



# Applying New Zealand Geothermal Expertise to Asia

- Putting expert resources, skills, and experience to use

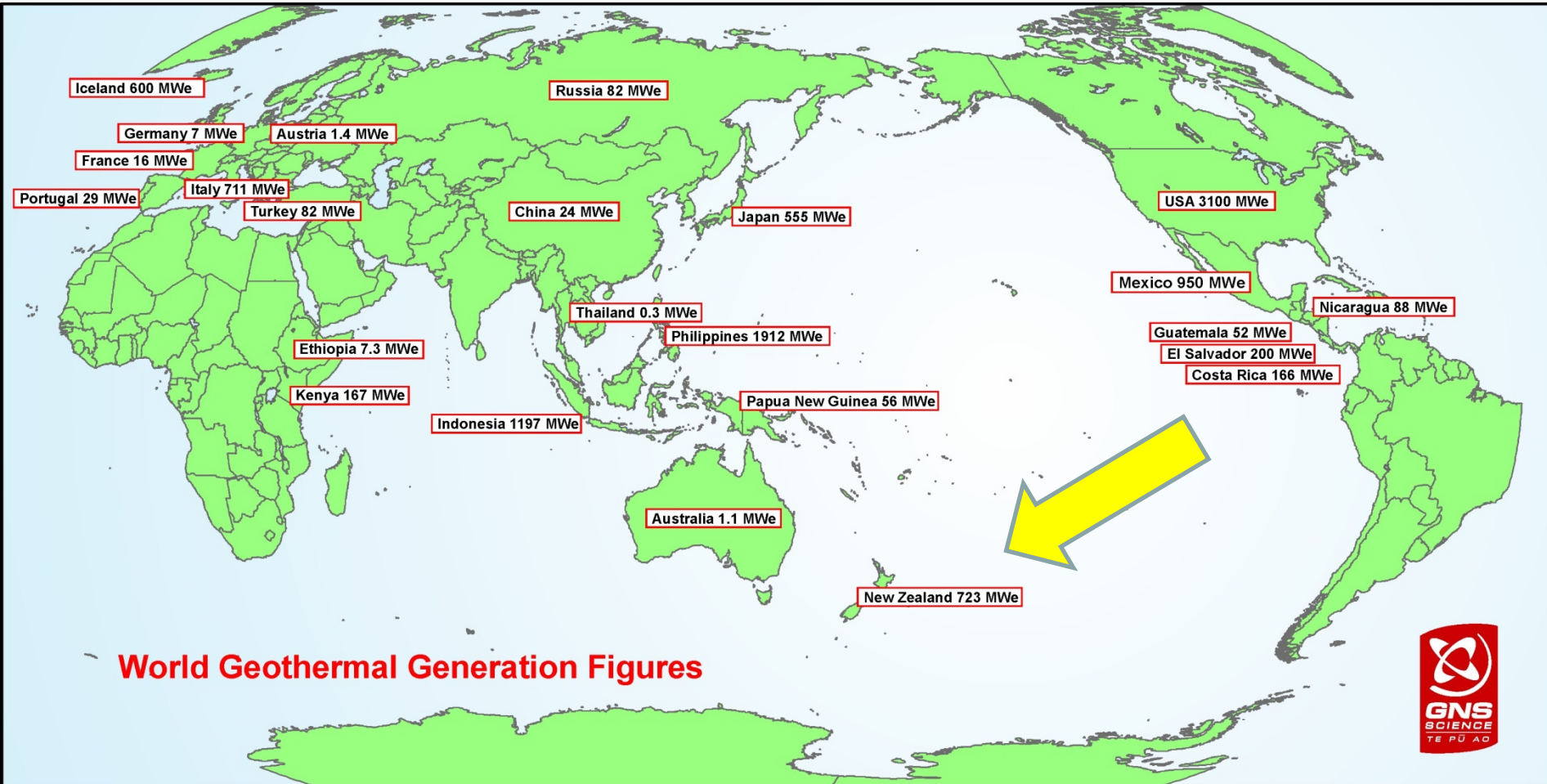
# New Zealand Geothermal – business is booming

- New Zealand's generation up to 740 MWe by July 2010 (approx 6th place globally)
- Geothermal contribution to national generation is around 13.5% (c.f 6.4% only 5 years ago)
- Growth in geothermal for process heat and direct use
- Premium geothermal resources
- Extensive training and education resources
- Workforce experienced and skilled in geothermal
- Experts with international experience

.....NZ geothermal is booming



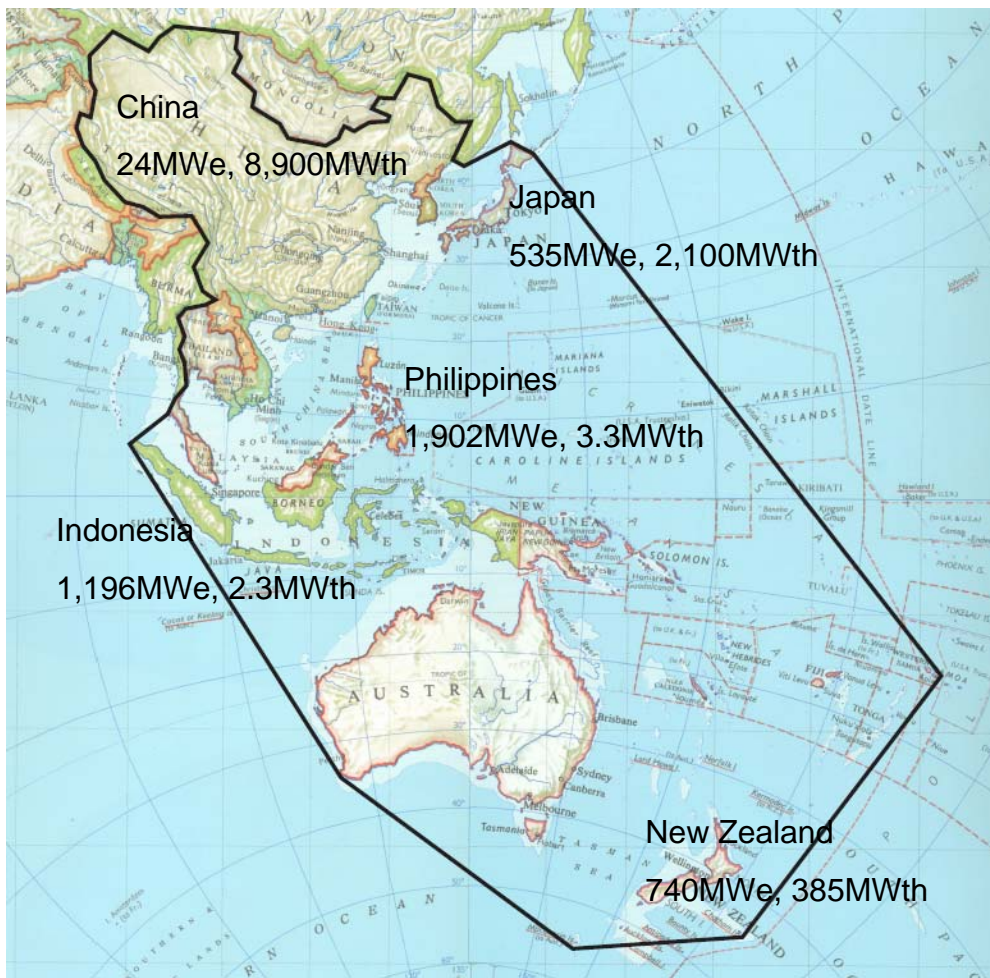
# NZ Geothermal on the World Scene (currently 6<sup>th</sup> largest,- rapid expansion underway)



**World Geothermal Generation Figures**



# Western Pacific Regional Branch of the International Geothermal Association

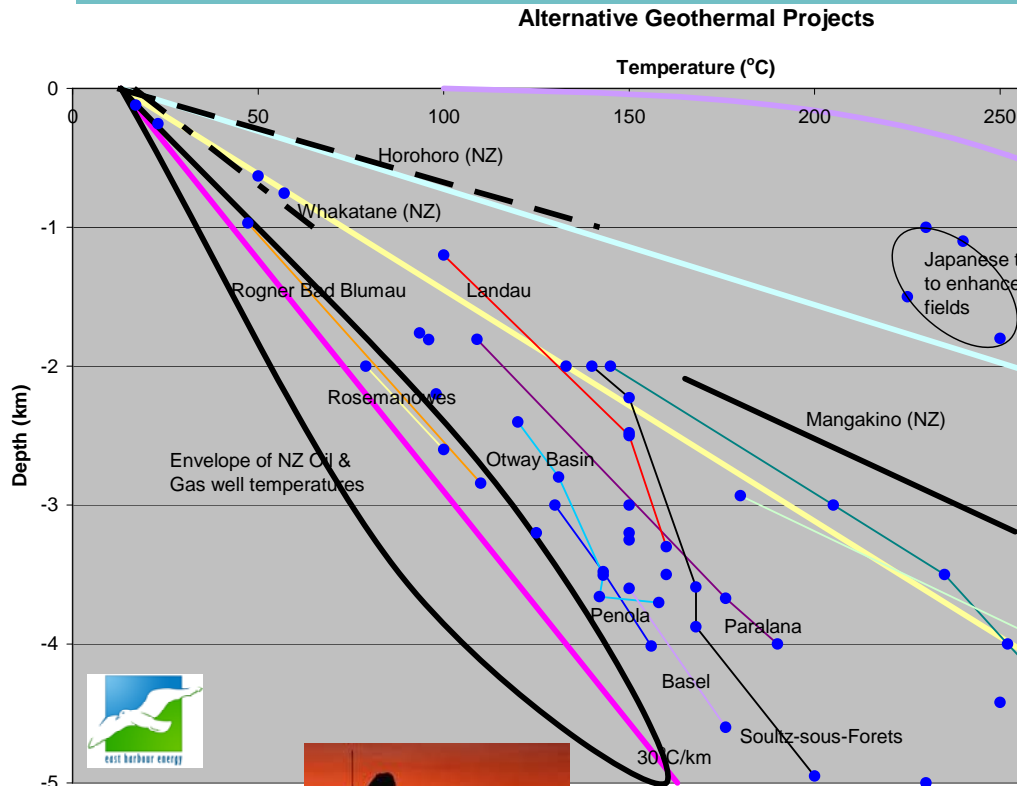


- A community of, and forum for geothermal interests with similar characteristics and applications
- Some countries have active programs
- Significant more potential available.
- Collective action

# Types of Geothermal Resources

- Heat pumps – take advantage of the steady temperature in earth or water e.g. lake, river or sea – can be used anywhere
- Natural thermal gradient – Earth’s temperature increases by about 30°C/km most places
- Better gradients due to radiogenic decay or shallow magma – could be used in “engineered systems”
- Hydrothermal resources e.g. as found around the Pacific “Ring of Fire” (parts of New Zealand, Indonesia, the Philippines)

# Natural thermal gradients



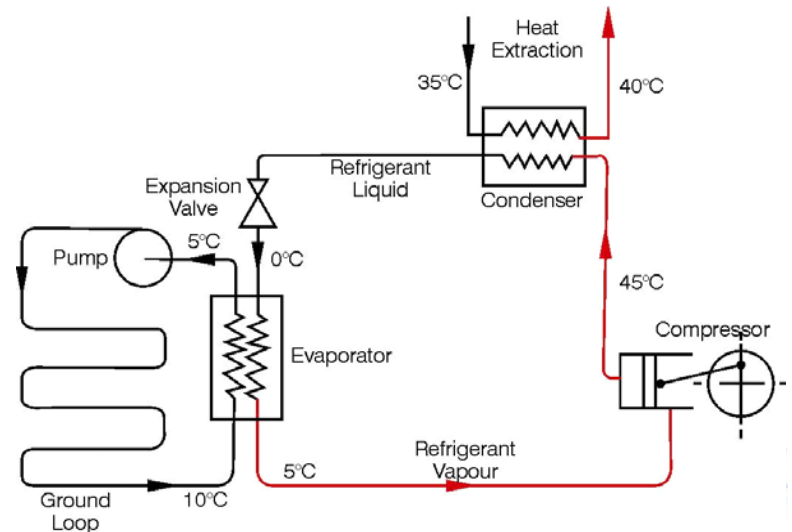
- Power stations have already been developed based on thermal gradients found in O&G wells
- Temperatures at various strata could be useful for a range of direct use applications



Rogner Bad Blumau 250 kW, Austria

# Heat Pumps

- Heat pumps use the steady temperature of water or soil as a source of energy for other heating
- Applications include space and water heating



# Geothermal – The NZ advantage (1)

- Premium geothermal resources – best generation option
- Expansion opportunities on existing operations - attractive economics in current domestic market
- Attractive return on investments (generation and direct use)
- Developers keen to invest in local resources - established staff bases and experience, coupled with availability of skills
- Government reforms – reducing investment barriers
- Government funded R&D programmes
- Local Authority planning initiatives to facilitate development
- Expert training, education

## Geothermal – The NZ advantage (2)

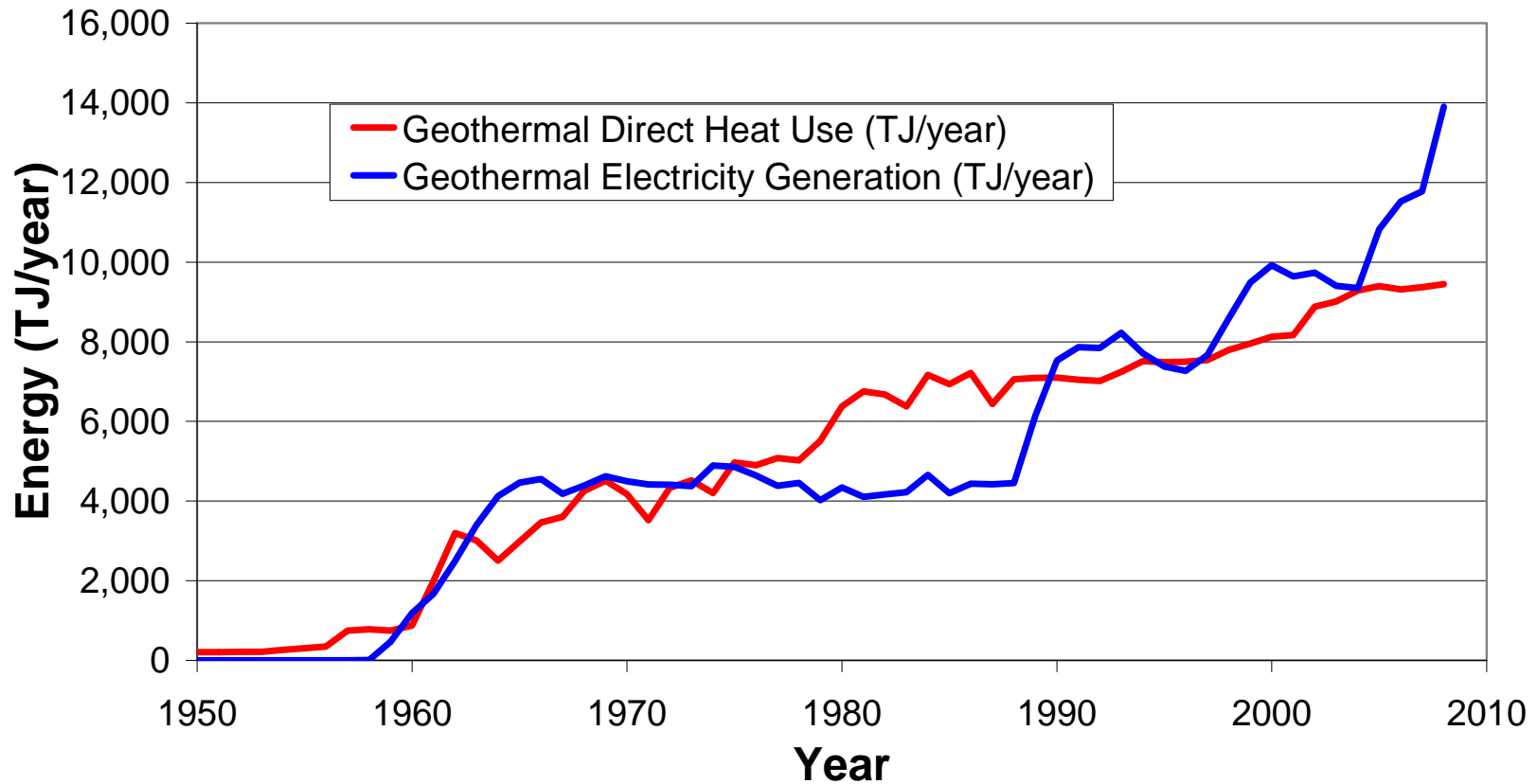
- Resource allocation procedures improved - quality of decisions and associated processes; reduction of the time required to obtain consents
- Central Government submissions to support renewable developments at the individual project level
- Cost of carbon encourages geothermal developments
- Government policy initiatives to encourage geothermal
- Active Geothermal Association representing experts

....increased investment and development

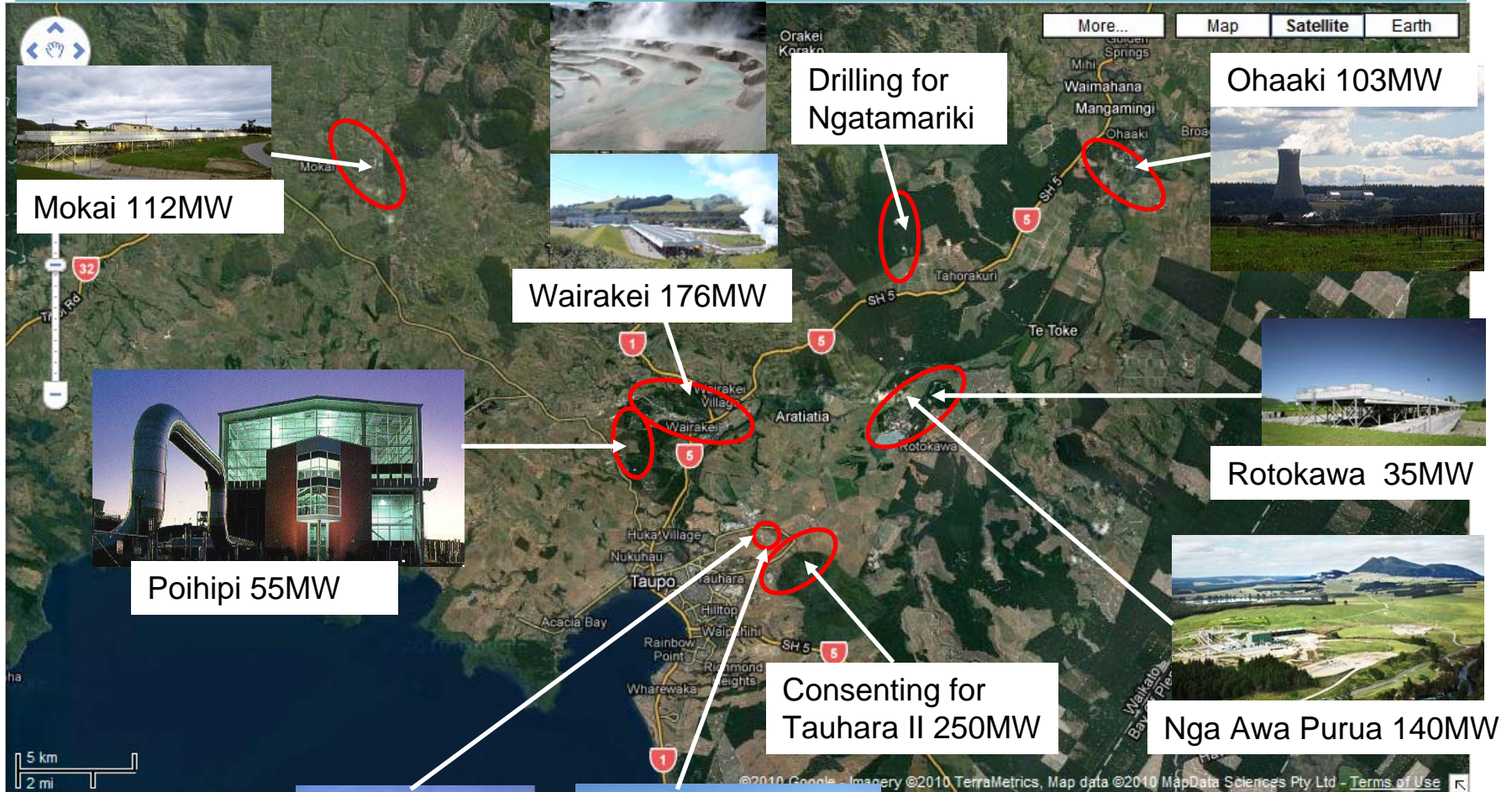
# Why Geothermal?

- Renewable
- Low emissions
- Baseload
- Reliable
- Competitive unit cost (for attractive resources – heat or electricity)

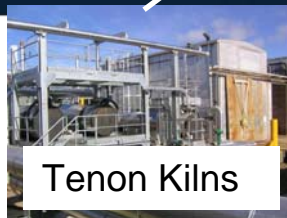
# Geothermal electricity generation and direct use in New Zealand 1950 to present day



# Clustered Developments



**Note: there are other projects at Kawerau and Ngawha**

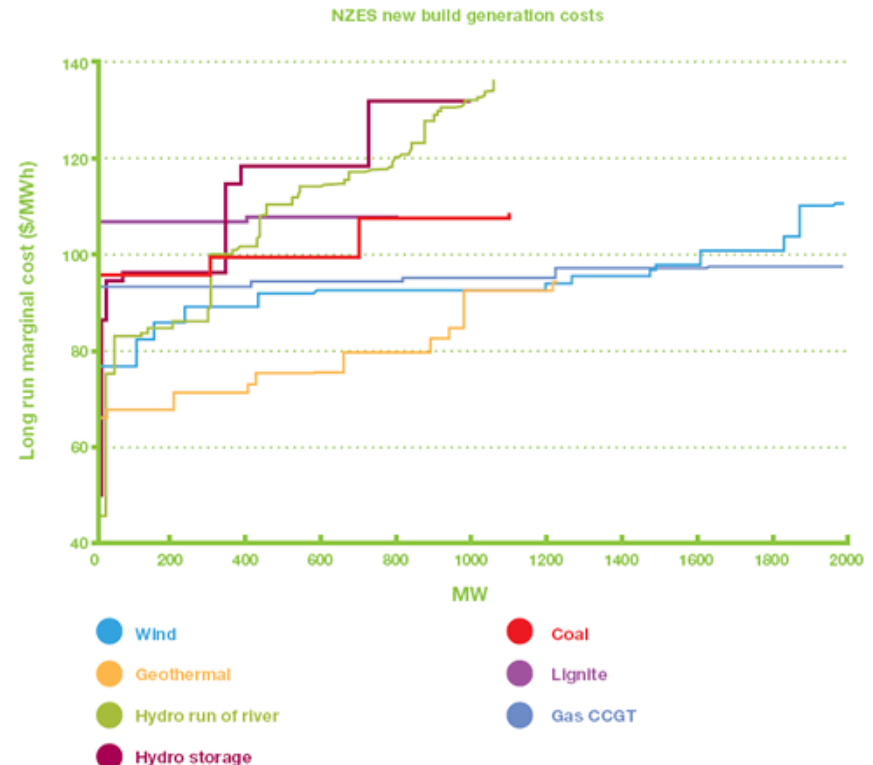


# Cost of Recent NZ Geothermal Electricity Developments

- Inclusive recent capital costs
  - Kawerau:~NZ \$3.0 M / MWe
  - Rotokawa:~NZ \$3.4 M / MWe
  - Tauhara Centennial:~NZ \$3.4 M / MWe
  - New projects ~NZ \$4 M / MWe

(~US\$ 2.8 M / MWe in 2010)

- Geothermal electricity can be supplied at around US5c/kWh
- At that price it can be cheaper than all other generation alternatives in New Zealand

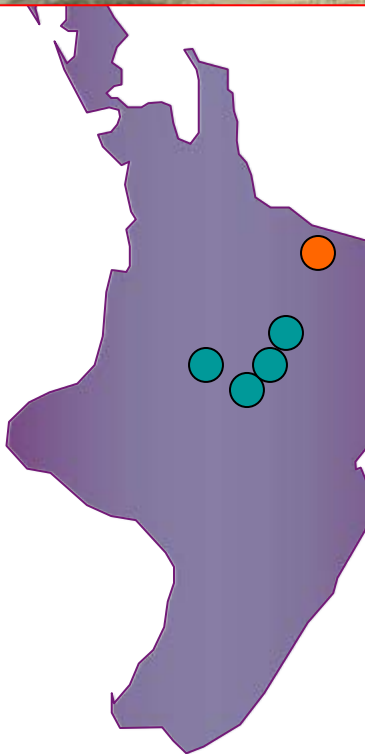


# Some recent developments

- Generation
  - Kawerau
  - Rotokawa and Ngatamariki
  - Wairakei –Poihipi –Tauhara
- Direct Use
  - Mokai Glasshouses

# Kawerau

- Largest industrial direct geothermal heat use in the world (~200 MWth ; 5300 TJ/yr)
- Small power plants
- 100 MWe expansion commissioned in 2008



# Rotokawa and Ngatamariki

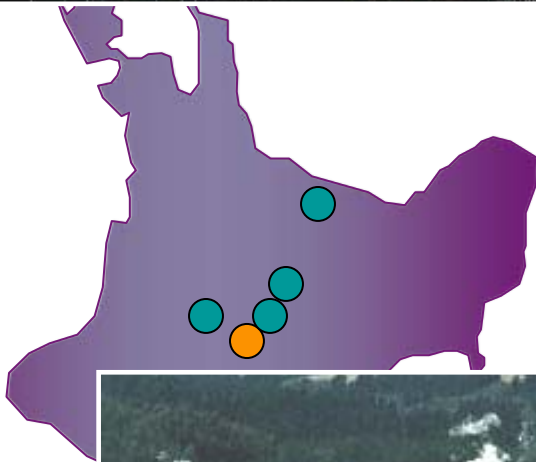


35 MW combined steam turbine and binary plant in 1997

- 132 MW Nga Awa Purua station – commissioned in March 2010 – includes the largest geothermal steam turbine in the world
- nearby Ngatamariki development - drilling successful (80 MW planned)



# Wairakei –Poihipi - Tauhara



## WAIRAKEI (and Poihipi)

- Original Wairakei station has been operating for 50 years
- Current generation ~220MWe
- Contact Energy considering replacing part of the original plant

## TAUHARA

- 16MWth direct heat supply for timber drying
- 23MWe binary plant commissioned 2010
- Consenting underway for further ~250 MWe

# Mokai Glasshouses



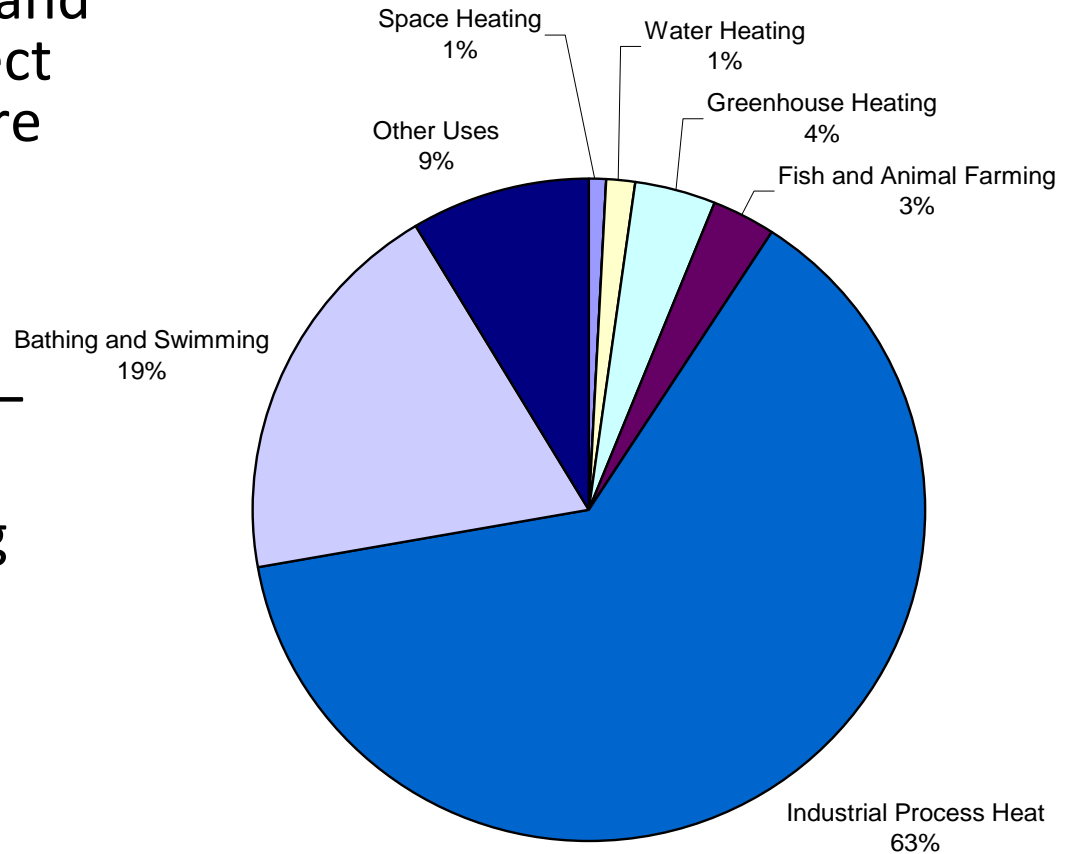
- Horticultural activities use about 300TJ/year of geothermal heat
- The fifth largest direct user of geothermal energy in New Zealand.
- Expansion plans to extend the current 12 hectares of glasshouses to 20, and then 50, hectares.



# NZ Direct Use vs Your Applications

- Proximity of farm land and forestry mean that direct uses related to these are favourable
- We have diversified to fish/prawn farming
- Hot pools and tourism – major business sector
- Home and pool heating because of our climate
- Possible use in food processing

Breakdown of New Zealand Geothermal Direct Use



Total energy use ~ 10PJ/year

What would be best for you?

## Extensive Training / Research Facilities

- NZ Geothermal Institute
- Established in 1978
- First course offered 1979, 30 students
- Diploma course, and short courses in reservoir engineering & environmental
- Now University of Auckland
- A world-leading international training institution

# Extensive Research and Training Facilities

## Geothermal Program

### Research- Basic, Applied & Services

- Reservoir engineering
- Reservoir modelling
- Geothermal geology
- Geothermal geophysics
- Geothermal geochemistry

### Education

- Short Courses
- Postgraduate Certificate in Geothermal Energy technology
- Master of Energy
- Master of Engineering and Master of Science
- PhD



# Advanced Training

## Geothermal Postgraduate Training

- ~1300 alumni
- More than 150 Indonesians
- Large proportion of Geothermal alumni are graduates of the Postgraduate Diploma/Certificate in Geothermal Energy Technology
- >900 student reports and theses, 110 conference papers, 155 refereed papers, >70 technical reports
- Practical, field aspect to courses, thanks to the NZ Geothermal industry co-operation.



# Capabilities/skills offered by NZ companies

NZ geothermal consultants work throughout Asia and the world

- Training and Research specialists
- Geoscience
- Drilling
- Testing
- Environmental
- Resource Assessment
- Engineering Services
- Refurbishment
- Due Diligence
- Generation
- Generation equipment providers

(see New Zealand Geothermal Companies details)



# The Future

- Geothermal energy – ultimate renewable energy source
- Well developed technology
- Experienced practitioners
- Large number of role models
- Minimal community disruption
- Available for heat and electricity generation.
- Is under every piece of land we stand on
- Our collective experience can release large amounts of energy.

**Geothermal energy – a wise investment**

