>
<td>47%</td>
<td>2145</td>
</tr>
<tr>
<td>2014</td>
<td>1290</td>
<td>1136</td>
<td>47%</td>
<td>2426</td>
</tr>
<tr>
<td>2015</td>
<td>1142</td>
<td>1044</td>
<td>48%</td>
<td>2186</td>
</tr>
<tr>
<td>2016</td>
<td>856</td>
<td>1058</td>
<td>56%</td>
<td>1878</td>
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<tr>
<td>SUM</td>
<td>9532</td>
<td>6044</td>
<td>39%</td>
<td>15536</td>
</tr>
</tbody>
</table>
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Technology – Disruption?
Don’t forget about efficiency - the quiet competitor
Or even just....
A new dynamic?

- Meeting this demand used to be about competition between large generation investments

- Now it’s also about competing with customer investments: efficiency, ‘irrational’ distributed generation, behaviour change.

- BUT we could also see the electrification of process heat, transport
It’s just clearing supply and demand

- So how does the new consumer participate in a half hourly market?
- How do we coordinate (optimise) the flexibility and uncertainty of distributed energy resources?