Commitment to an (almost) 100% renewable electricity sector by 2030

Lots more solar and wind

Security of supply with intermittent generation
Normalized seasonal generation and demand

Source: Transpower 2020
LAKE ONSLOW PUMPED HYDRO STORAGE

- Up to 2000MW capacity
- Turbine can be used to charge and discharge
  - 80% efficiency
- 4 to 12 TWh of storage
  - New Zealand currently has 4 TWh storage
- Cost $4billion
MODELLING 2050

- Historical data 2001 – 2009
- Wholesale demand at various pricing nodes
  - Scaled to a new demand profile
- Weather reanalysis data – simulate future wind and solar
- Historical Hydro inflows
- Solve using linear optimization with a simplified version of pricing nodes and transmission constraints
- Add a reinforcement learning algorithm that models market power
Must-run surpluses and line flows - all years

Must run supply - demand vs Total transmission.
Weekly moving average dispatch - Dry year (GWh)
Price variability

- 6 Month moving-average price
- Monthly moving-average price
### Average wholesale electricity price ($MWh)

<table>
<thead>
<tr>
<th></th>
<th>Wet year</th>
<th>Regular year</th>
<th>Dry year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>62</td>
<td>91</td>
<td>166</td>
</tr>
</tbody>
</table>

**Price duration**

- **Wet year**
- **Regular year**
- **Dry year**
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dispatched</td>
<td>13.4TWh</td>
</tr>
<tr>
<td>Total charged</td>
<td>16.8TWh</td>
</tr>
<tr>
<td>Electricity only cost (MWh)</td>
<td>$2.30</td>
</tr>
<tr>
<td>Mean revenue/MWh</td>
<td>$183</td>
</tr>
<tr>
<td>Profit yearly</td>
<td>$209m</td>
</tr>
<tr>
<td>Payback period at $r = 0.04 (NPV)</td>
<td>52 years</td>
</tr>
<tr>
<td>Payback period at $r = 0.02 (NPV)</td>
<td>31 years</td>
</tr>
<tr>
<td>Payback period at $r = 0.01 (NPV)</td>
<td>27 years</td>
</tr>
</tbody>
</table>
WHERE TO NEXT

▪ Onslow could potentially drop prices for consumers?

▪ Methods of Dispatch
  ▪ Price mechanism to balance supply and demand
  ▪ Government operated, low cost dispatch paid for using levy on all electricity sold
  ▪ Fully profit maximizing.
  ▪ Thermal alternative?
CONTACT

Isaac Gumbrell

isaacgumbrell@gmail.com