International Geothermal Development

Case Study: Ngatamariki Geothermal Field, New Zealand

Fourth London Geothermal Symposium, 13 October 2014

Presentation Outline

1. History of geothermal development in New Zealand
2. Key differences between geothermal development in New Zealand and UK
   - Tectonics
   - Electricity market
3. Ngatamariki project timeline
4. Importance of understanding the resource

Geothermal Development In New Zealand

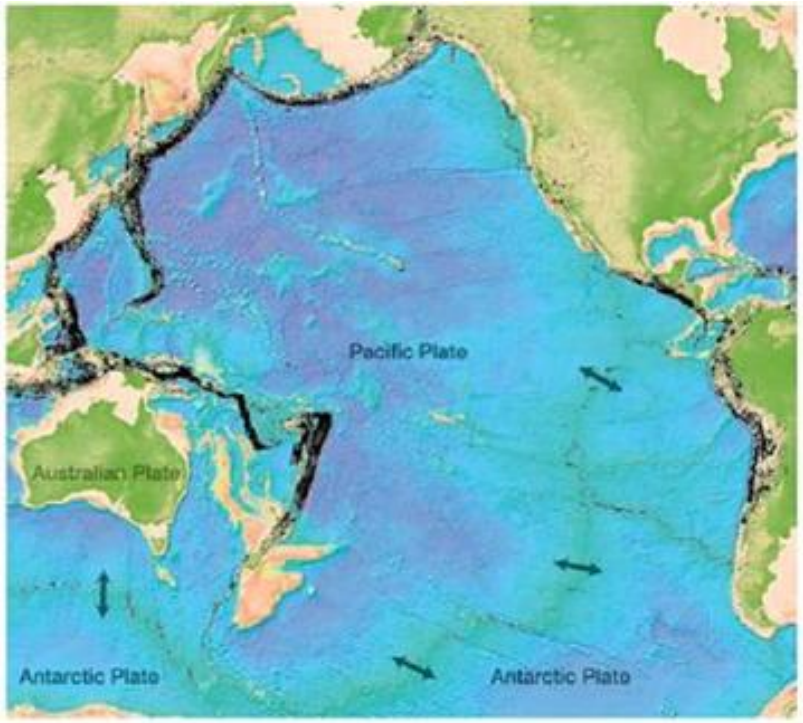
- Wairakei Power Plant commissioned 1958;
- Followed by intensive period of govt. led R&D;
- Large gas discovery in 1980's put further geothermal development on hold;
- Geothermal 'renaissance' period from mid-1990's;
- Today, ~900 MW installed geothermal capacity, equivalent to 14% of NZ electricity generation.
- Current low electricity demand – no further geothermal development for estimated 3-5 years.

Te Mihi Geothermal Power Station

Key Differences with UK Market

1. Tectonic setting

- New Zealand located on ‘Pacific Ring of Fire’
- Subduction of pacific plate
- >14 high temperature geothermal fields associated with volcanic activity in the Taupo Volcanic Zone
- Both steam and liquid resources up to >300°C at 2000-3000m depth



www.gns.cri.nz

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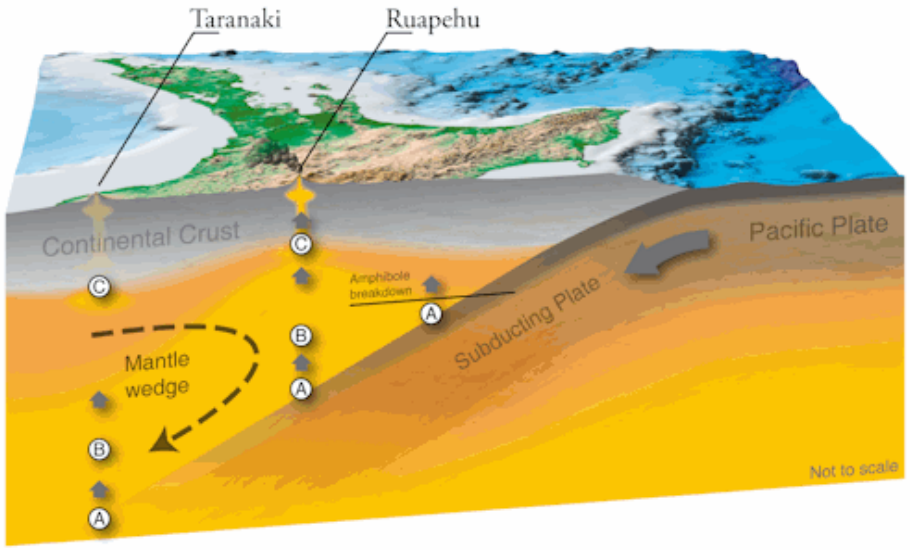

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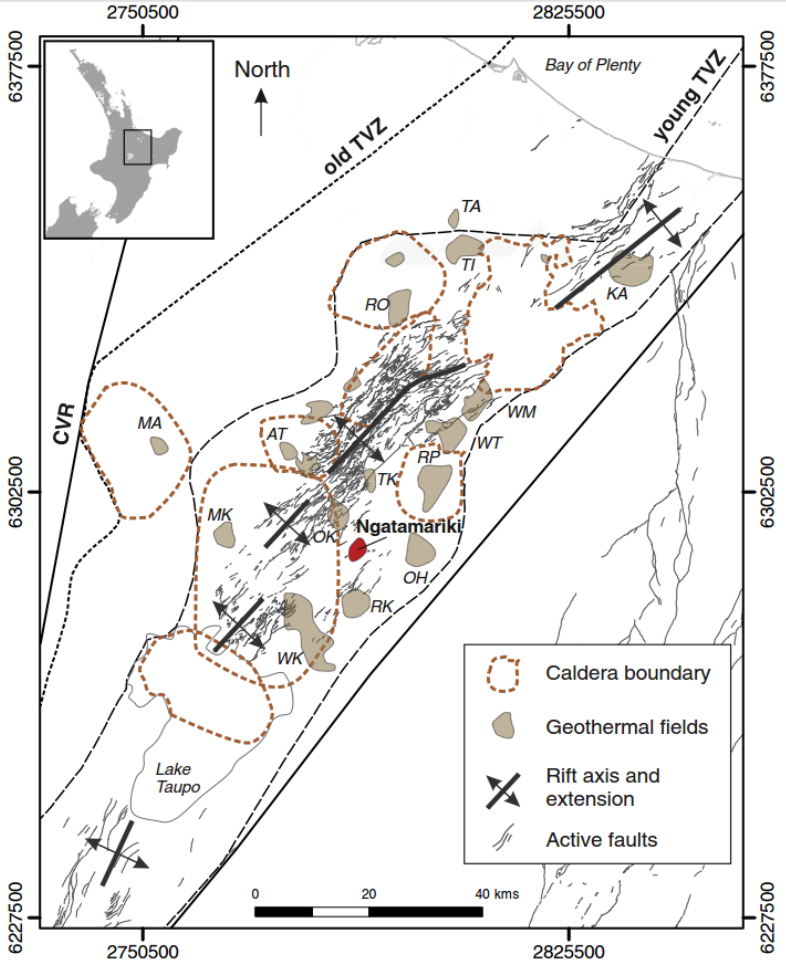


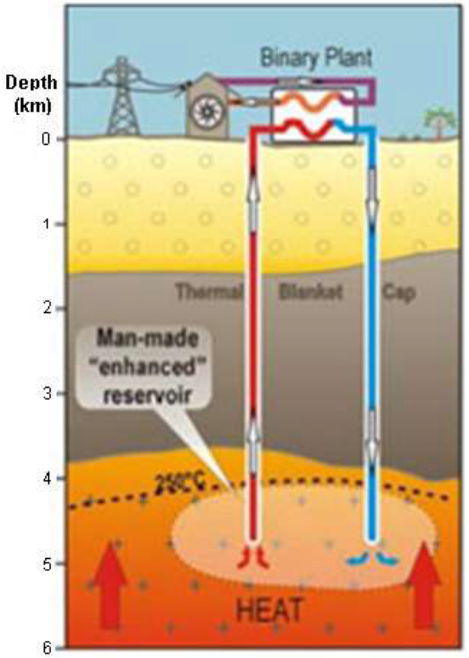
Chambefort et al., 2014

Key Differences with UK Market

1. Tectonic setting

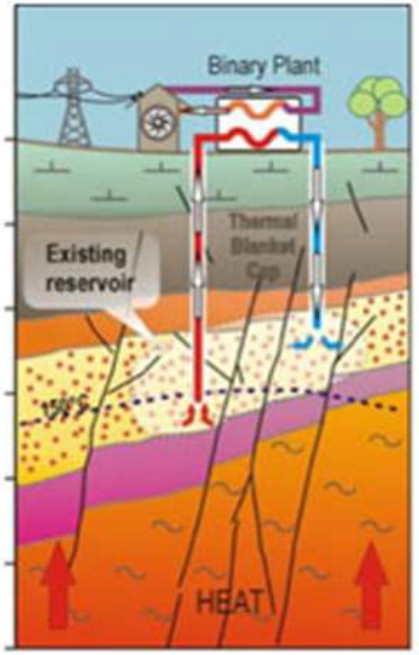
- UK is tectonically stable
- Hosts geothermal resource in radiothermal granites (EGS) in Cornwall, Weardale and Scotland
- EGS technology trialled at Rosmanowes in 1970's – 1980's
- Hot sedimentary aquifers (HSA) in several basins throughout the UK
- District heating scheme at Southampton using HSA in Wessex Basin
- Shallow geothermal resources utilised for GSHC

Enhanced Geothermal Systems (EGS)



Power?
Direct use?

Hot Sedimentary Aquifers (HSA)



Power?
Direct use?

Key Differences with UK Market

2. Finance

New Zealand

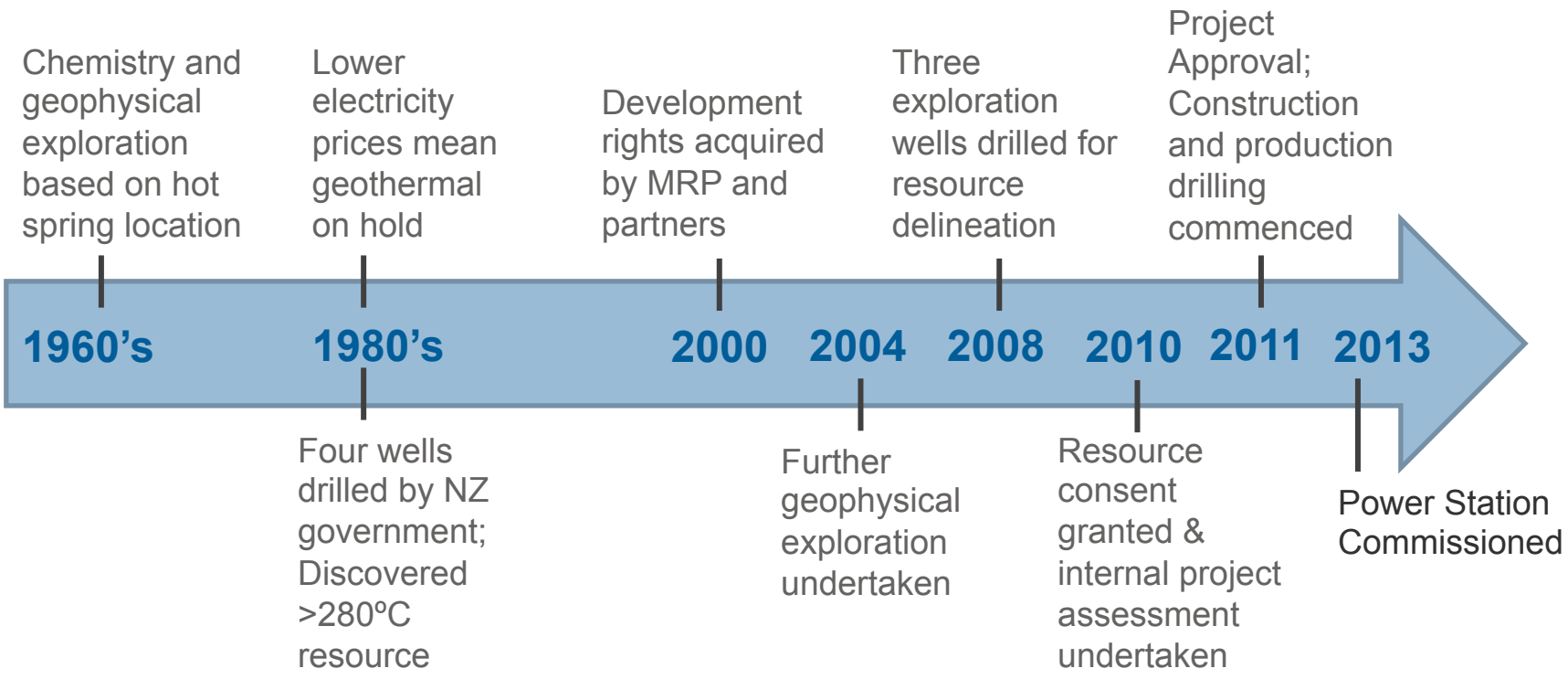
- 75% electricity from renewables
- Prior govt. investment in exploration catalyst for future development
- Balance sheet funded
- ROI based on economy of scale
- Competitive against other fuel sources on spot market
- Vertically integrated generator/ retailers negates need for PPA's

United Kingdom

- Abundance of carbon based resources (coal, gas, oil)
- Drive towards a lower carbon economy, EU goal of 20% renewable energy by 2020
- Renewable portfolio dominated by wind and solar
- Incentive schemes to support uptake of renewables

Case Study

Ngatamariki Project Overview



Case Study

Ngatamariki Project Overview

Chemistry and geophysical exploration based on hot spring location

Lower electricity prices mean geothermal on hold

Development rights acquired by MRP and partners

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1960's **1980's** **2000** **2004**

Four wells drilled by NZ government; Discovered >280ºC resource

Further geophysi
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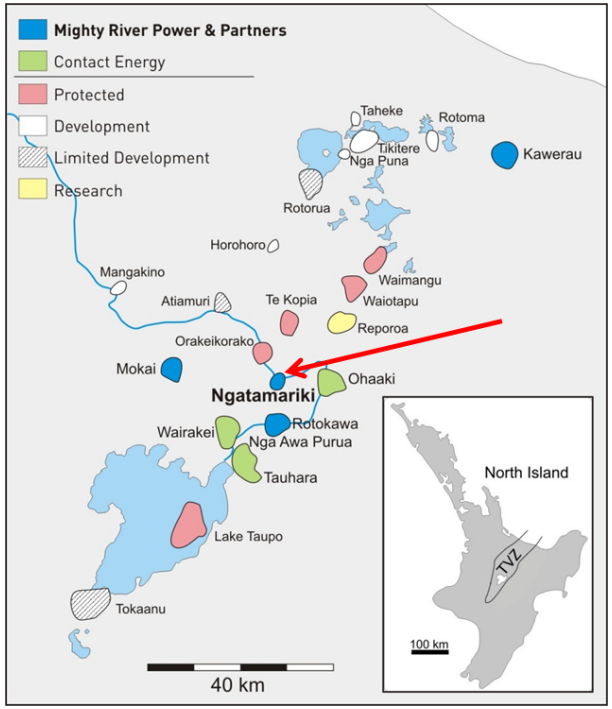
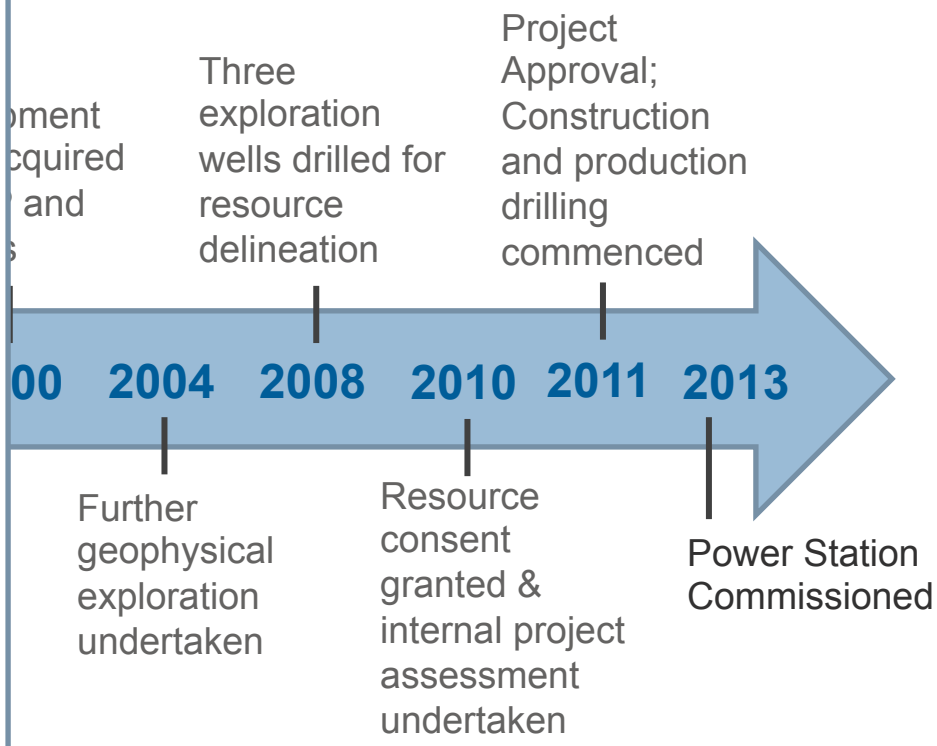


Boseley et al., 2010

Case Study

Ngatamariki Project Overview

www.mightyriver.co.nz



Importance of Understanding the Resource

UPFRONT CAPITAL INVESTMENT REQUIRED TO SECURE PROJECT FINANCE

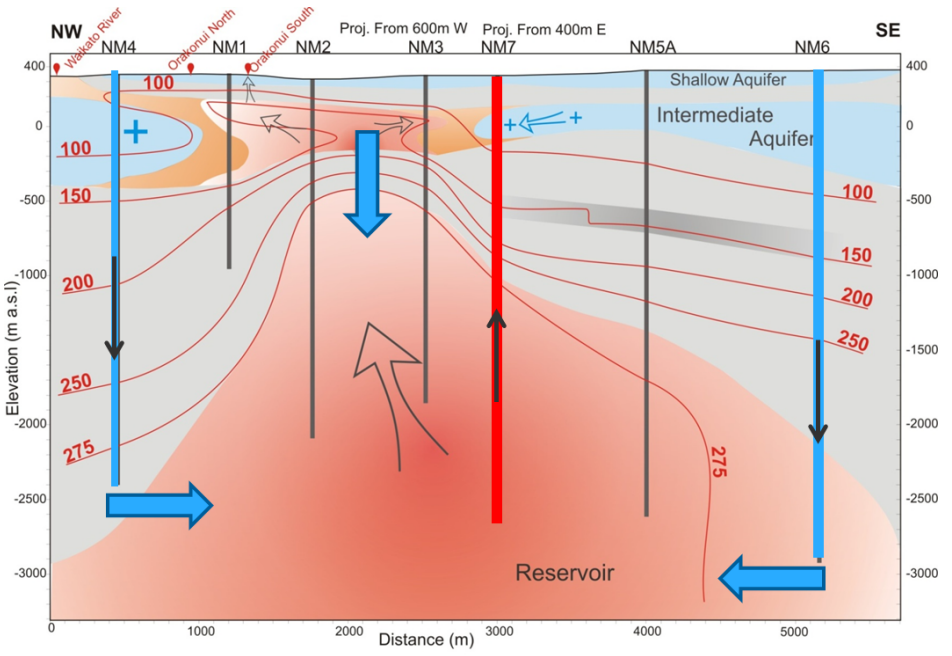
Understanding the resource:

- Geophysics
- Geochemistry
- Exploration wells
- Conceptual model
  - Analogous fields and international experience
- Numerical modelling
- Resource monitoring (incl. reservoir, surface features, groundwater)

Important to:

- Optimise development for resource characteristics
  - Resource size, enthalpy, chemistry conditions
- Inform investment decisions
  - Plant sizing, technology options
- Understand and manage inherent risks

Example: Risk of cold water down-flow from overlying aquifer



Boseley et al., 2010

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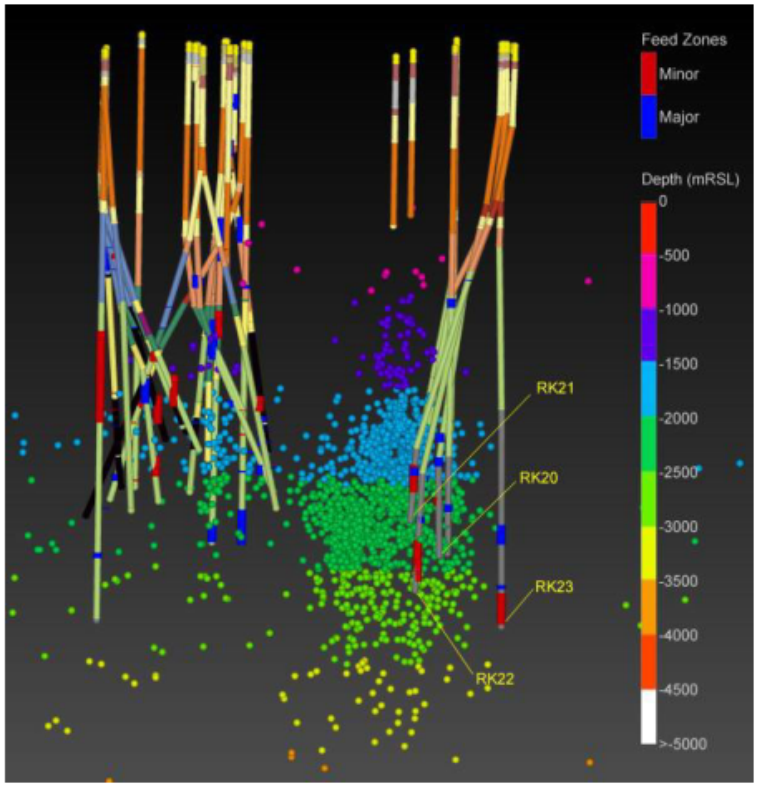
Example: Understanding Seismicity



Boseley et al., 2010; Sewell et al., 2013

Lessons Learned

- Geothermal development requires considerable upfront investment for successful realisation;
  - Early government investment in exploration was a catalyst for future development
  - Up front investment required to prove the resource and secure project approval
- Understanding the resource & demonstrating sustainability is important;
  - Each resource is different
  - Understand resource risk
  - Inform investment decisions
- Geothermal can provide reliable base-load energy, important in the mix of renewable technologies;

Thank You

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