

Geothermal and Distributed Generation



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Geothermal Generation and Distributed Generation

- Geothermal generation is frequently larger scale distributed generation
- The Spa Hotel (Taupo) and Wairakei construction power supplies were all from small geothermal generators in the 1950s
- The next geothermal distributed generation was a 10MW turbine at Kawerau pulp and paper mill in 1966
- There have been many examples since, and the next major geothermal station will be MRP's 70 MW Kawerau station which will be embedded in Norske Skog Tasman facilities i.e. will be one of the largest examples of distributed generation to be seen in coming years

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History of Development to 2006



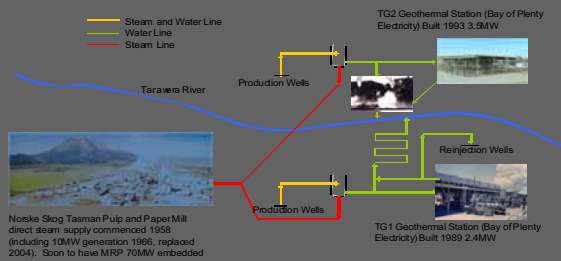
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Exploitation and developments since 2000

- Mokai has added 39 MWe
- Wairakei has added a 14 MWe binary
- Rotokawa expansion of about 6 MWe
- Norske Skog Tasman replaced their old 10MWe back-pressure turbine (distributed generation)
- Kawerau consents pending for 70 MWe
- Wairakei consents pending for expansion
- Ngawha consents pending for expansion (DG)
- Several new resources under exploration (DG?)

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An example from Kawerau



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Some Thoughts on Non-DG Developments

Of the few developments not highlighted as DG in the previous slides:

- Unison has their Taupo substation link into the Wairakei substation
- Ohaaki now only generates 30-40MW and could conceivably be embedded in Unison's network
- Poihipi was developed in joint-venture with Mercury
- Mokai had a provision at concept stage for a portion of the generation to be distributed directly to what is now The Lines Company

All other New Zealand geothermal developments are examples of DG

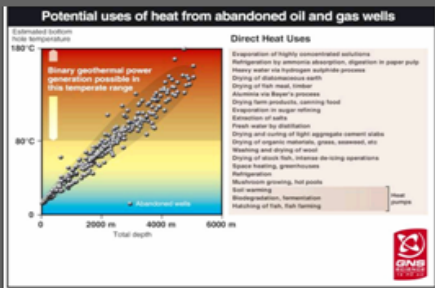
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NZ Geothermal Fields – High Temperature



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Another Potential Geothermal Source - Old Oil & Gas Wells

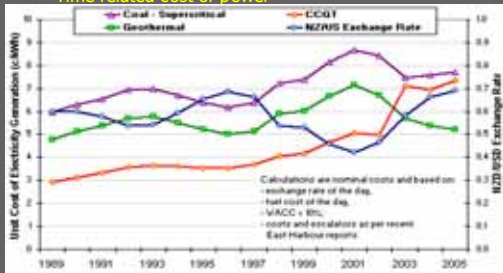


Note: any electricity generated from this source will be small scale and embedded

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Geothermal power is cost effective

Time related cost of power



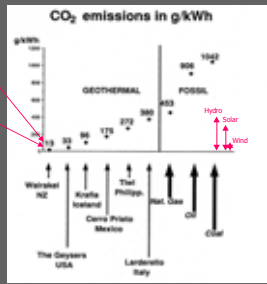
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Geothermal has low green house gas emissions

CO₂ emissions in g/kWh (Barbier,2002)

Ohaaki (100 g/GWh)
High Gas
Wairakei (42 g/GWh)
Low Gas

Direct Use emissions
are lower!



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Changes in Power Technology with Time

- Extraction of higher temperature by deeper drilling on resources
- Binary cycle technology, which includes:
- Isopentane cycle, allows more complete utilisation of the resource
- More efficient heat recovery (eg Kawerau, Mokai, Rotokawa, Ngawha and Wairakei (under construction)).

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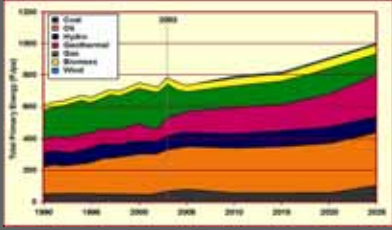
Direct Use in New Zealand

Use	Installed Capacity (MWt)	Annual Energy Use ^b (TJ/yr = 10 ¹² J/yr)	Capacity Factor ^c
Space Heating	>22	>700	
Fish & Animal Farming	18.6	363	0.62
Agricultural Drying	29.3	>253	
Industrial Process Heat	210	5500	0.83
Bathing & Swimming	28	265	0.3 (est)
SubTotal	307.9	7081	

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Looking to the Future

Demand for electricity expected to grow at 1.2% annually through to 2025
Using geothermal enables NZ to better meet the Kyoto Protocol targets



With research the geothermal contribution can increase further

New Zealand Energy Outlook to 2025 (MED)

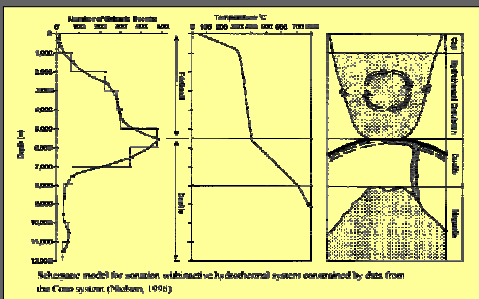
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The Future

- The previous MED view reflects a view that between 400 and 600 MW of new geothermal development is likely in the next two decades
- Some of this will be DG
- Ngawha field provides a prime opportunity to meet Top Energy, Northland (and North Auckland) electricity demand beyond the current transmission constraints out of Whakamaru
- Deep drilling and new technology could extend potential development opportunities further

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Deeper Drilling towards the Brittle Ductile Transition Zone



Schematic model for variation within active hydrothermal systems constrained by data from the Taupo system. (Nicholson, 1998)

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