The Development of Wind Industry in New Zealand

EGEE 497 Final Presentation
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Development of the wind industry

- New Zealand Vision
- New Zealand Electricity
- Wind Generation
- Diversity in Generation
- Handling Uncertainty and Variability
- Barriers
- NZ Wind Farms
- References
Vision

- Wind Energy to be 20% of NZ generation by 2035 with capacity 3.5 GW
The transformers are warm,” says Barbara Jackson, a Manawatu farmer. “The sheep like to snuggle up to them.” The sheep also use the towers to shield themselves from driving wind and rain.
The New Zealand Electricity

- Total installed generation capacity: 10,539 MW
- Peak load: 6,414 MW
- Electricity production (2014): 39.7 TWh
- Thermal plant (gas and coal): 20%
- Hydro generation: 59%
- Geothermal generation: 15%
- Wind generation: 6%
Wind Generation

- New Zealand has good wind resources
  - NZ locates in the Southern Ocean between 34S and 47S
  - Capacity factor reach 45% in NZ and the global average is 24%
  - Researcher collected good quality wind data showing NZ have a world class wind resource
  - Distribution companies are eager to develop generation in their local areas

- Wind generation is scalable
  - Distribution companies are eager to develop generation in their local areas

- The technology is straight forward to install

- Wind was profitable for lines companies

Domestic generation organization recognizing wind to be a potential future for of generation
Diversity in Generation

Enabling the system to respond and maintain supply even when there is a serious problem with one form of generation

- In February 2010, the HVDC system was shut down for over three hours. The outage coincided with a period when a number of North Island power stations were offline for maintenance.

Fortunately, strong winds at the North Island wind farms during this time, and so the wind farms met the demand. West Wind near Wellington ran at approximately 75% of rated capacity and the wind farms in the Manawatu ran at around 50%.

- Improving power quality in rural areas

Prior to White Hill’s commissioning in 2007, the local network experienced fluctuations in voltage as load varied throughout the day.
Handling Uncertainty and Variability
Handling Uncertainty and Variability

- The aggregation of wind farms reduce the forecast error because of smoothing effects
- The power generating units:
  - Peak units: hydropower plants and open cycle gas turbines
  - Mid-merit units: biomass and combined cycle gas turbines (CCGT)
  - Base load units: geothermal, coal fired plants
- The reserves units
  - Primary or frequency response: stabilizing the system frequency after a disturbance
  - Regulation reserve: restoring the frequency and interarea power exchanges
  - Tertiary or replacement reserve: restoring secondary reserve levels
Barriers

- In 1998 the government passed a new law
  - Run the distribution network only or
  - Become a retailer and or/generator.

The wind generation development ceased in 1998 to 2006 affecting the whole development of wind generation

- Geothermal development growth
  
  Considerable number of expertise and government subsides

- The government concerned that the ability of delivering sufficient generation

  In 2004 New Zealand suffered an electricity shortage caused by drought so they commissioned Gas fired generation plant (400 MW) in 2007
## NZ Wind Farms

### Proposed wind farms

<table>
<thead>
<tr>
<th>Site</th>
<th>Developer</th>
<th>Region</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueskin Bay</td>
<td>Local community project</td>
<td>Otago</td>
<td>Consent and environment court appeal declined</td>
</tr>
<tr>
<td>Putau Forest</td>
<td>Meridian</td>
<td>Northland</td>
<td>Site under investigation</td>
</tr>
<tr>
<td>Ah piano Gurnfields</td>
<td>Meridian</td>
<td>Northland</td>
<td>Site under investigation</td>
</tr>
<tr>
<td>Slopedown</td>
<td>Genesis Energy</td>
<td>Southland</td>
<td>Site under investigation</td>
</tr>
<tr>
<td>Cape Campbell</td>
<td>Mercury</td>
<td>Marlborough</td>
<td>Site under investigation</td>
</tr>
<tr>
<td>Mt Stalker</td>
<td>Waitaki Wind</td>
<td>Otago</td>
<td>Site under investigation</td>
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</table>

### Consented wind farms

<table>
<thead>
<tr>
<th>Site</th>
<th>Developer</th>
<th>Region</th>
<th>Capacity (MW)</th>
<th>RMA Application publicly notified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waverley</td>
<td>Tilt Renewables</td>
<td>South Taranaki</td>
<td>130</td>
<td>July 2017</td>
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<tr>
<td>Castle Hill</td>
<td>Genesis Energy</td>
<td>Northern Wairarapa</td>
<td>800</td>
<td>August 2011</td>
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<tr>
<td>Martinborough (Stage 2)</td>
<td>Tilt Renewables</td>
<td>Clutha</td>
<td>160</td>
<td>November 2009</td>
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<tr>
<td>Long Ebook</td>
<td>Windflow</td>
<td>Wellington</td>
<td>upto 12.5</td>
<td>May 2009</td>
</tr>
<tr>
<td>Taranaki</td>
<td>Mercurry</td>
<td>Manawatu</td>
<td>upto 180</td>
<td>January 2009</td>
</tr>
<tr>
<td>Waikana</td>
<td>Contact Energy</td>
<td>Southern Hawkes Bay</td>
<td>upto 150</td>
<td>September 2008</td>
</tr>
<tr>
<td>Central Wind</td>
<td>Meridian</td>
<td>Ruapehu &amp; Rangarika</td>
<td>upto 150</td>
<td>July 2008</td>
</tr>
<tr>
<td>Mc Cus</td>
<td>MainPower</td>
<td>Hauraki</td>
<td>upto 78</td>
<td>June 2008</td>
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<tr>
<td>Kaimo Downs</td>
<td>Tilt Renewables</td>
<td>Gore</td>
<td>upto 240</td>
<td>November 2007</td>
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<tr>
<td>Takarau</td>
<td>Tamarua Card PowerCoast</td>
<td>Kawhia</td>
<td>upto 54</td>
<td>December 2005</td>
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<tr>
<td>Hawkes Bay</td>
<td>Meridian</td>
<td>Hastings</td>
<td>upto 225</td>
<td>May 2005</td>
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<tr>
<td>Tairua</td>
<td>Meridian</td>
<td>Hastings</td>
<td>upto 48</td>
<td>April 2005</td>
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<td>Arirua</td>
<td>Tilt Renewables</td>
<td>Franklin</td>
<td>upto 18</td>
<td>April 2004</td>
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<td>Taumatapea</td>
<td>Ventus</td>
<td>Waitakaro</td>
<td>upto 37</td>
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<tr>
<td>Hurunui</td>
<td>Meridian Energy</td>
<td>Hurunui</td>
<td>upto 75.9</td>
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<tr>
<td>Pukatani</td>
<td>Mercury</td>
<td>Taranaki District</td>
<td>upto 318</td>
<td></td>
</tr>
</tbody>
</table>

### Operating & under construction

- Brookshore
- Pin Hill
- Titikaveka
- Meeto Wind
- Heke Wind
- Peele Point
- Te Kamea
- Bluff Point
- Te Kakea
- Seabirds
- Seabirds
- Te Akau
- Oreti Point
- Waitaki Point
- Wairau Point
- South Shore
- Hanga Roa
- Tangaroa
- Te Aroha
- Te Aroha
References

- https://ac.els-cdn.com/S1364032111000700/1-s2.0-S1364032111000700-main.pdf?_tid=93471c15-1da5-43d2-86b1-1e72ae2444eb&acdnat=1524695118_7f70875046e7e165f2b00cf606728764