Geothermal Energy

International Growth and New Zealand Opportunities

Brian Carey

16 August 2012

GNS SCIENCE
TE PŪ AO

Please phones to off or vibrate

Please move out of the room to talk

Outline

- **Introductions**
- **Definitions**
- **World Scene**
- **New Zealand Scene**
  - Hotter and Deeper
- **How Does it all Work**
- **Low Temperature Geothermal**
- **Concluding Remarks**
  - Geothermal New Zealand

Introductions

- **Brian Carey**
- **Geothermal Manager**

  GNS Science
- **Vice President**

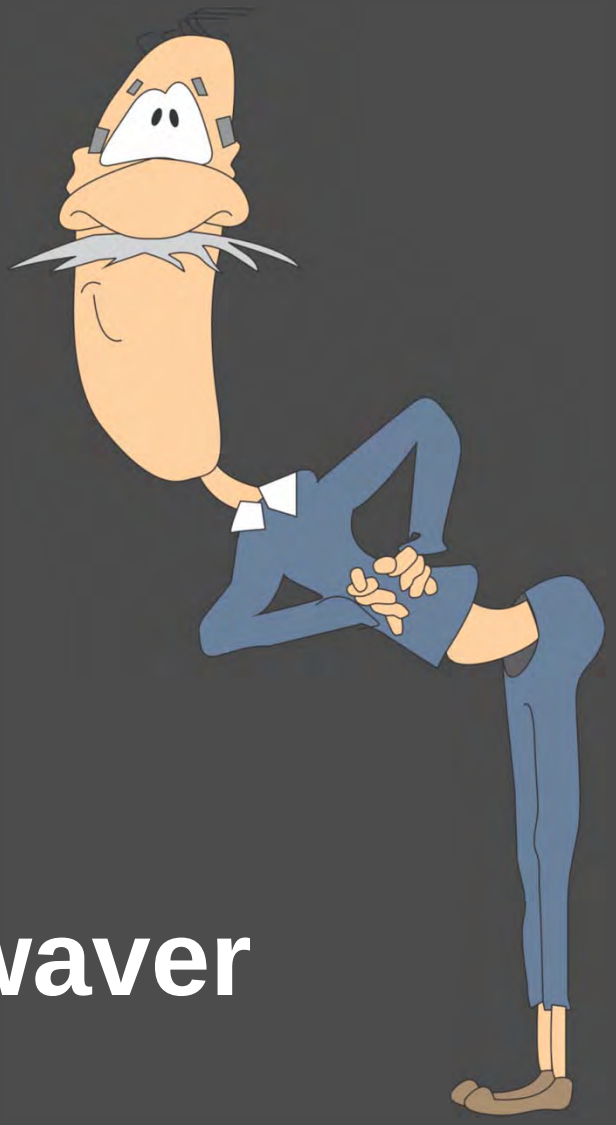
  NZ Geothermal Association
- **Chair**

  Geothermal Heat-pump Association of NZ (GHANZ)

Trust you enjoy todays presentation

Introduction

- **Big Hand Waver**



Actually no

Skinny hand waver

Background

- **Mechanical Engineer**
- **Ministry of Works – Wellington + Wairakei - 1981**
  - IEA Two Phase Power Turbine Test Programme
  - Steamfield Design Engineer
- **New Zealand Electricity – Wairakei - 1985**
  - Station Engineer
- **Electricity Corporation of NZ – 1987**
- **Contact Energy - 1996**
  - Geothermal Resource Manager
- **GNS Science – Wairakei – 2007**
  - Geothermal Manager

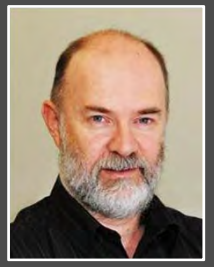
GNS Wairakei Research Centre

≈ 75 Total

≈ 35 Geothermal Team

GNS Science Geothermal Team

Geologists



Greg Bignall
Geology Team Leader
Geothermal Geology / Petrology / Alteration Mineralogy / Resource Evaluation

Andrew Rae
Petrology / Alteration Mineralogy / well targeting / Rig Geology

Isabelle Chambefort
Geology / Petrology / Alteration Mineralogy / Mineral Isotopes

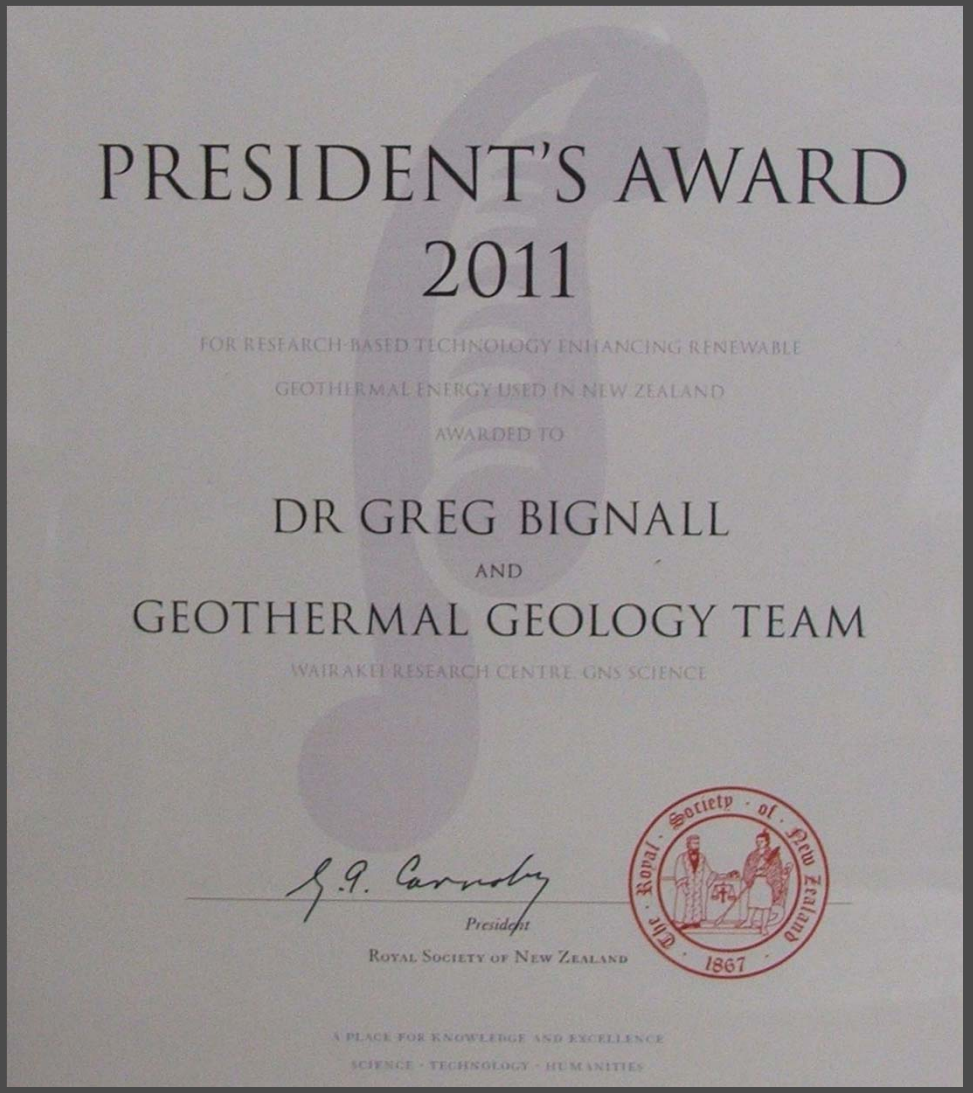
Mark Lawrence
David McNamara
Cecile Massiot
Image Log Interpretation

Samantha Alcaraz
Angela Prieto
3D Geological Modeller, GIS

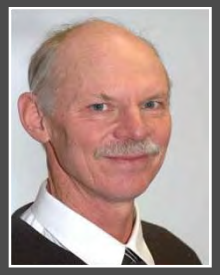
Fiona Sanders
Brandon Lewis
Rig Geologists

Royal Society Presidents Award 2011

For research based technology enhancing renewable geothermal energy used in New Zealand


PRESIDENT'S AWARD
2011
FOR RESEARCH-BASED TECHNOLOGY ENHANCING RENEWABLE
GEOTHERMAL ENERGY USED IN NEW ZEALAND
AWARDED TO
DR GREG BIGNALL
AND
GEOTHERMAL GEOLOGY TEAM
WAIRAKEI RESEARCH CENTRE, GNS SCIENCE
President
ROYAL SOCIETY OF NEW ZEALAND
The Royal Society of New Zealand 1867
A PLACE FOR KNOWLEDGE AND EXCELLENCE
SCIENCE · TECHNOLOGY · HUMANITIES

Geothermal Geophysicists



Chris Bromley
Geothermal Geophysics, Resource Assessment, Environmental Effects & Monitoring Specialist

Supri Soengkono
Magnetics, Gravity

Rob Reeves
TEM, surface monitoring, groundwater

Sophie Pearson
Reservoir Modelling

Stephen Bannister
Seismic / Microseismic Specialist
Steve Sherburn

Grant Caldwell
Ted Bertrand

Wiebke Heise
Graham Hill
MT / Electrical Methods Specialist

Geochemists + New Zealand Geothermal Analytical Laboratory

Ed Mroczek
Geo chemistry Team leader
Geothermal (water and gas) chemistry / Resource Evaluation / Plant Chemistry, Resource Monitoring

Bruce Mountain
Geochemist, Methods Development , Hydrothermal Experimental Geochemist

Stuart Sanderson
Laboratory Manager

NZ Geothermal Analytical Laboratory

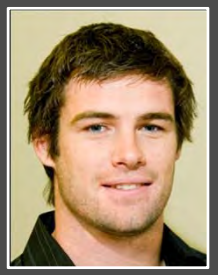
Eleven Staff

Others

Extremophile Team

Matt Stott
Microbiology Team Leader

Karen Houghton Jean Power
Research Assistants



Liam O'Halloran Duncan Graham
Field Technicians - Sampling

Plus PhD Students

Nellie Olsen
(Chemistry)

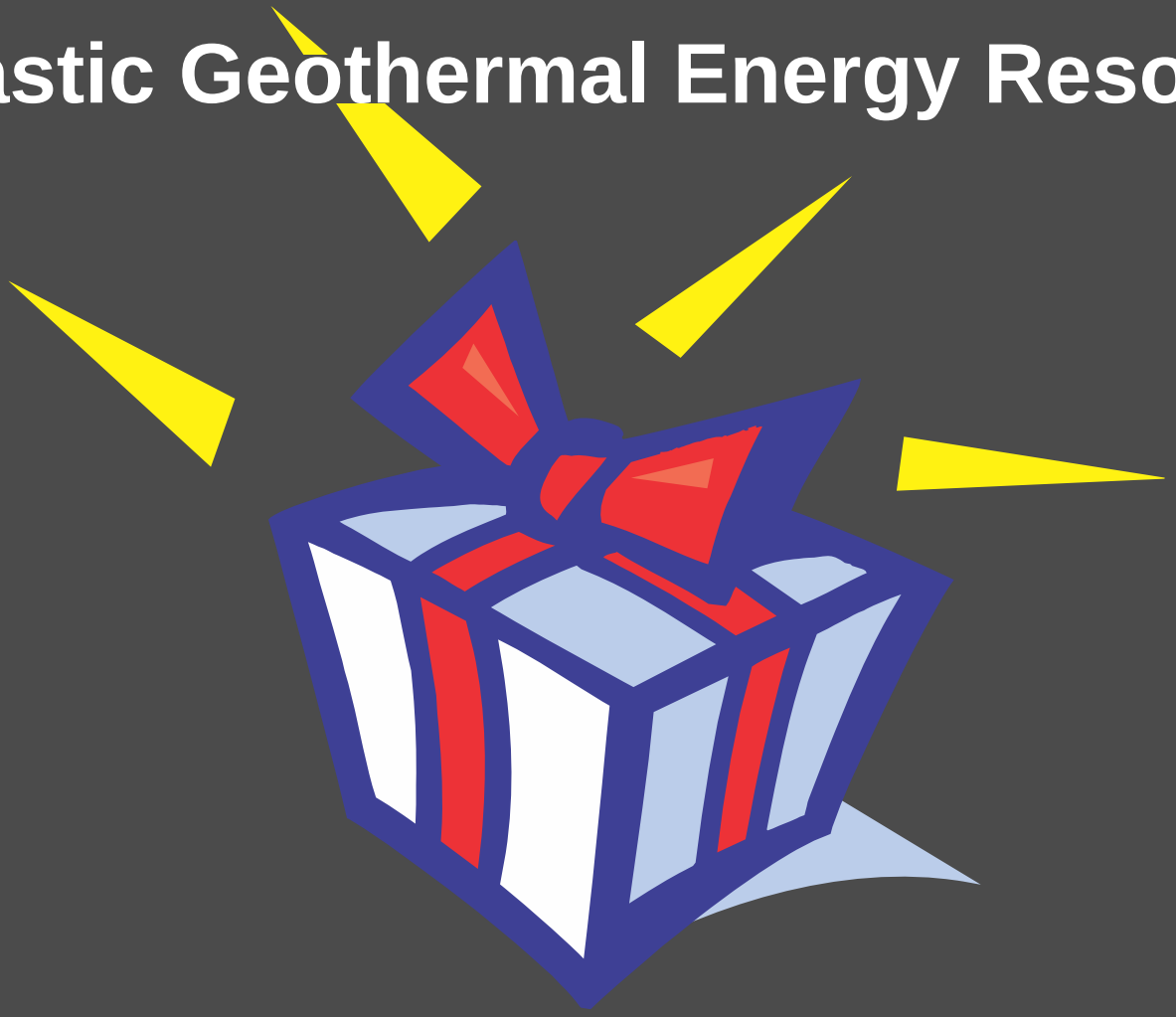
Sarah Milicich
(Geology)

Kevin Lee
(Microbiology)

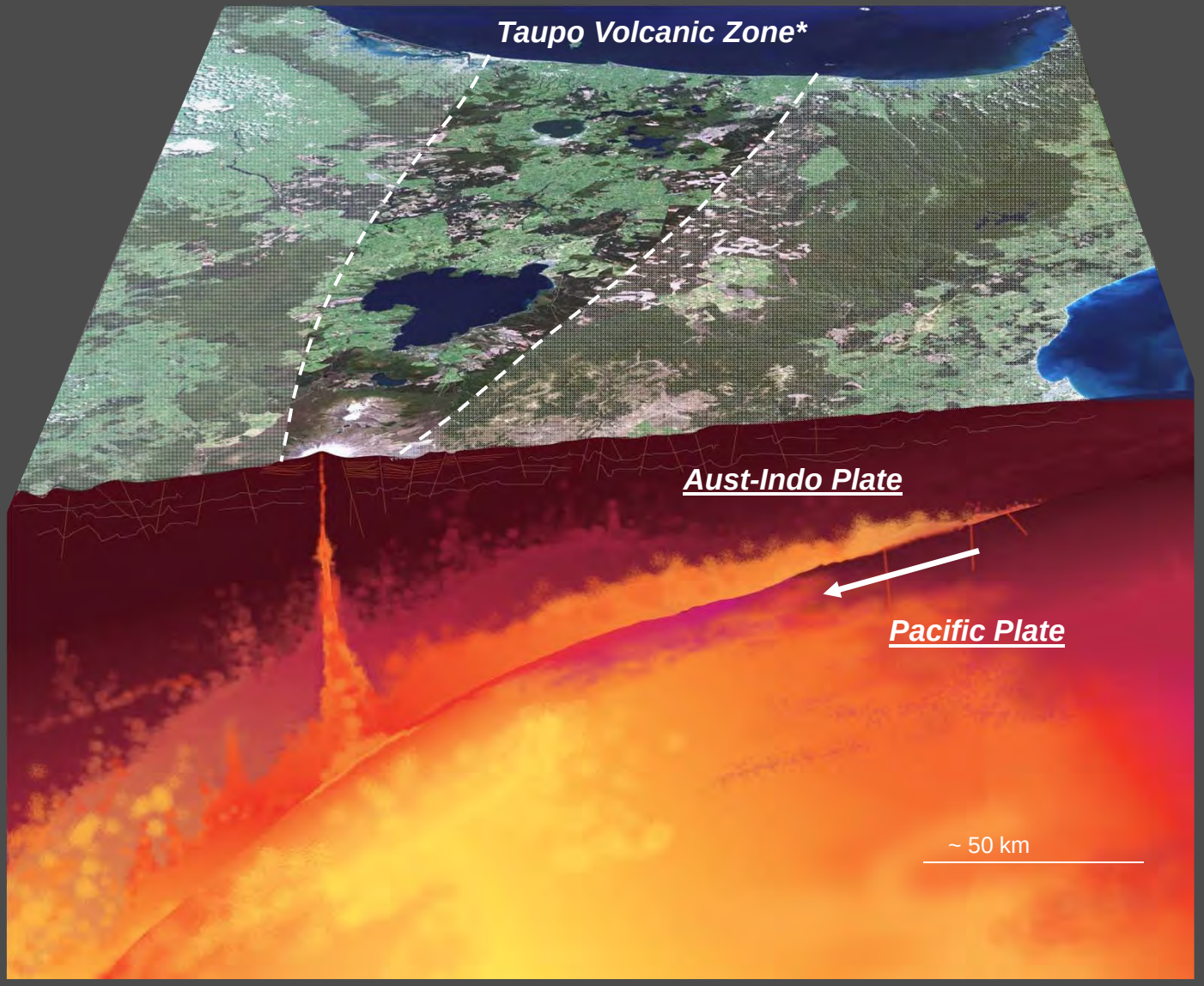
Julia Bjorke
(Chemistry)

Blessed as a nation with

Fantastic Geothermal Energy Resources



Live on top of this amazing Heat Engine



Terms and Units

- **Capacity**
  - kW, MW, GW, TW
- **Energy – capacity times time**
  - kWh, MWh, GWh
  - kJ, MJ, GJ, TJ, PJ, EJ
- **1 Exa joule = 1000 Peta joule**
- **Electricity and heat**
  - Same units but different quite different energy forms
  - Electricity higher quality form

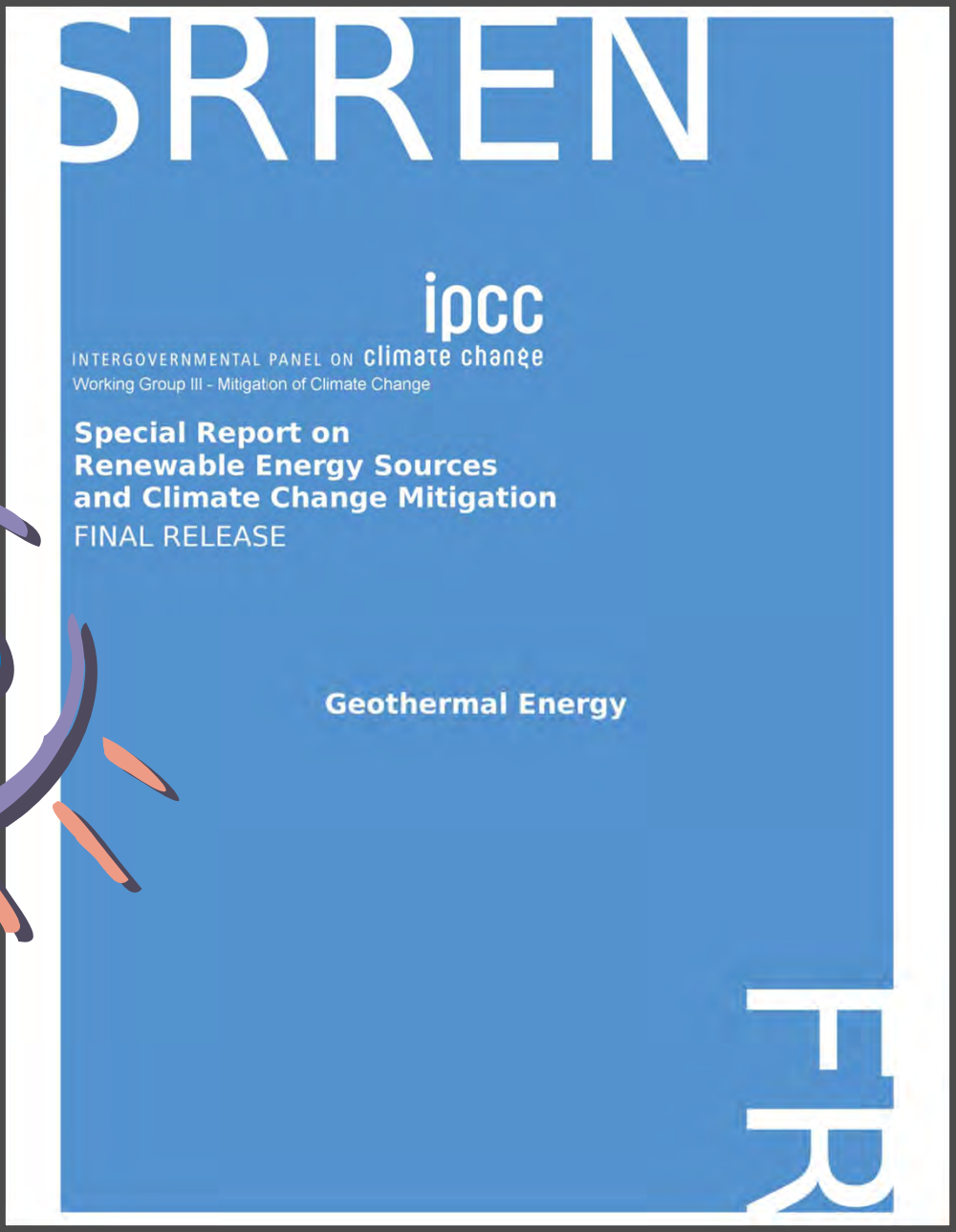
Uses of Geothermal Resources

- Convert it to Electricity
- Use directly as heat energy
- Lower temperature geothermal energy
  - Can be pumped to a useful temperature
    - Geothermal Heat Pumps (GHP)
      - Ground Source Heat Pumps
- Source of novel microbes
- Tourism

World Scene

World Installed Geothermal Electricity Generation Capacity

Looking Forward



GNS Science Involvement

- **Chris Bromley**

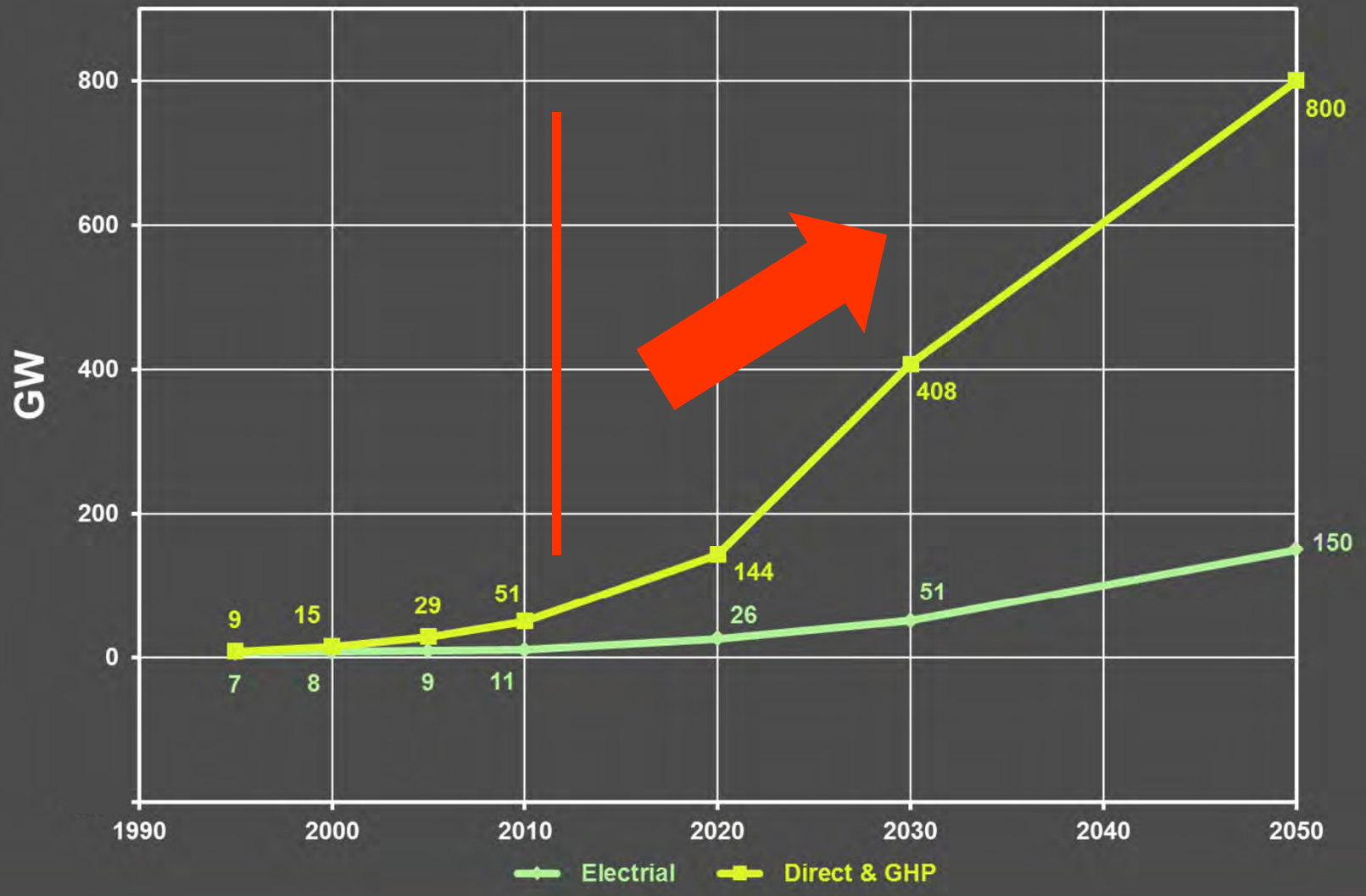
  Senior Geothermal Geophysicist

  GNS Science - Wairakei

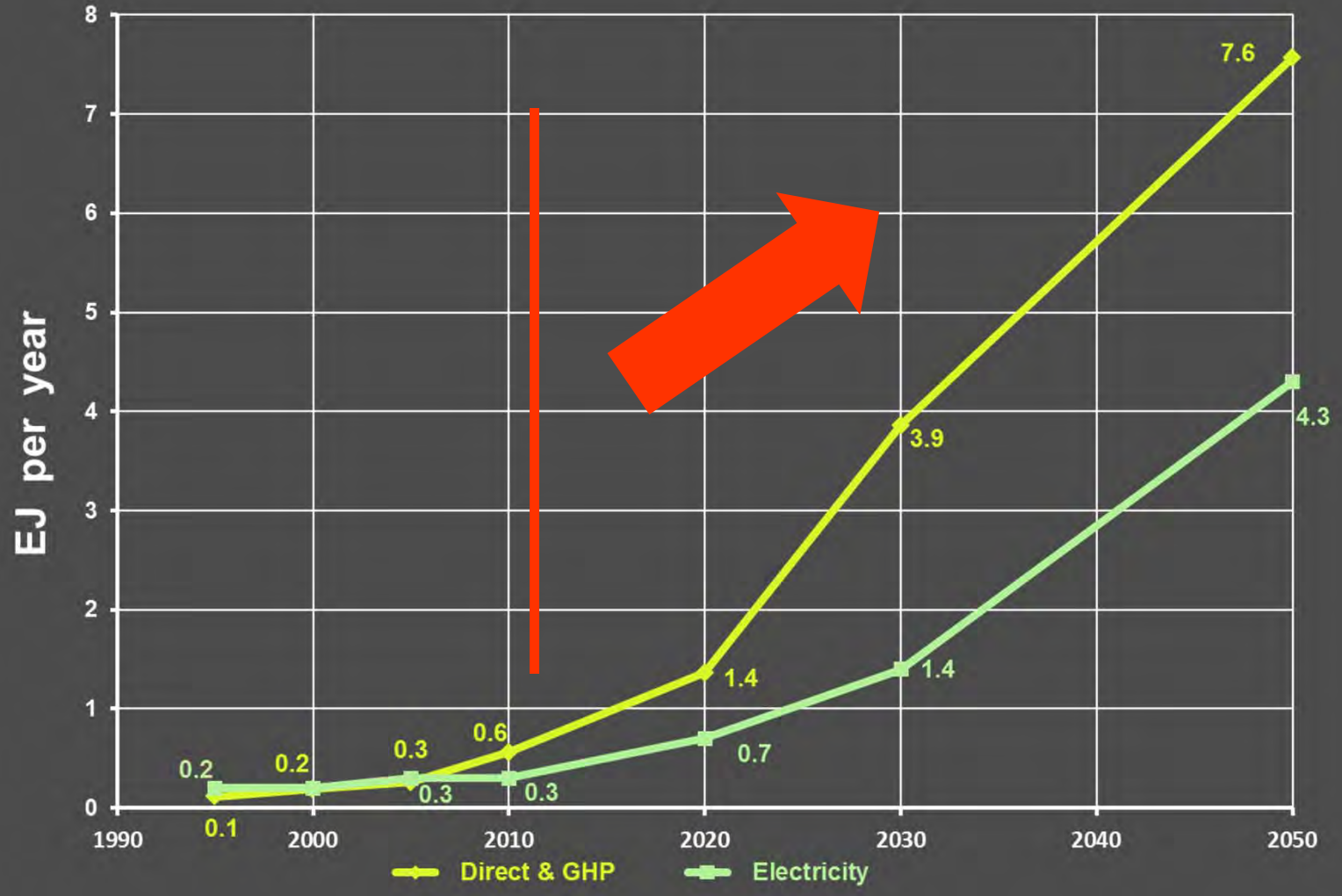
Lead Author

IPCC – Geothermal Energy

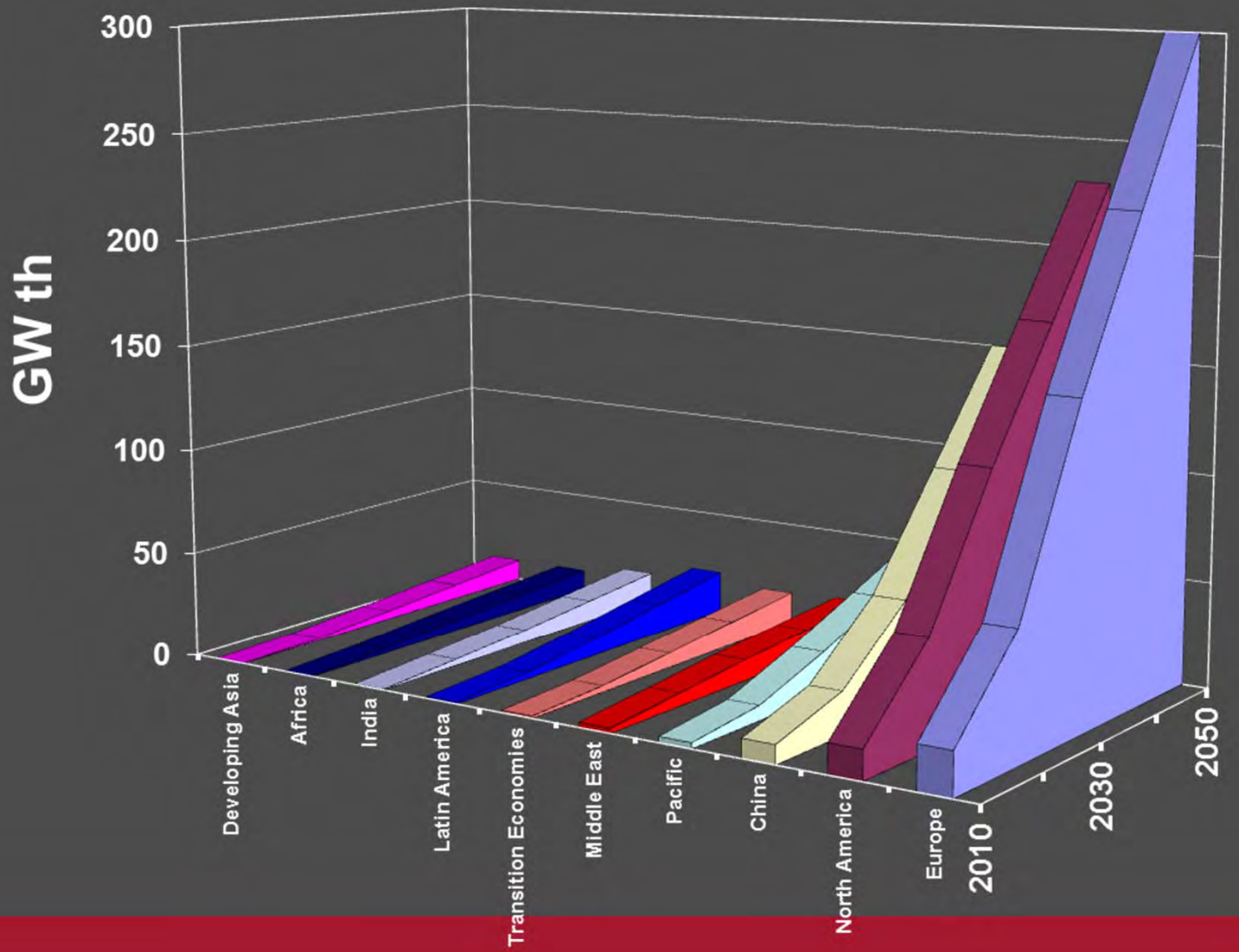
Geothermal Capacity Growth



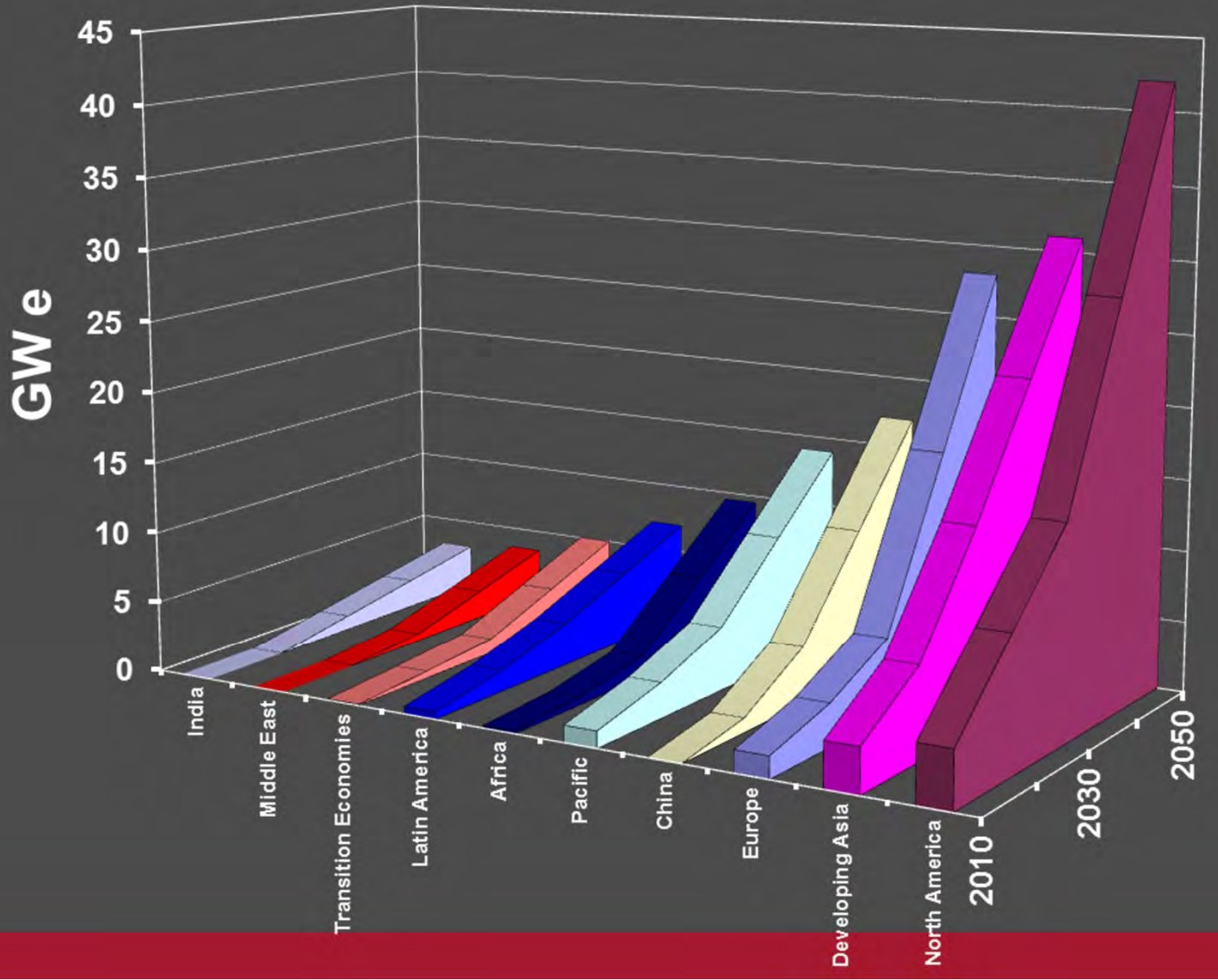
Geothermal Energy Growth



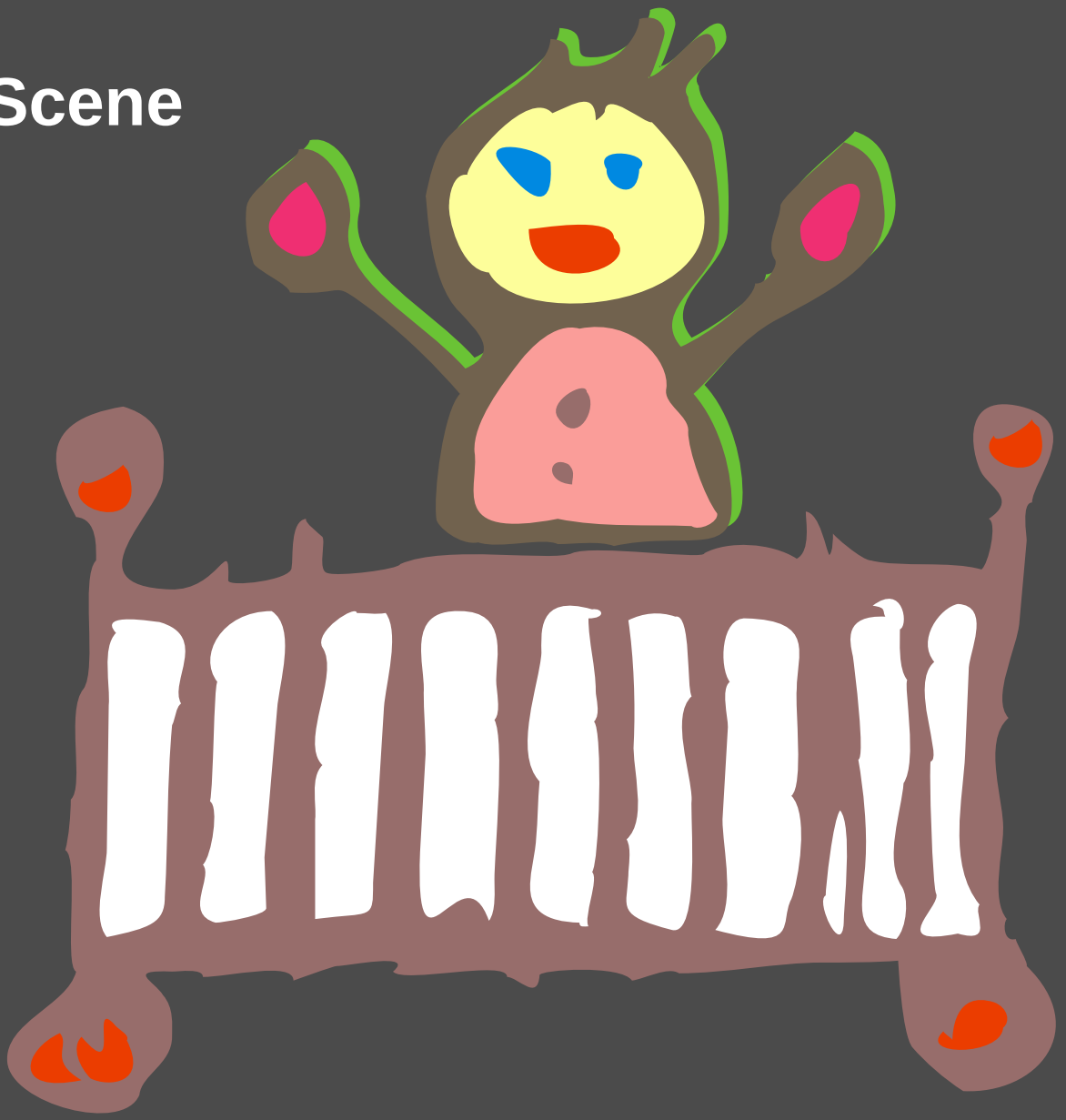
Geothermal Direct Heat Energy Growth 2010 to 2050 by Region



Geothermal Electric Energy Growth 2010 to 2050 by Region



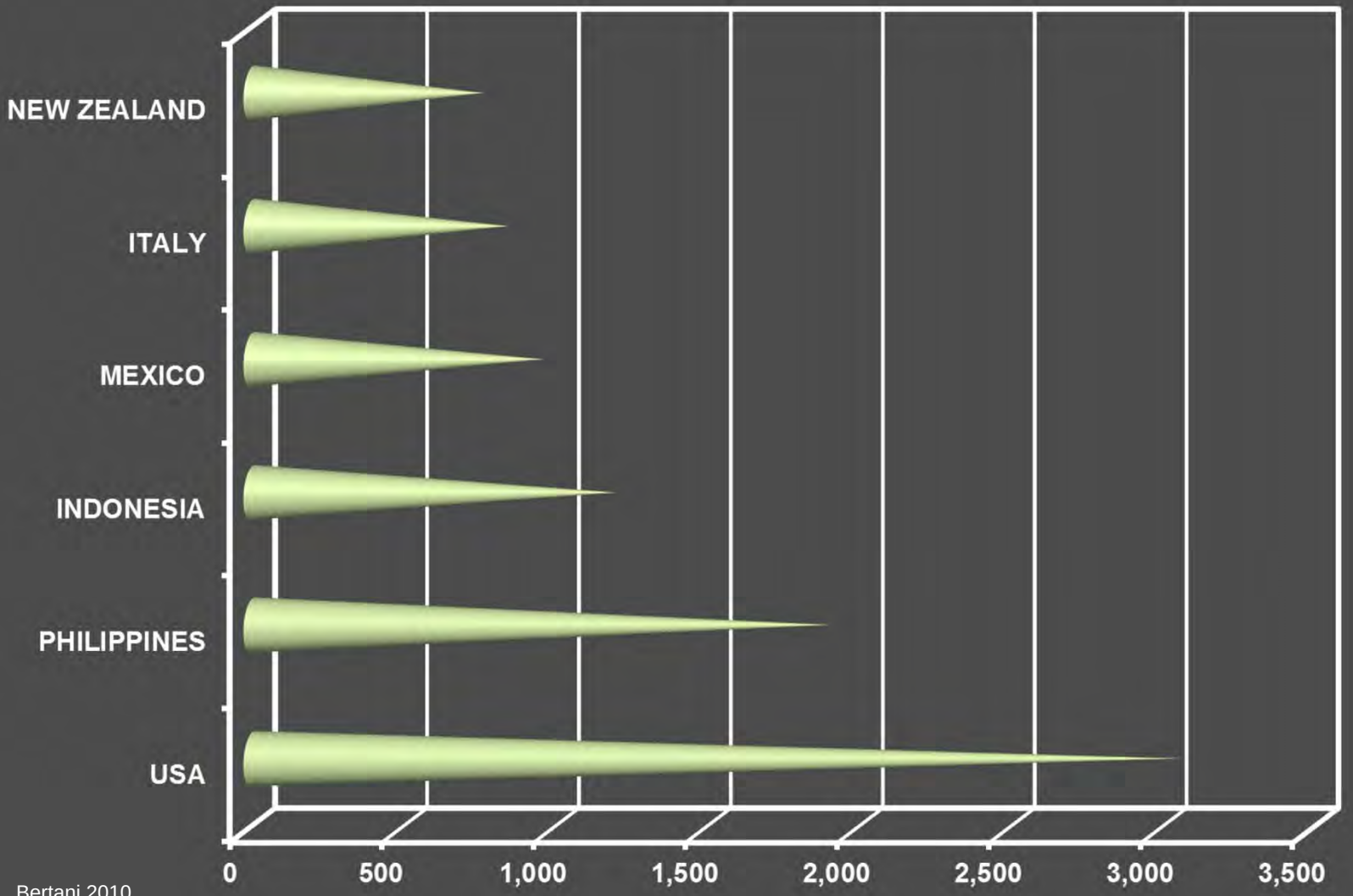
New Zealand Scene



New Zealand Scene

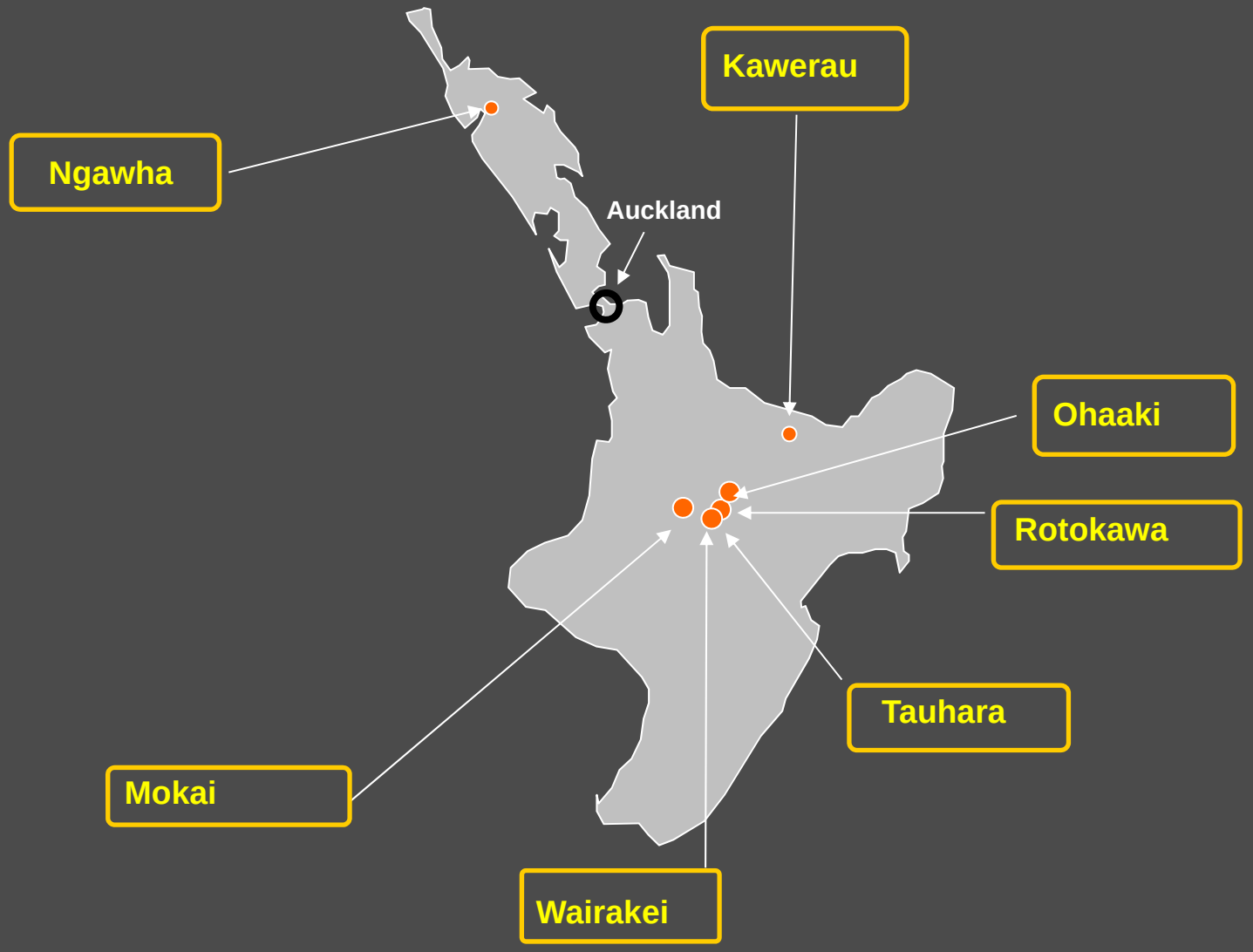
- No 6 in the world for installed geothermal electricity generation capacity
- Worlds largest geothermal heat use at one site
- Slow in other direct use and Geothermal Heat Pumps

Geothermal Generation Capacity – 6TH



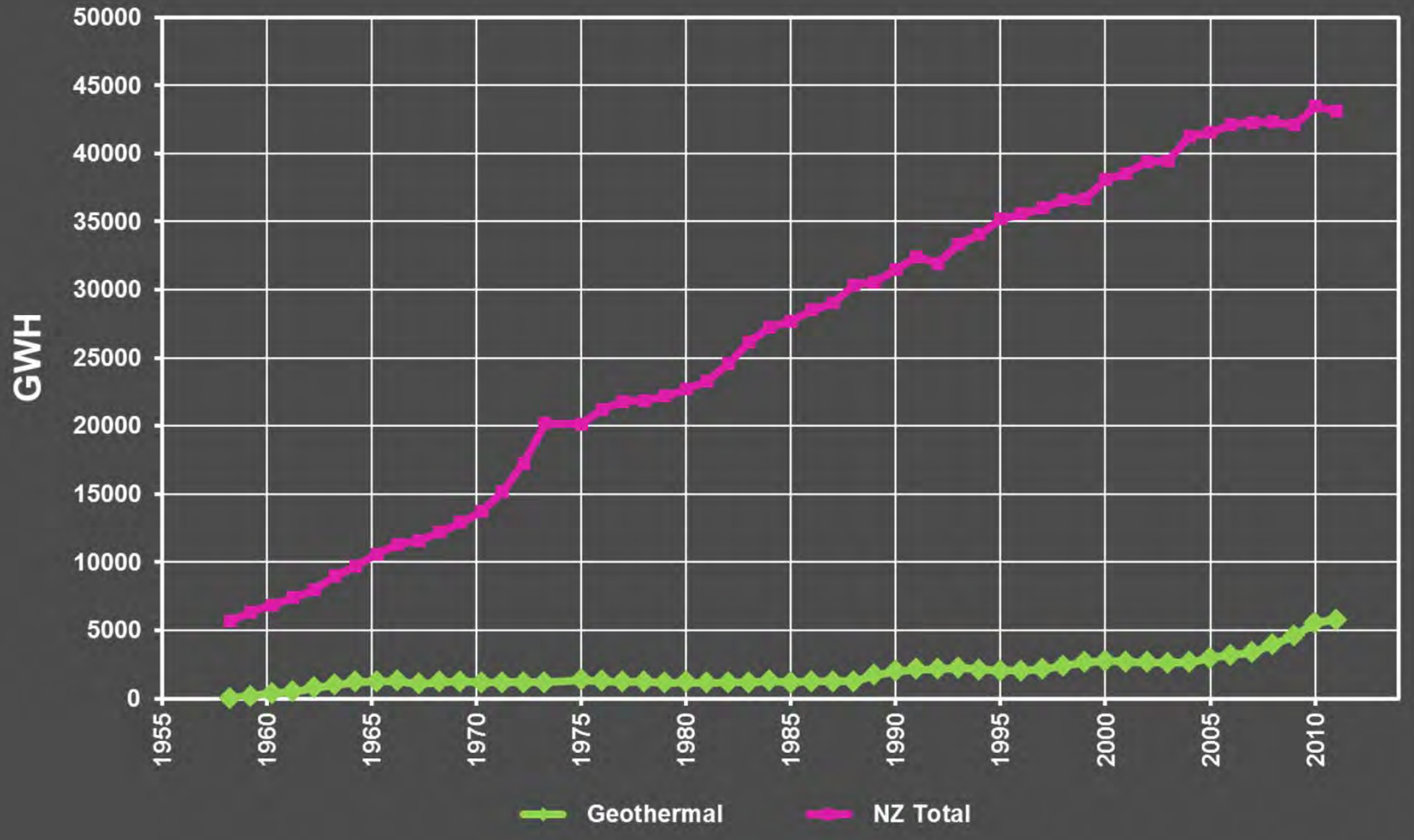
Bertani 2010

Locations for Power and Large industrial

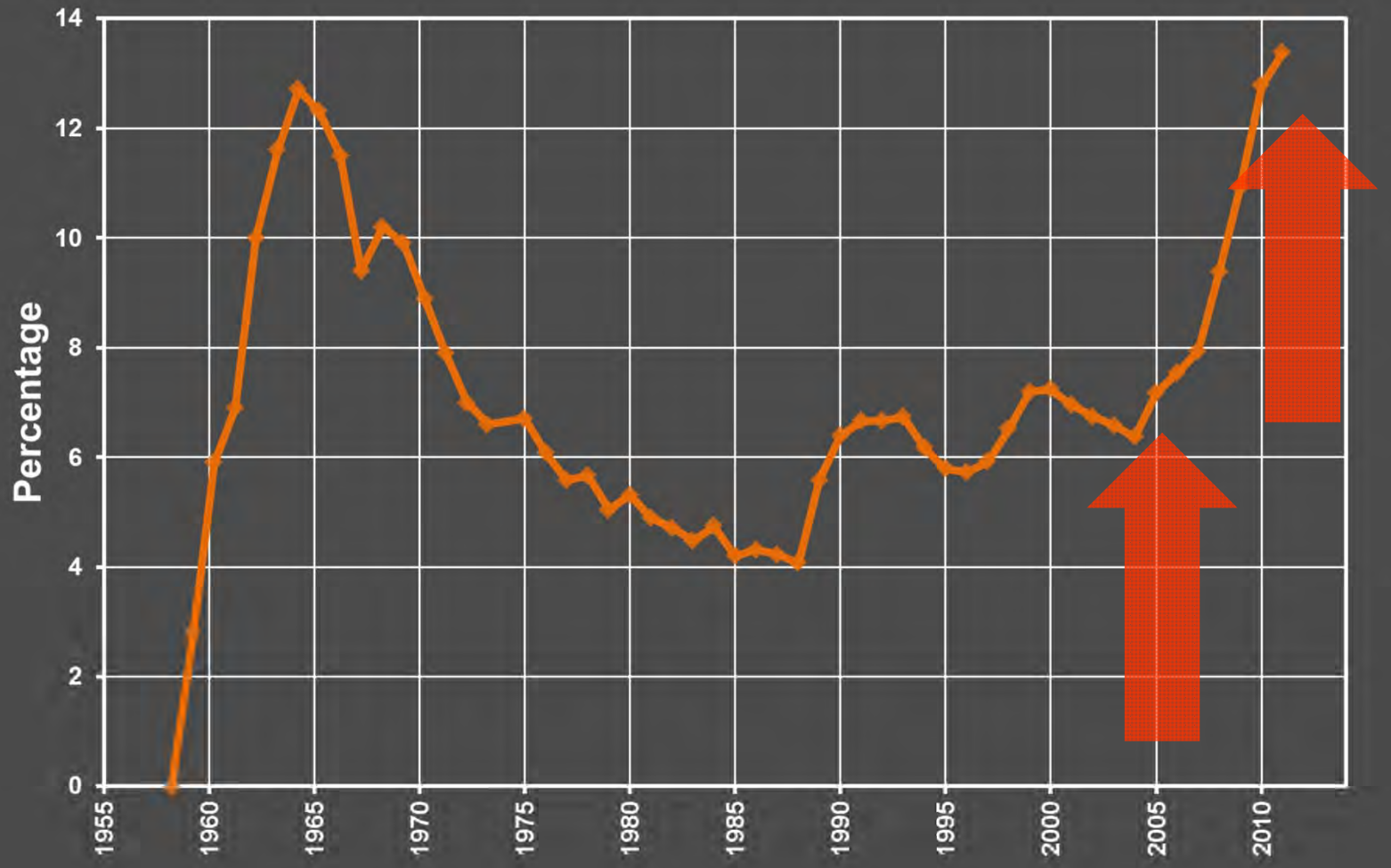


Growth Geothermal Electrical GWH

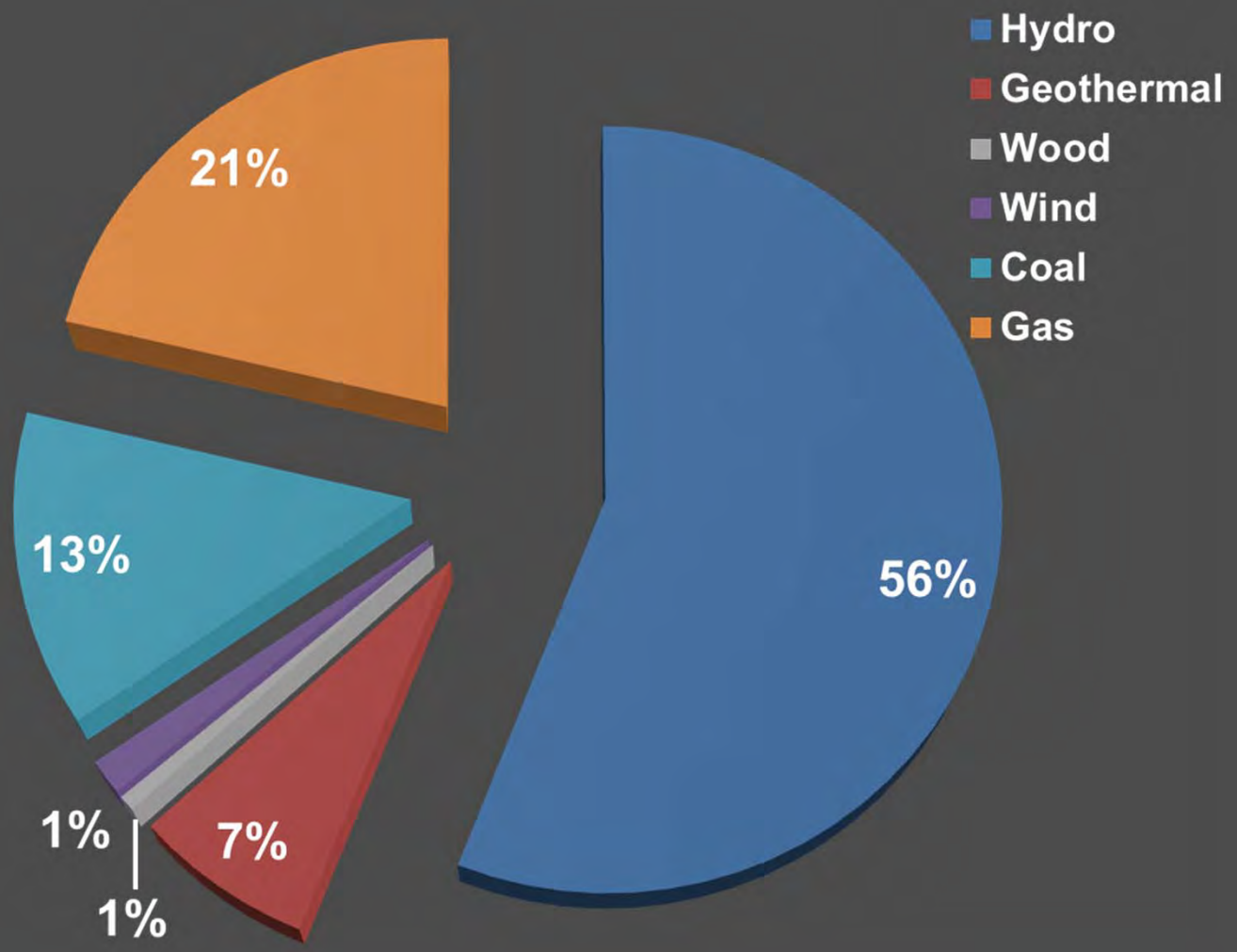
NZ Electrical Energy Nett Generation
GWH per year



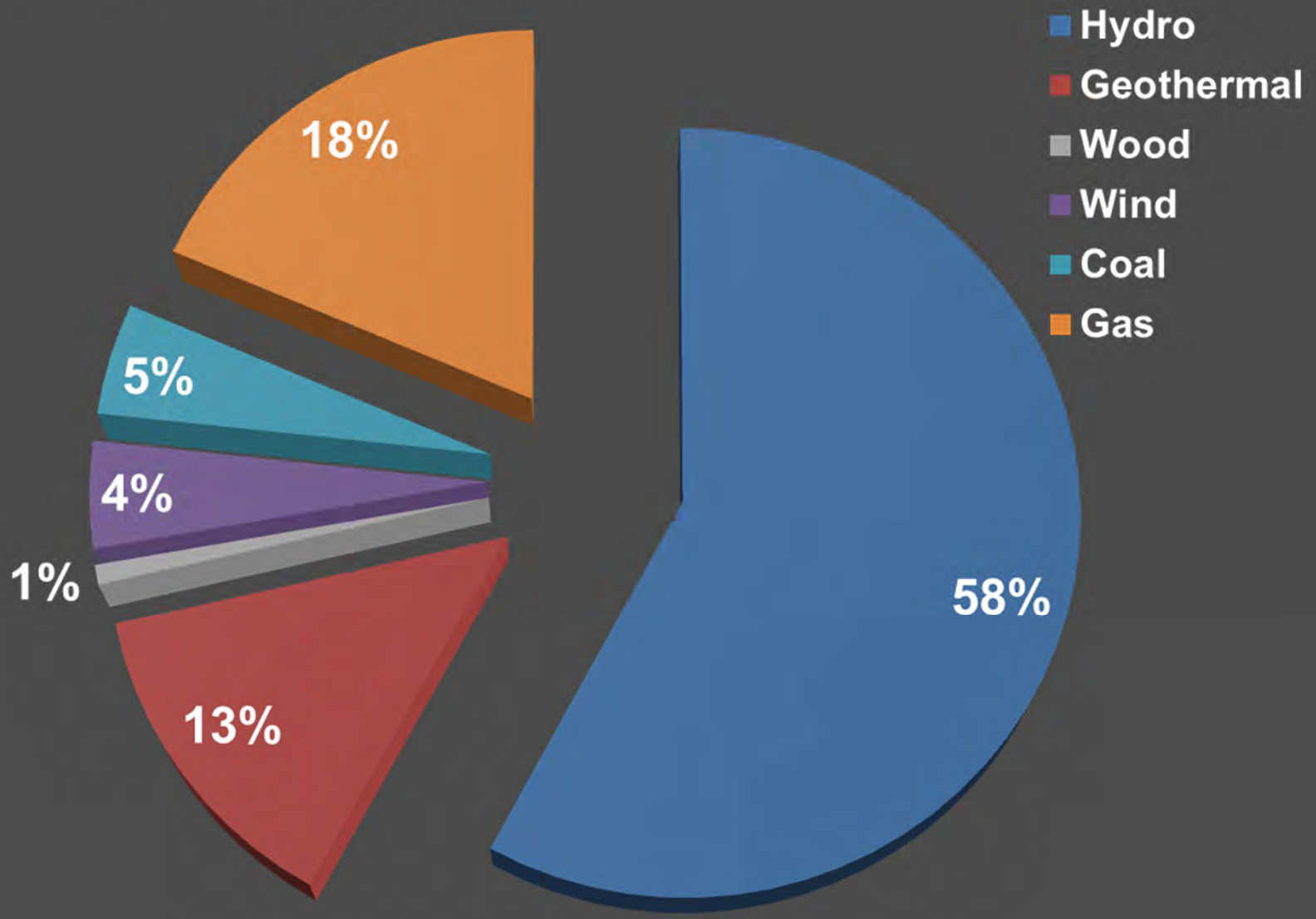
Geothermal – Percentage of Total



2005 Electricity Mix



2011 Electricity Mix



Further Growth in NZ Geothermal Capacity

- **Te Mihi Uenukukopako - 160 Mwe**
- **Two 80 MWe Toshiba Steam Turbine Machines**
  - Replaces some of Wairakei so ≈110 MWe Increment
  - Scheduled on line 2013
    - First unit early 2013
  - $623 Million

Further Growth in NZ Geothermal Capacity

- **Ngatamariki – 80MWe**
  - Under Construction
  - Scheduled on line by mid 2013
  - Organic Rankine cycle
  - $440 Million

Futher Growth in NZ Geothermal Capacity

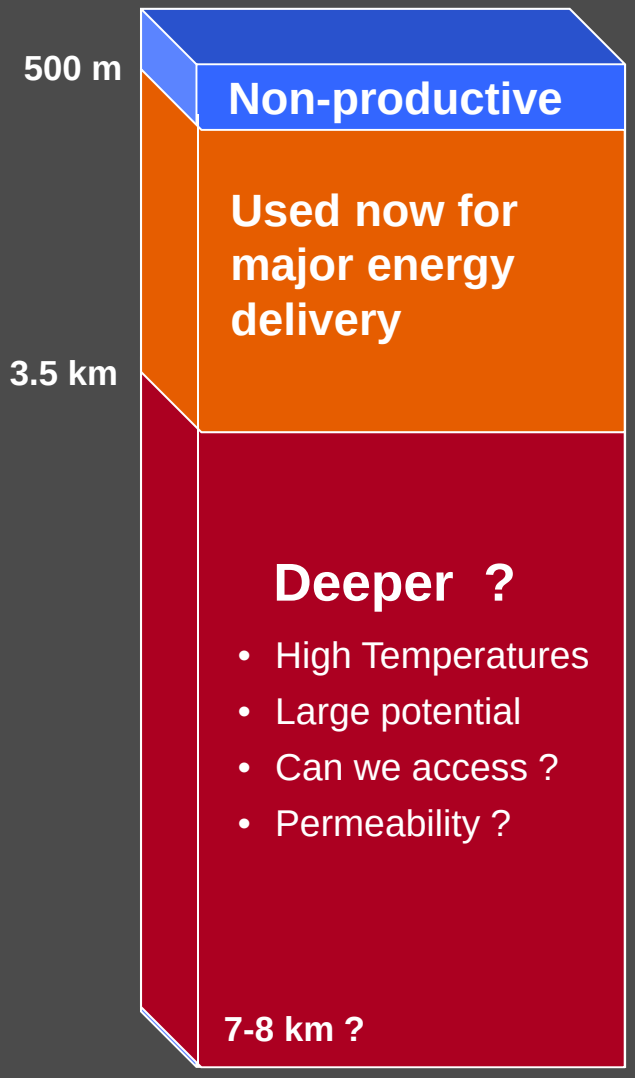
- **NST Kawerau – 20MWe**
  - Later in 2012
- **Consents in place for more**
  - Tauhara – 250 MWe
  - Other consenting activities and investigations
- **More to come**

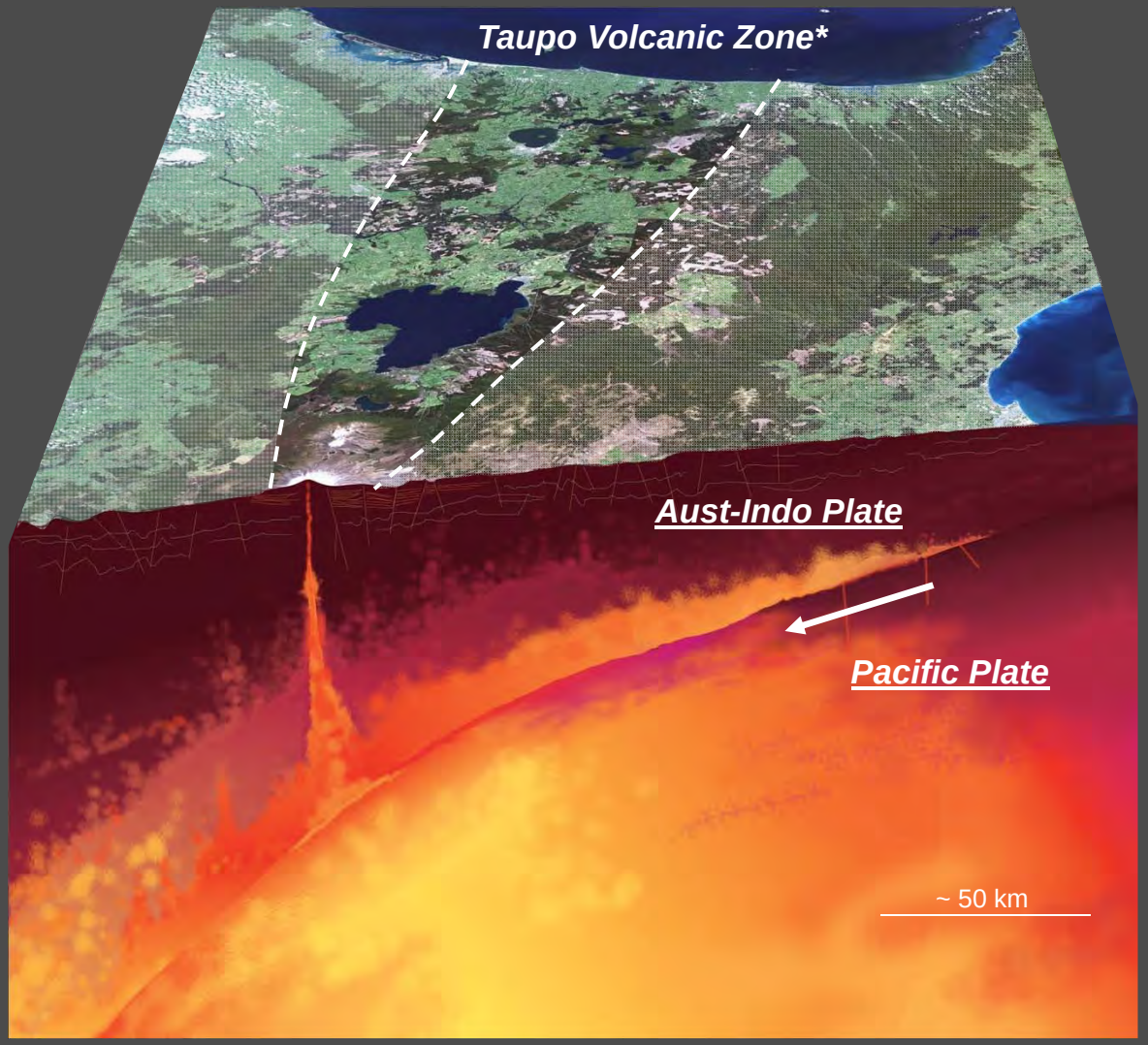
More to come

- 2020 - 20%
- What if we are able to develop deep resources

> 30 %

Hotter and Deeper





Possibly Very Large Deeper Resource

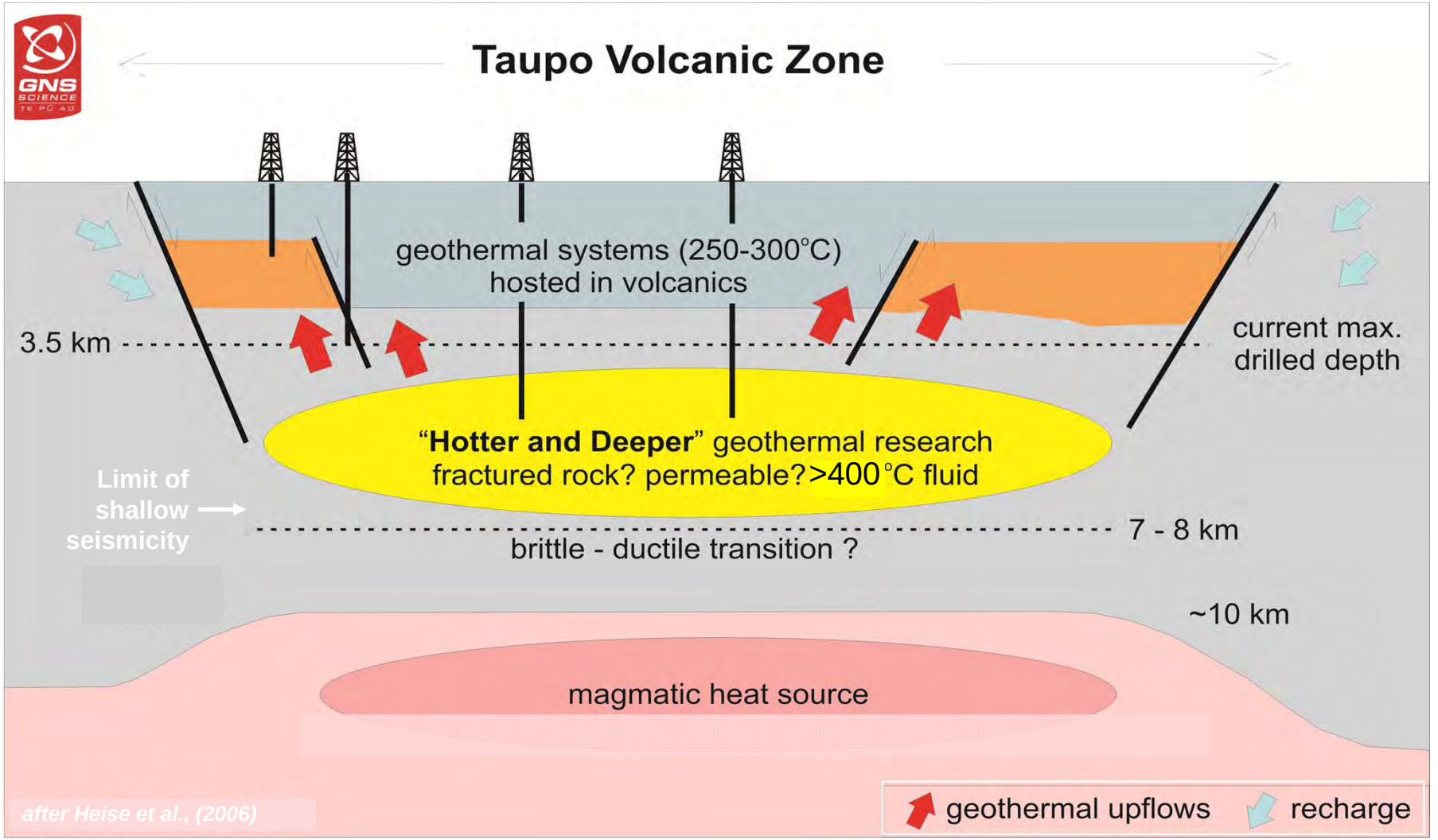
- **Depth 3500 m to 7000 m**

  $T_{initial}$ = 260 to 350 ^{o}C

  T_{final} = 180 ^{o}C 100 years out

- **600 km^2 – beneath the convective systems**

- **10,000 MW(e) for 100 years ?**
- **Non one knows**
- **Big enough to say its worth looking.**

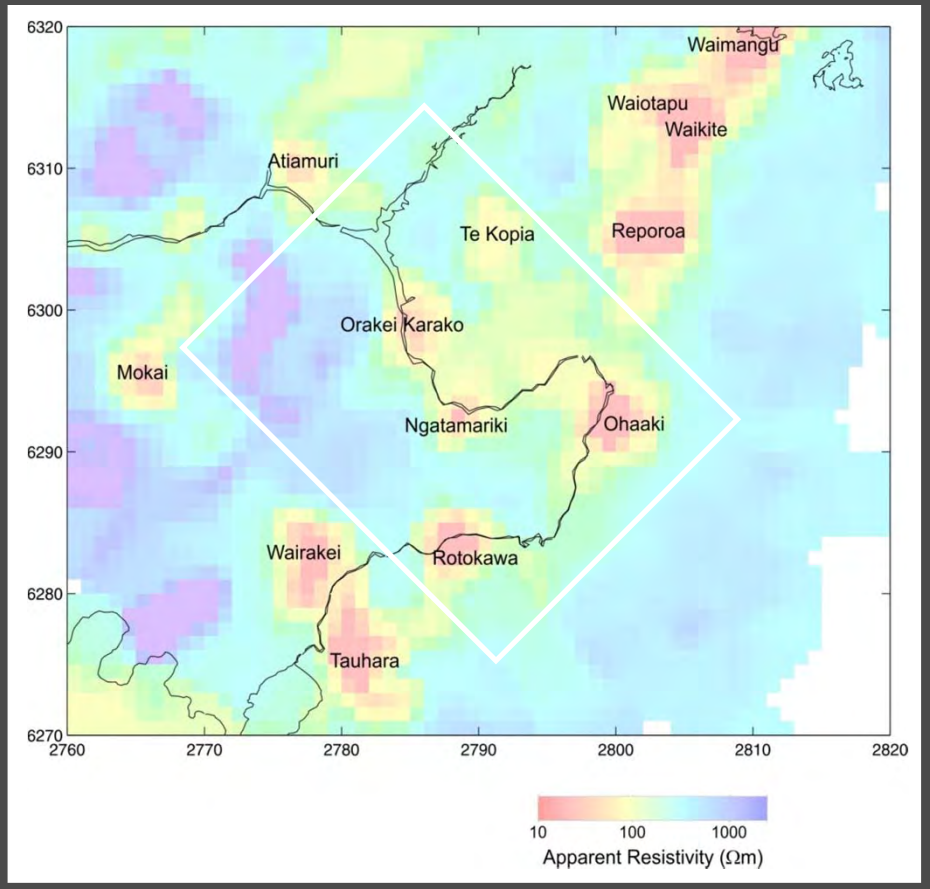


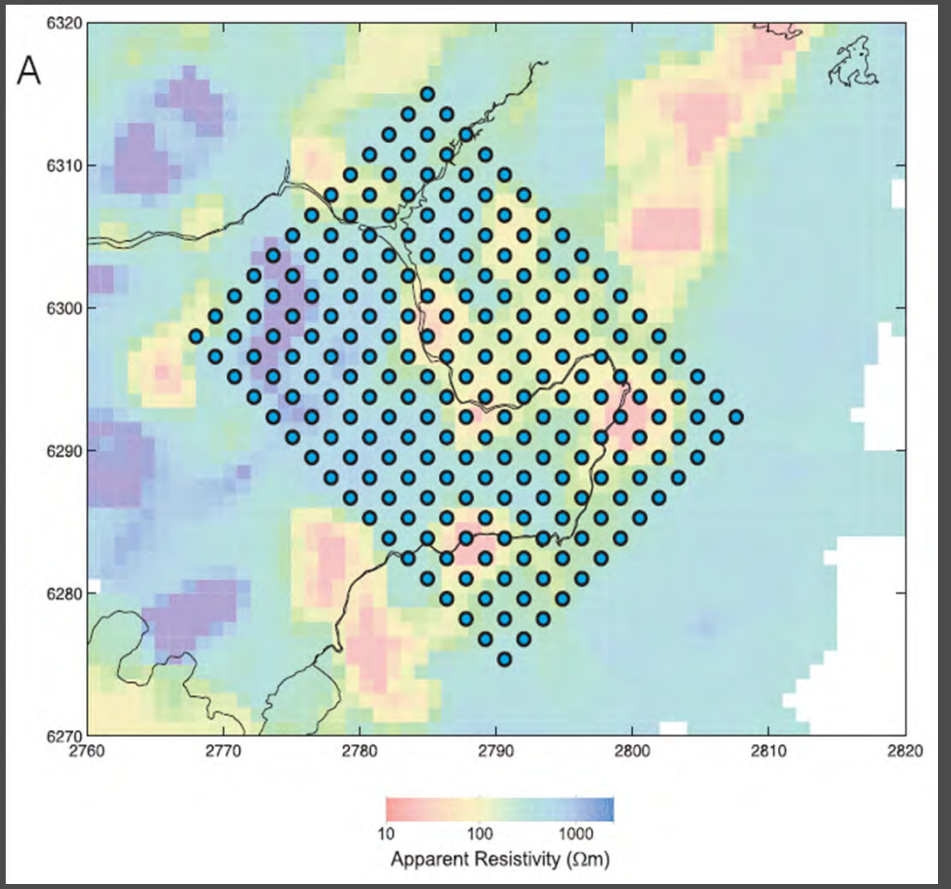
Permeability that can be tapped is key to realising deep geothermal potential

Hotter and Deeper – work going on

- **Gaining a better understanding of :**
  - Deep structure of the Taupo-Reporoa Basin.
  - Physical and chemical nature of deep fluids, and their flow paths.
- **Deep MT and Seismic field work completed**
  - Some analysis completed
- **Progressing planning towards a deep hole with an international science component**

Southern TVZ imaged

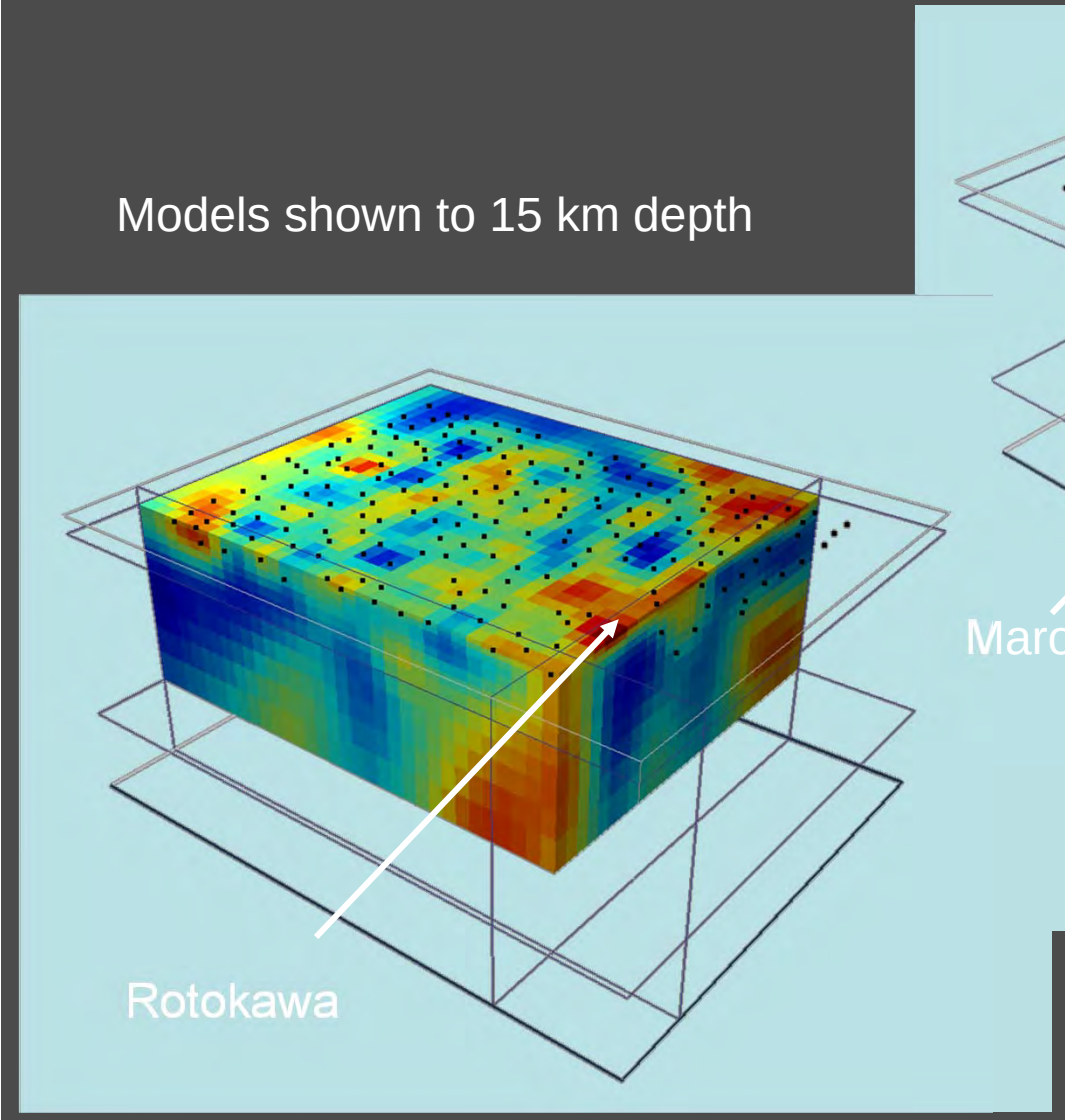


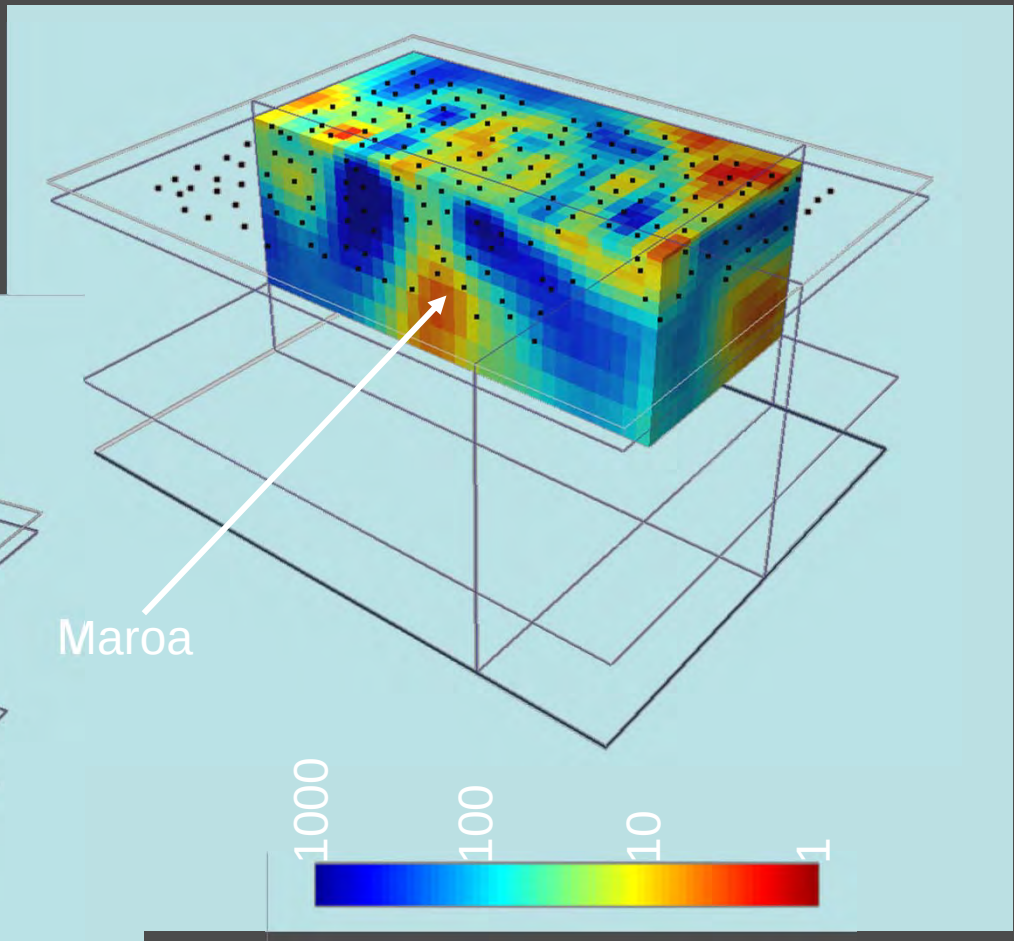


MT Measurement sites – nominally 2km spacing – subject to landowner approval

Inversion Models

Models shown to 15 km depth





Looking forward

International science drilling project to >5 km in Taupo-Reporoa Basin.

Well planning

- 4.5, 5.5 and 6.5 km holes being investigated

… will require engineering and science innovation

International Continental Scientific Drilling Programme (ICDP)

- Programme that releases funds for advancing data acquisition for scientific advancement in land drilling projects
- New Zealand is a member (GNS manages this)
- Possible source of up to $1 million USD per project (from a pot of $4M/y).
- Funds are for data gathering - not analysis or interpretation

Taupo Volcanic Zone – Deep Geothermal Drilling Project

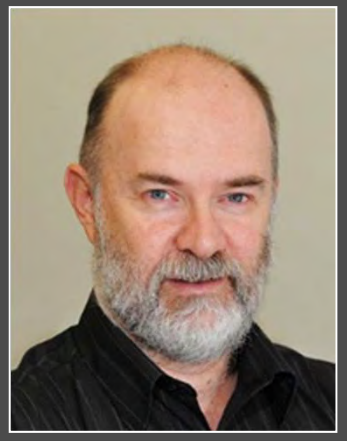
TVZ – DGDP

Application for funding for deep drilling, coring and data acquisition in a >4 km TVZ deep hole is underway

- GNS is leading the funding application
- Expression of interest lodged and accepted
- NZ geoscience/engineering workshop : August 2013
- Full proposal to ICDP for science drilling funds : January 2014

Time for more planning ahead of deep well drilling

Contact people at GNS Science



Greg Bignall
Geology Team Leader
Wairakei Research Centre
ph 07 376 0161
Email : g.bignall@gns.cri.nz

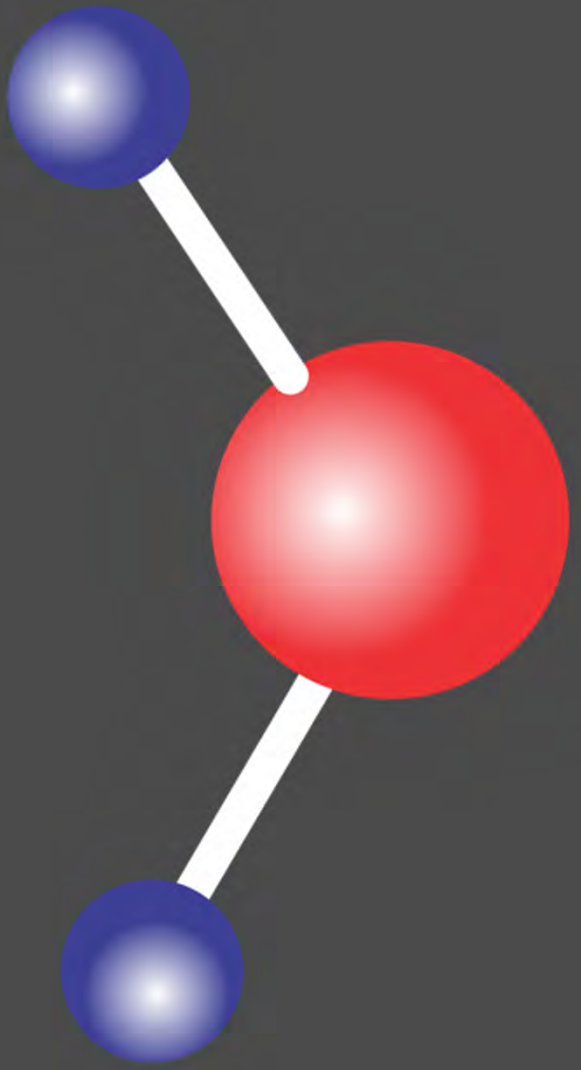
Brian Carey
Geothermal Manager
Wairakei Research Centre
ph 07 374 8211
Email : b.carey@gns.cri.nz

NZ blessed with a great gift to unwrap

But Really How Does It All Work

Methods to Produce Well Fluids

- Self discharging - boiling
- Pumped discharge



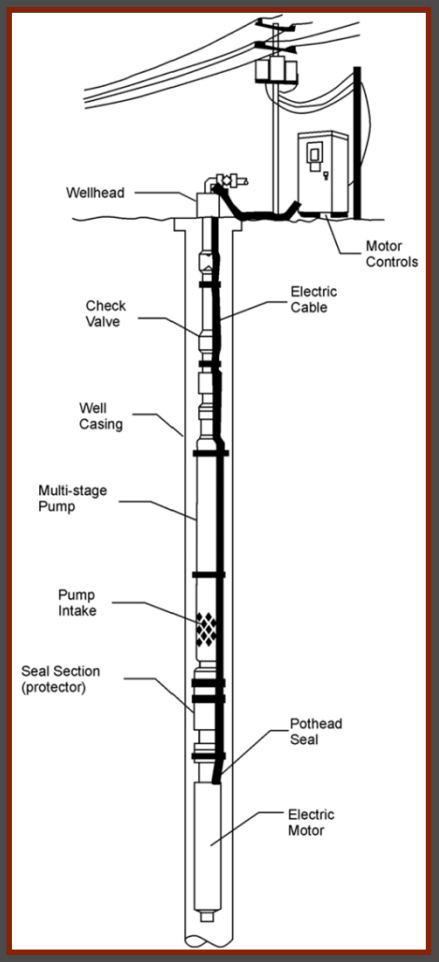
At surface

- Use single phase fluid
- Separate water and steam
- Two phase fluids

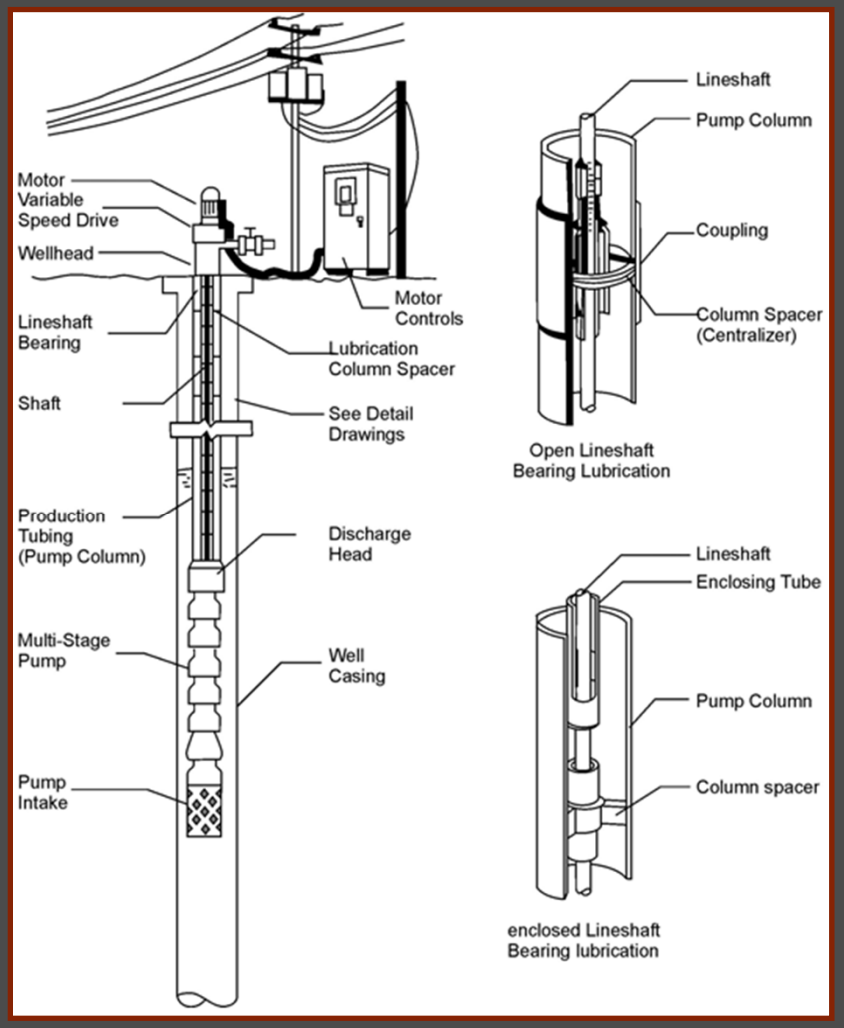
Pump wells

- **Temperature < 170 to 180 ^{o}C**
- **Maintain liquid under pressure**
  - Can assist geochemically
- **Two types**
  - Downhole
  - Line shaft

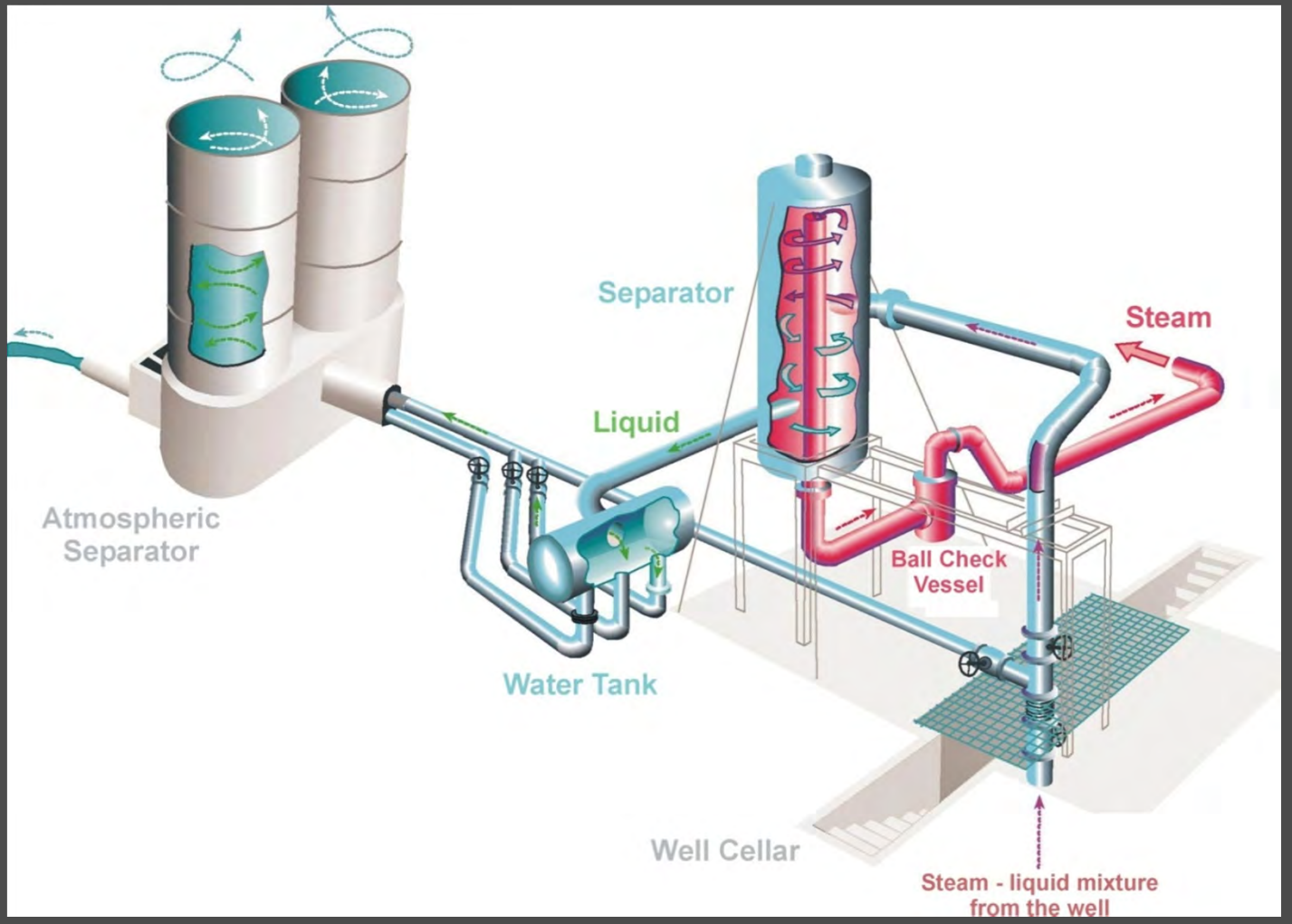
Downhole


Wellhead
Motor Controls
Check Valve
Electric Cable
Well Casing
Multi-stage Pump
Pump Intake
Seal Section (protector)
Pothead Seal
Electric Motor

Line Shaft Pump



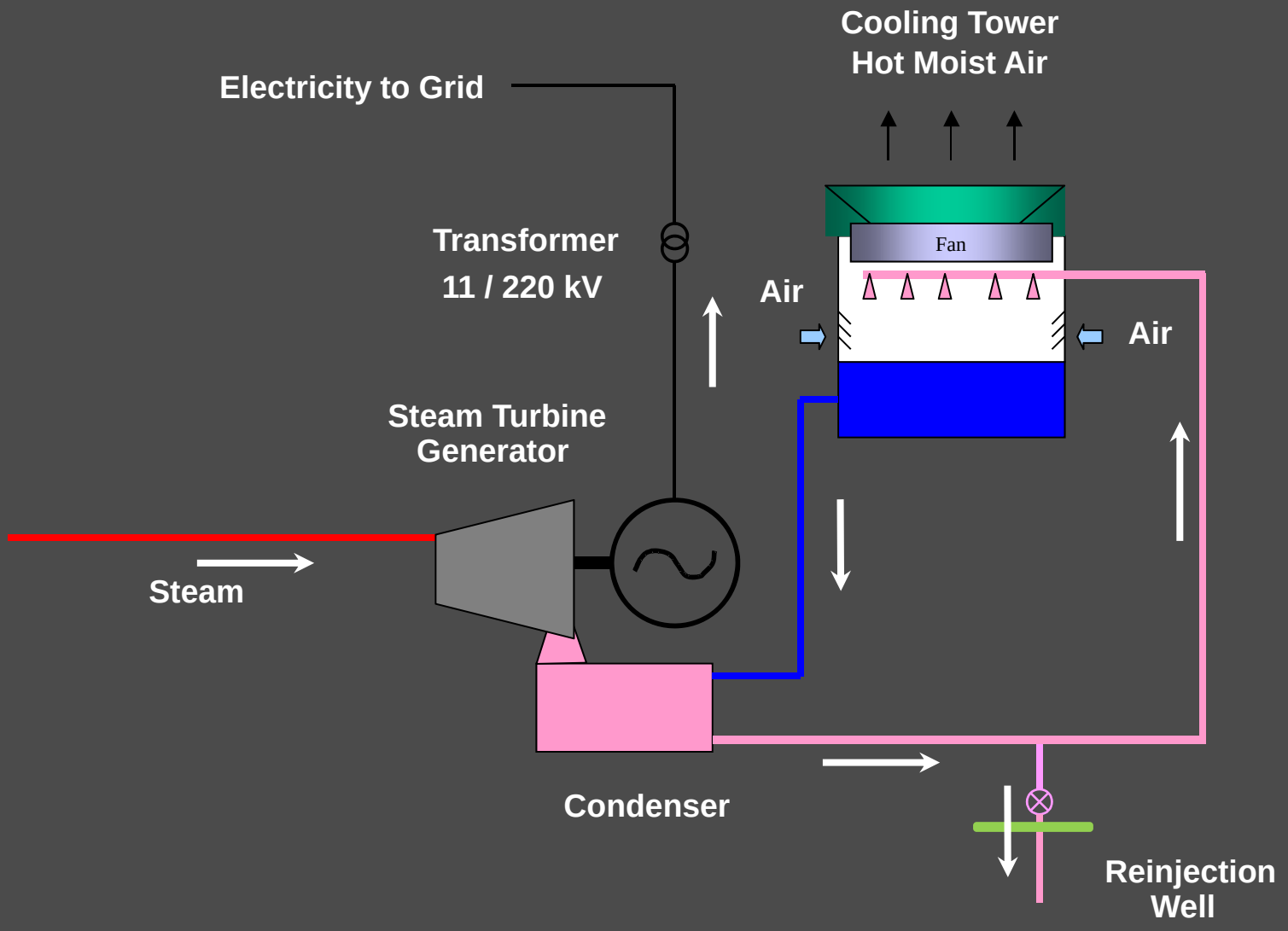
How to deal to a two phase mixture



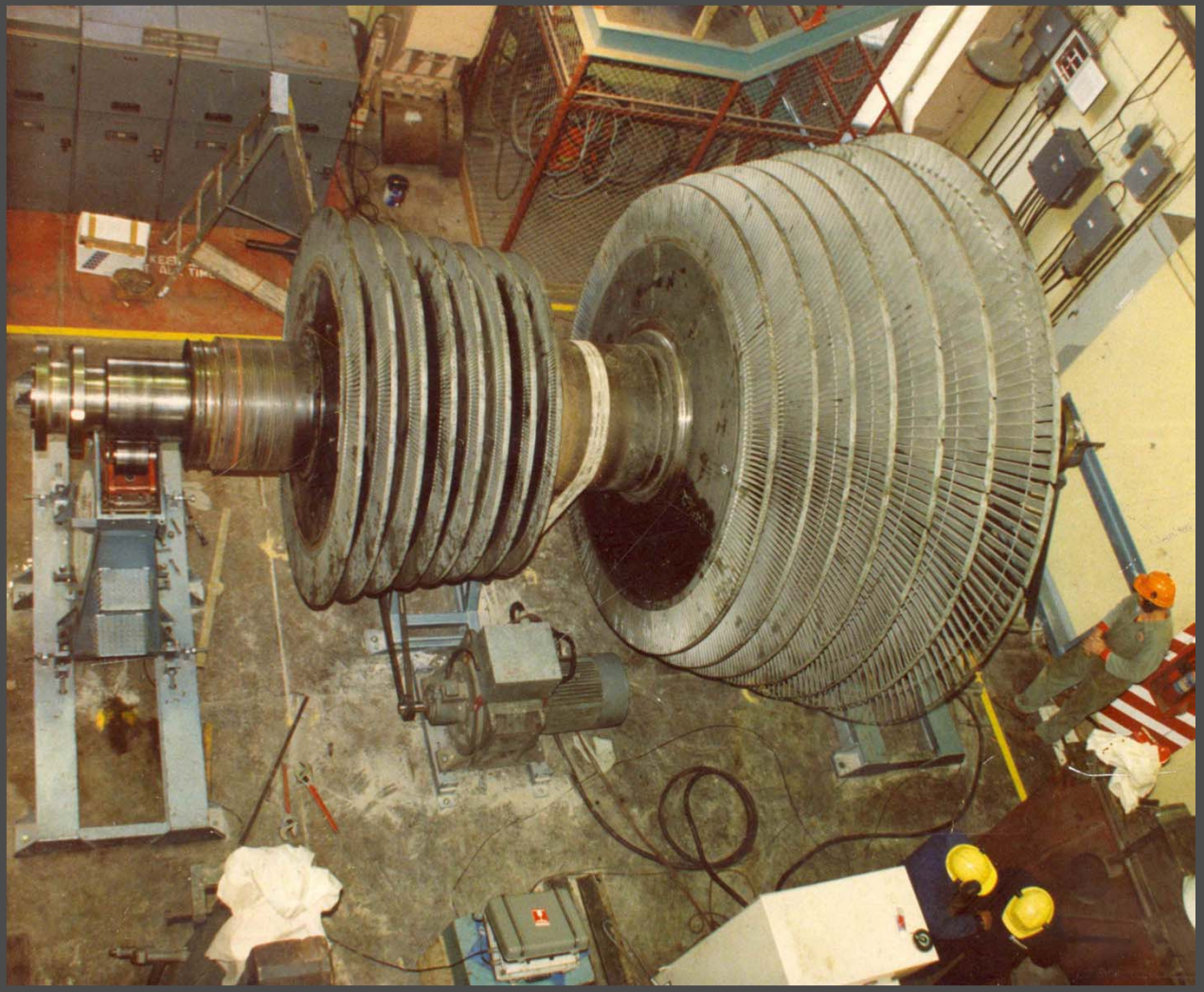
Two Fluid Streams available for Generation

- Steam – Steam Turbine plant
- Water – Organic Rankine cycle plant
- Vapour Expansion is the driving mechanism for power turbines

Condensing Steam Turbine Plant



Steam Turbine Rotor

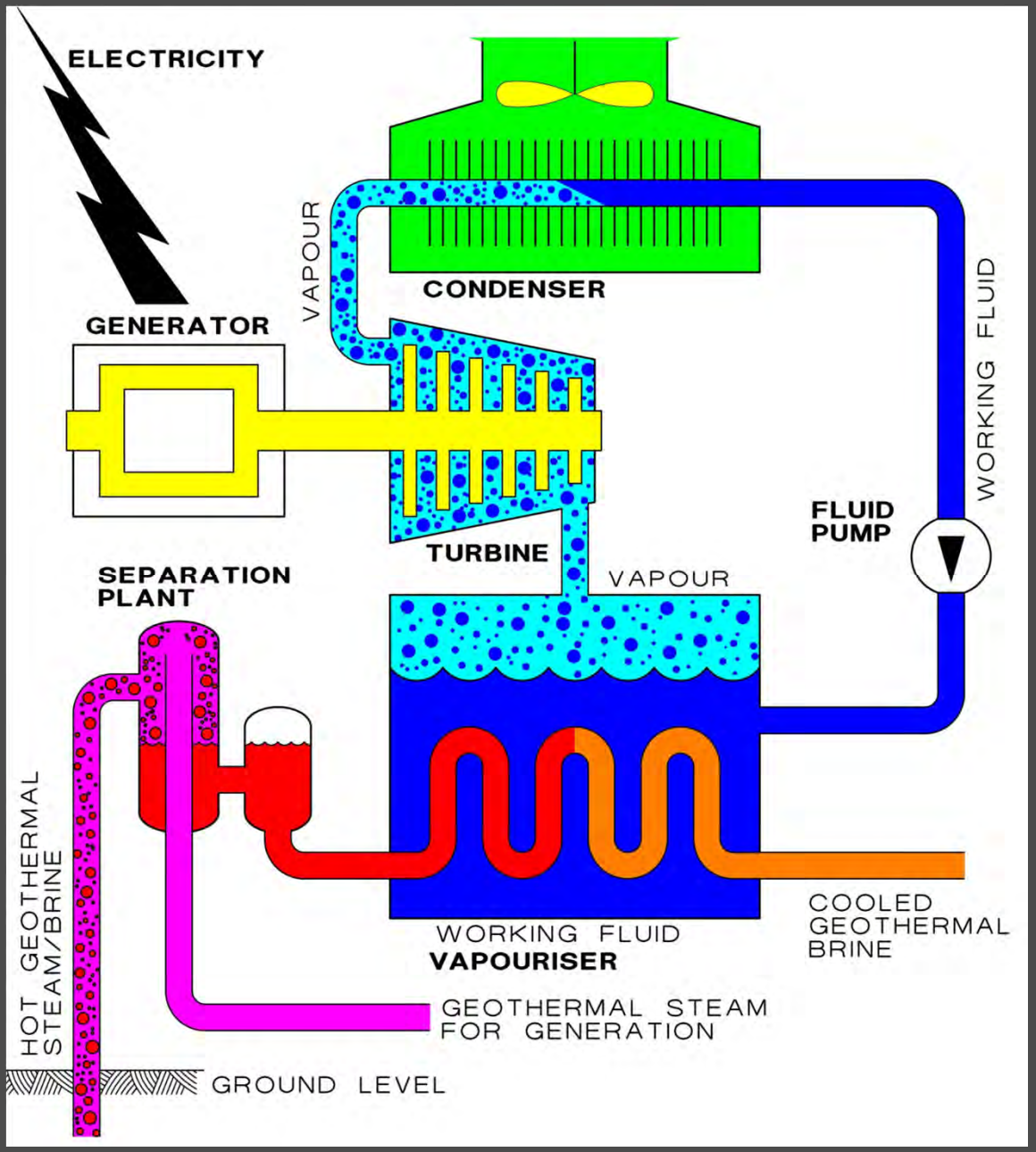


Cooling Towers – Turbine Hall

Water to Organic Rankine Cycle

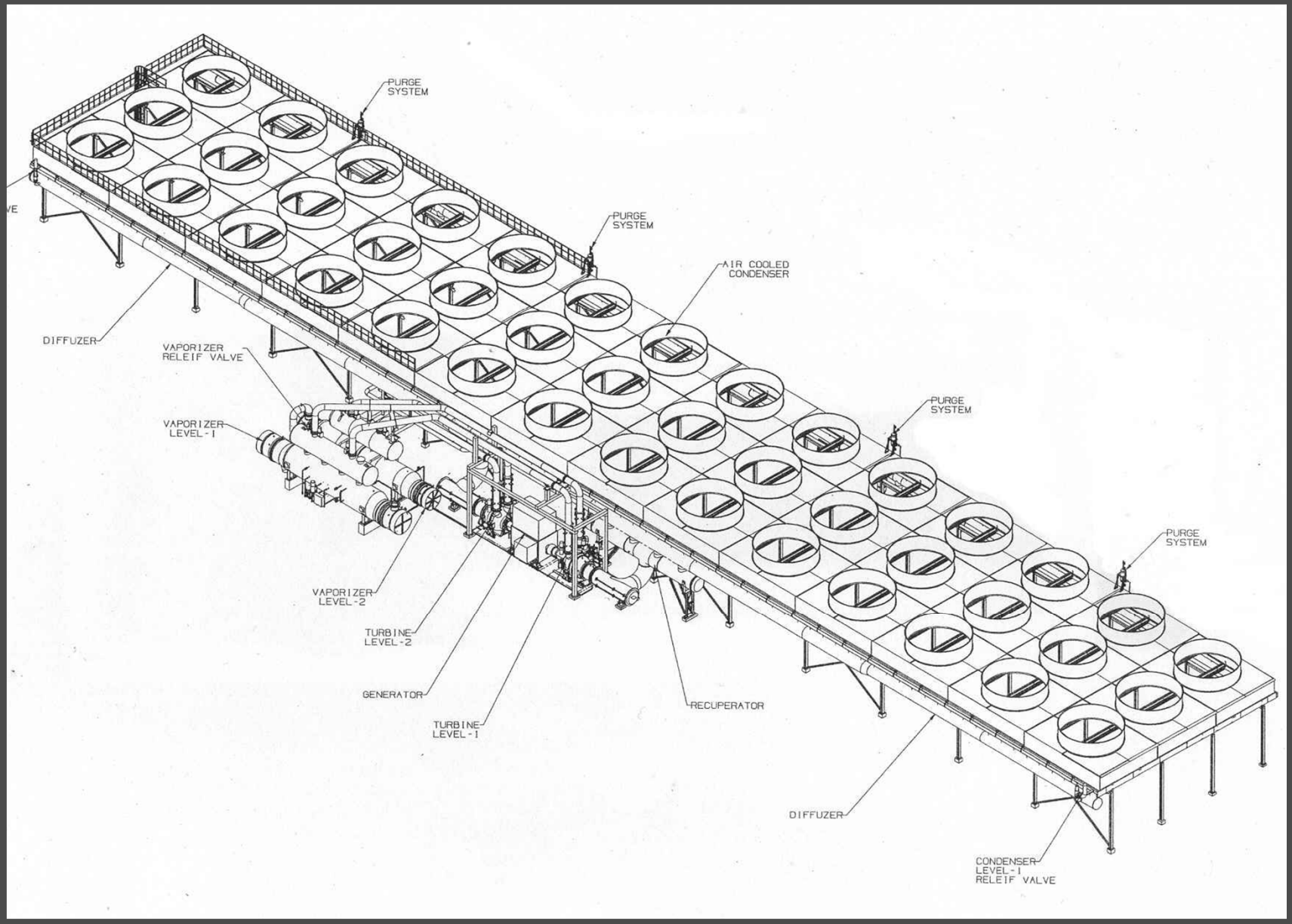
Or Binary Cycle

Simplified Organic Cycle



Te Huka - Preheaters and Vaporiser


OEC12


PURGE SYSTEM
PURGE SYSTEM
AIR COOLED CONDENSER
PURGE SYSTEM
PURGE SYSTEM
DIFFUZER
VAPORIZER RELEIF VALVE
VAPORIZER LEVEL-1
VAPORIZER LEVEL-2
TURBINE LEVEL-2
GENERATOR
TURBINE LEVEL-1
RECUPERATOR
DIFFUZER
CONDENSER LEVEL-1 RELEIF VALVE

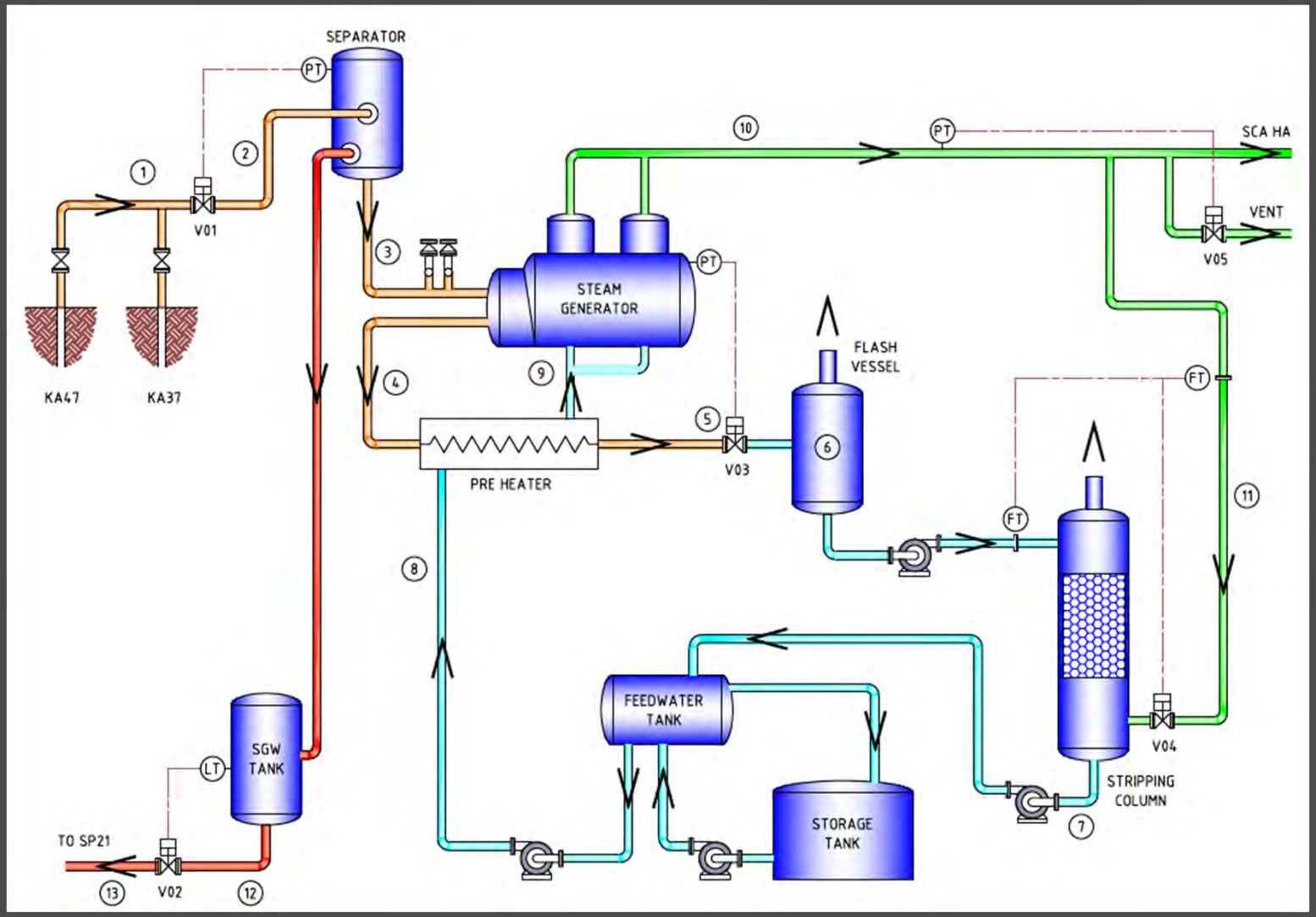
Direct Heat Use

- **Array of technologies**
- **Kiln Drying of timber**
  - Two phase fluids
  - Steam
- **Clean Steam Generation**
- **Heat and cool**
- **Desalinate water**

Smorgasbord of uses

Direct Heat – Kiln Drying

Direct Heat – Creating Clean Steam



NST – Kawerau

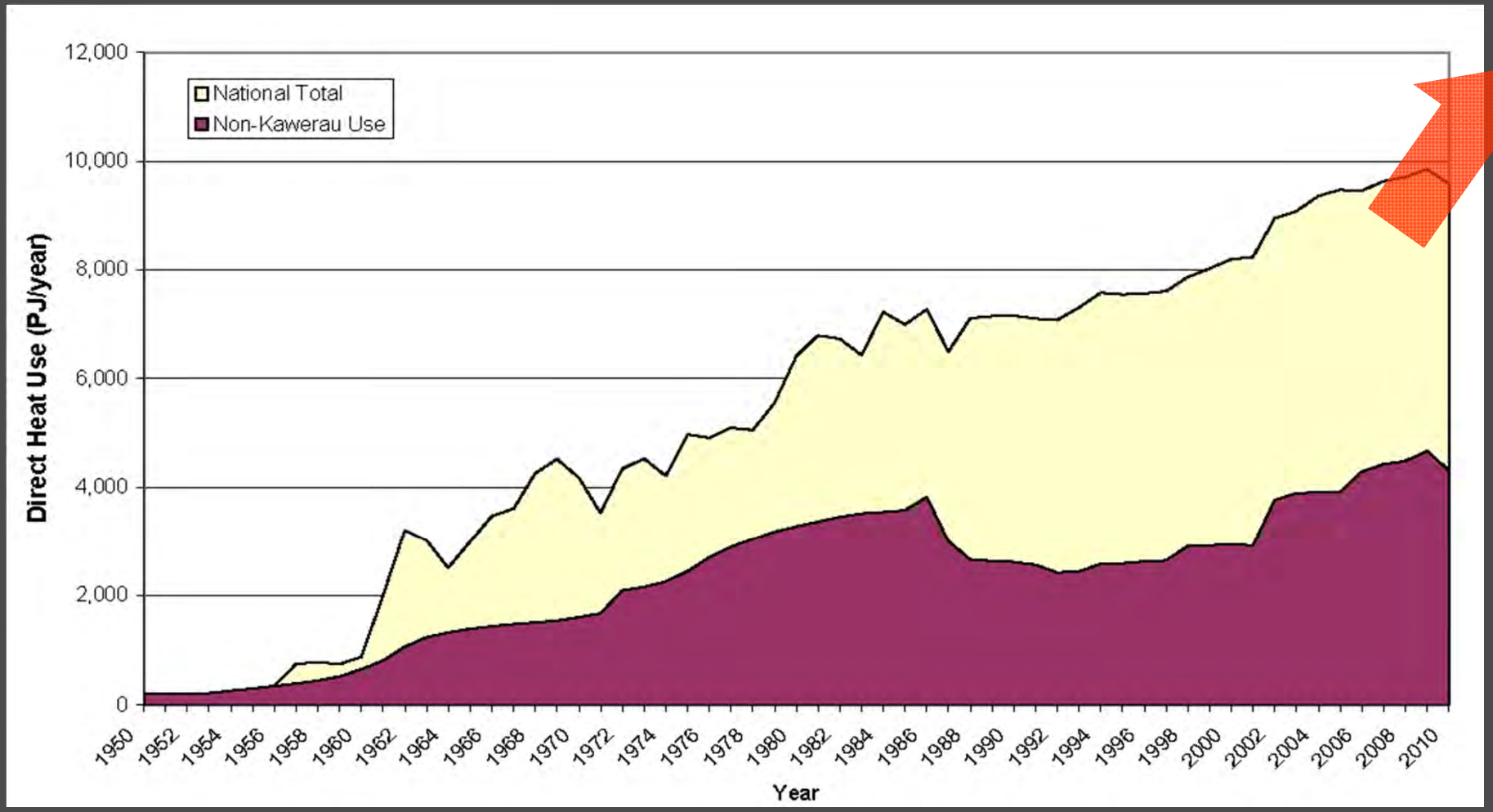
Miraka - Mokai

MB Century

SCA - Kawerau

Dobbie Engineers

Growth in Direct Geothermal Use



Geothermal Direct Use Targets for New Zealand

- **New Zealand Energy Efficiency and Conservation Strategy 2011 – 2016**

  3rd Edition

New Zealand **Energy Strategy 2011–2021**

Developing our energy potential

and the **New Zealand Energy Efficiency and Conservation Strategy 2011–2016**

Business Sector (p18)

Sector objectives and targets

Objectives	Targets
Transport A more energy efficient transport system, with a greater diversity of fuels and alternative energy technologies.	By 2016: The efficiency of light vehicles entering the fleet has further improved from 2010 levels.
Business Enhanced business growth and competitiveness from energy intensity improvements.	By 2016: An improvement in the commercial and industrial sector energy intensity level (GJ/$1,000 of GDP).
	By 2025: We will utilise up to 9.5 PJ per year of energy from woody biomass or direct use geothermal additional to that used in 2005.
Homes Warm, dry and energy efficient homes with improved air quality to avoid ill-health and lost productivity.	By 2013: Insulate 188,500 homes.
Products Greater business and consumer uptake of energy efficient products.	By 2016: Extend minimum energy performance standards, labelling and EnergyStar product coverage to remain in line with major trading partners.
Electricity System An efficient, renewable electricity system supporting New Zealand's global competitiveness.	By 2025: 90 percent of electricity will be generated from renewable sources, providing supply security is maintained.
Public Sector Greater value for money from the public sector through increased energy efficiency.	By 2016: Improve energy use per full-time staff equivalent compared with a 2010 baseline.

Official records of programme details

The NZEECS does not contain a full list of Government energy efficiency initiatives. As a statutory document with a five-year life, the NZEECS has been presented so as to ensure it won't be out-of-date as initiatives come and go over that period.

Initiatives provided by the public sector agencies listed in this strategy will be noted in their public documents, such as their statements of intent, which are published on their websites.

Information about energy efficiency and renewable energy

The Energy Efficiency and Conservation Authority (EECA), is the primary Government agency charged with promoting energy efficiency and renewable energy. Information about EECA's programmes can be found at:

www.eeca.govt.nz – all EECA programmes for householders, communities, business, Government, and local government.

www.eecabusiness.govt.nz – energy advice and support targeted at businesses.

www.energywise.govt.nz – energy advice and support targeted at householders.

These website links are also helpful:

www.rightlight.govt.nz – information about efficient lighting.

www.transport.govt.nz/ourwork/climatechange – Ministry of Transport information and initiatives relating to climate change and energy.

www.safednz.govt.nz – Safe and Fuel Efficient Driving New Zealand website, a driver development course for truck, bus and coach drivers.

www.rightcar.govt.nz – information on how vehicles rate for fuel economy, safety, CO_2 emissions and pollutants.

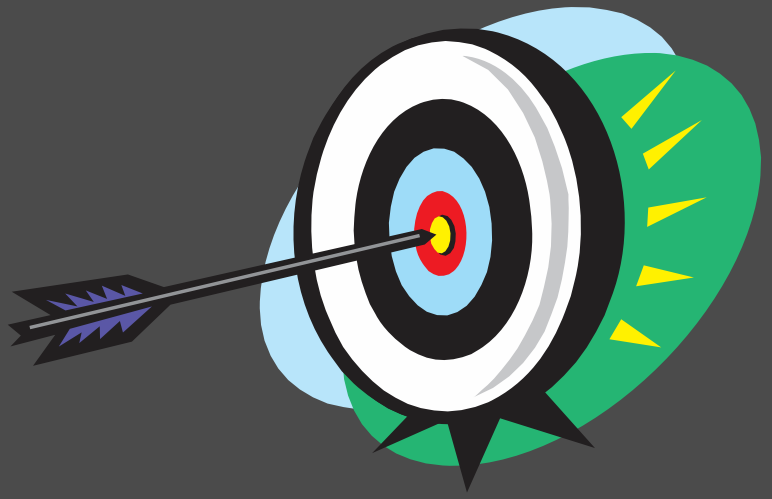
www.fuelsaver.govt.nz – information on vehicle fuel efficiency and tips on improving efficiency through driving behaviour

Geothermal Direct Use Targets are not new

- 2nd Edition of NZEECS October 2007
- Up to an additional 9.5 PJ per year of energy from woody biomass or direct use geothermal by 2025 (p12)
- By 2025 increase direct use geothermal by 2 PJ per annum off a 10 PJ per annum 2005 base (p38)

Geothermal Direct Use Target

- Up to an additional 9.5 PJ per year of energy from woody biomass or direct use geothermal by 2025 (off 2005 base).



Low Temperature Geothermal @ GNS

Commenced in 2008

A three (plus) year FRST programme
And now core GNS programme

Lead by

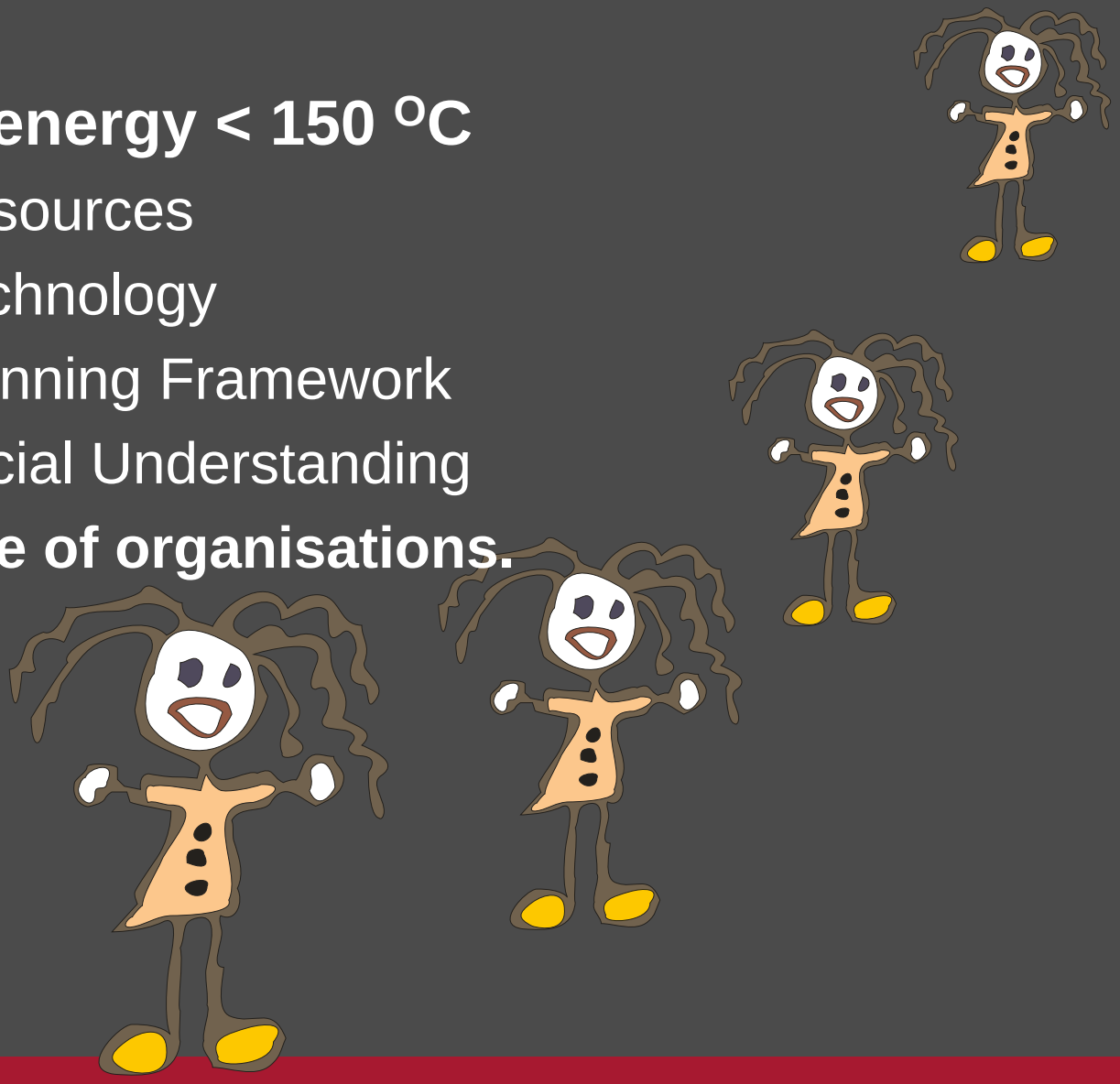
Lisa Lind
Chemical Engineer
Email lisa@lindpe.com

More Information from GNS

Melissa Climo
Email m.climo@gns.cri.nz

Stock Take

- **Earth energy < 150 ^{o}C**
  - Resources
  - Technology
  - Planning Framework
  - Social Understanding
- **A range of organisations.**



Low Temperature Geothermal @ GNS

- **Reports**
- **Case studies**
- **Fact Sheets**
  - Are all freely available
- **Visit the GNS Science web site to download**

For general Information
http://www.gns.cri.nz/earthenergy

For the reports
Learn More
6th item down
www.gns.cri.nz/Home/Our-Science/Energy-Resources/Geothermal-Energy/Reports-and-Publications

Home | About Us | Our Science | Services | Products | Learning | News and Events | Careers | Contact Us | Search

Home / Our Science / Energy & Resources / Geothermal Energy / Reports and Publications

Geothermal Energy
- Research
- Consultancy
- Training
- Analytical Services
- Project Examples
- Reports and Publications
- Team
- Links

Reports and Publications

The following reports are relevant to low temperature geothermal energy use.

Visit the Learning Zone for more information about Geothermal - Earth Energy!

Technical Information

- Residential householders' heating and cooling practises and views on energy...pdf (1.25 MB)
  GNS Science, 111 pages. 2011.
- Low temperature geothermal energy - Planning Assessment.pdf (1.53 MB)
  EMS, 63 pages. 2011.
- *Sources of solutes and heat in low-enthalpy systems.pdf (2.68 MB)*
  GNS Science, A. Reyes, 63 pages. 2011.
- Swedish Ground Source Heat Pump Case Study (2010).pdf (1.23 MB)
  GNS Science, 31 pages. 2011.
- Building people into plans - Insights into decisions about heating and cooling NZ homes .pdf (140.80 kB)
  GNS Science, 11 pages. 2010.
- Heating & Cooling Homes - A study of residential householders practises and views .pdf (1.17 MB)
  GNS Science, 91 pages. 2010
- Low temperature geothermal energy - Technology Review.pdf (4.61 MB)
  GNS Science, 59 pages. 2010.
- Energy demand estimation for cooling and heating in NZ.pdf (1.17 MB)
  GNS Science, 1.2MB PDF, 38 pages, 2010
- A practical guide to exploiting low temperature geothermal resources.pdf (3.47 MB)
  GNS Science, 79 pages. 2006.
- An assessment of geothermal direct heat use in NZ.pdf (1.16 MB)
  NZ Geothermal Association report, 30 pages. 2005.

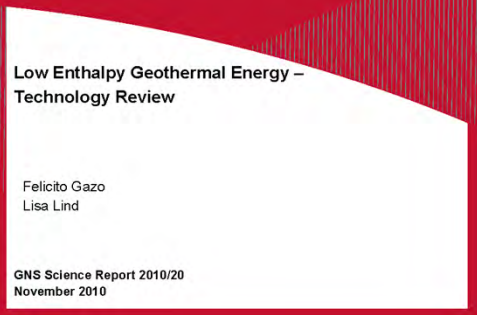
General Information

- Five maori trust groups' perspectives on low temperature geothermal energy resources.pdf (1.74 MB)
  GNS Science, 28 pages, 2011
- Using low temperature geothermal resources.pdf (2.02 MB)
  GNS Science; 8 pages. 2006.
- A preliminary evaluation of sources of geothermal energy for direct use.pdf (1.64 MB)

Today – I will draw on material from

- **Technology review**
  Cito Gazo + Lisa Lind
- **Social Understanding Study**
  Brendan Doody + Julia Becker
- **Heating and Cooling Demand Study**
  Pieter Rossouw + Lisa Lind
- **Low Temperature Geothermal Energy Road Map**
  Melissa Climo + Brian Carey

Technology Report



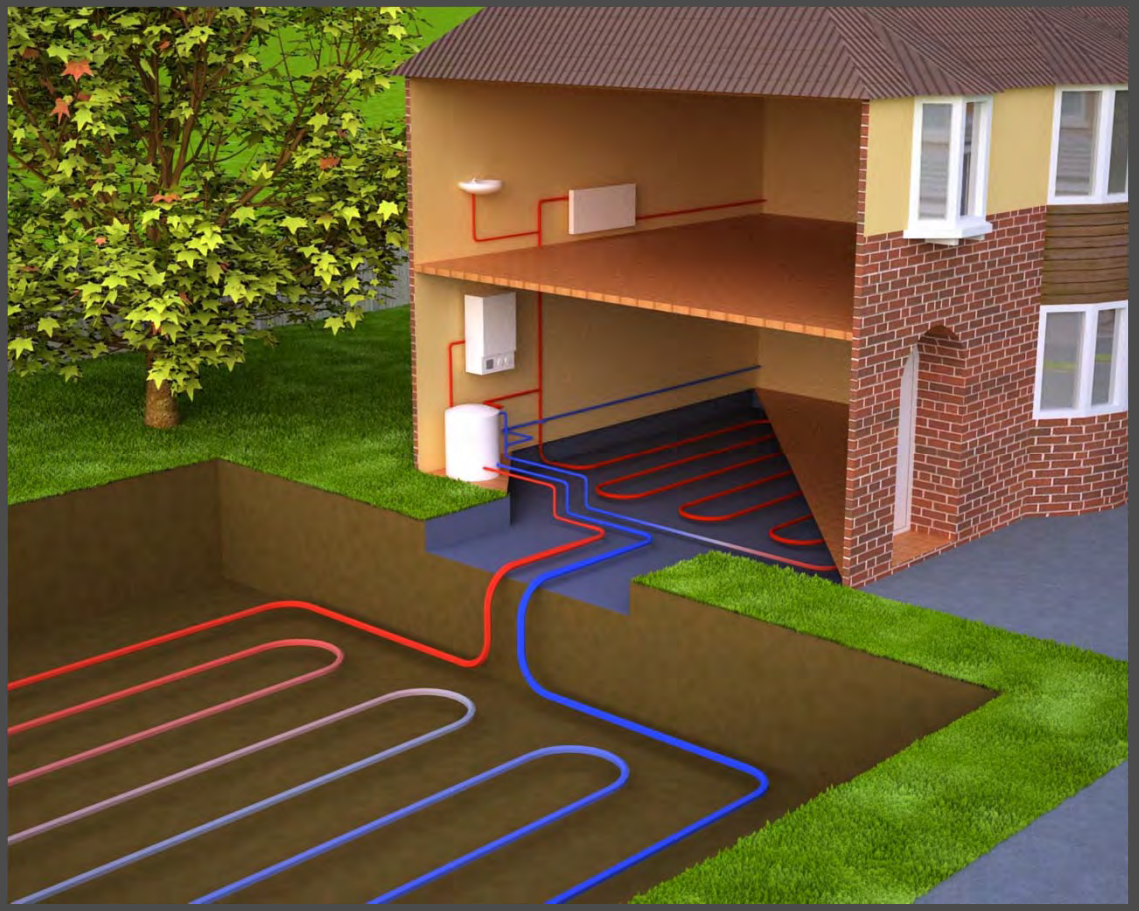
Have a read

Low temperature geothermal energy – Technology Review

Cito Gazo + Lisa Lind 2010

Heat Pumping

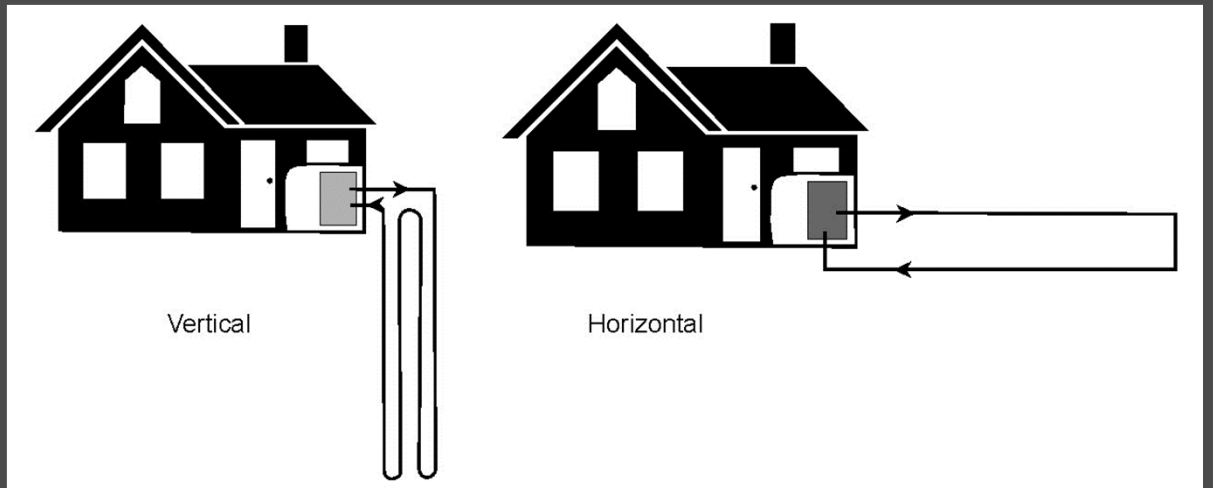
- Space heating
- Space cooling
- Water heating



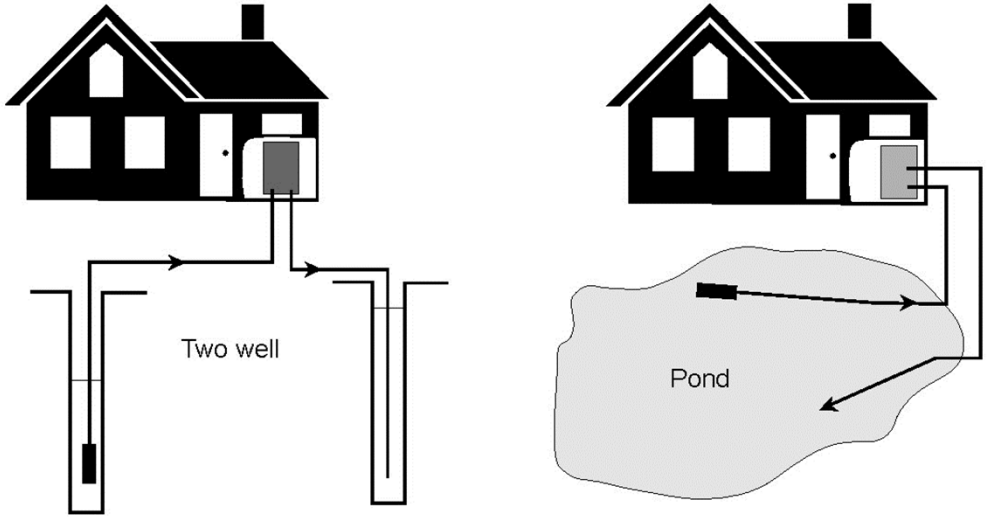
Two Basic Ways Moving Low Temperature Earth Energy

- Closed Loop Systems
- Open Systems - Fluid abstraction

Closed and Open Systems



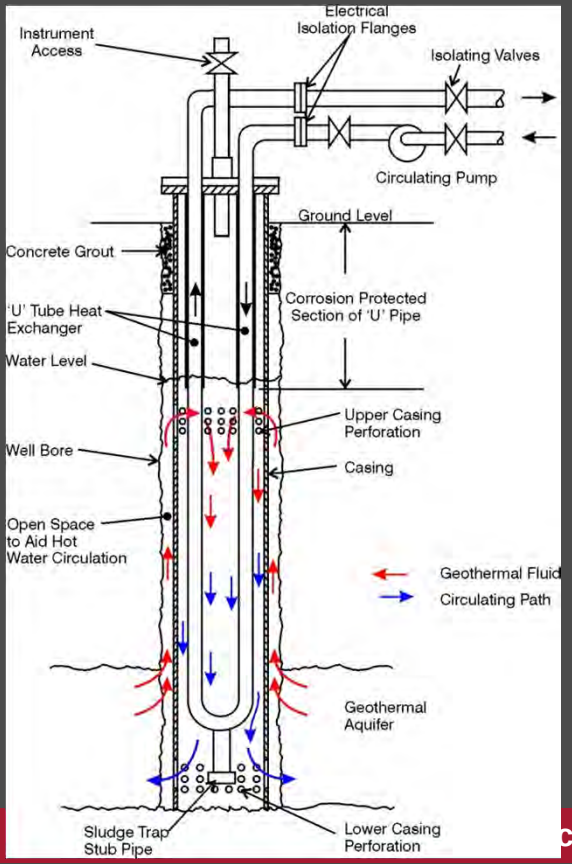
Closed loop heat pump systems (source: Geo-Heat Centre)



Open loop heat pump systems (source: Geo-Heat Centre)

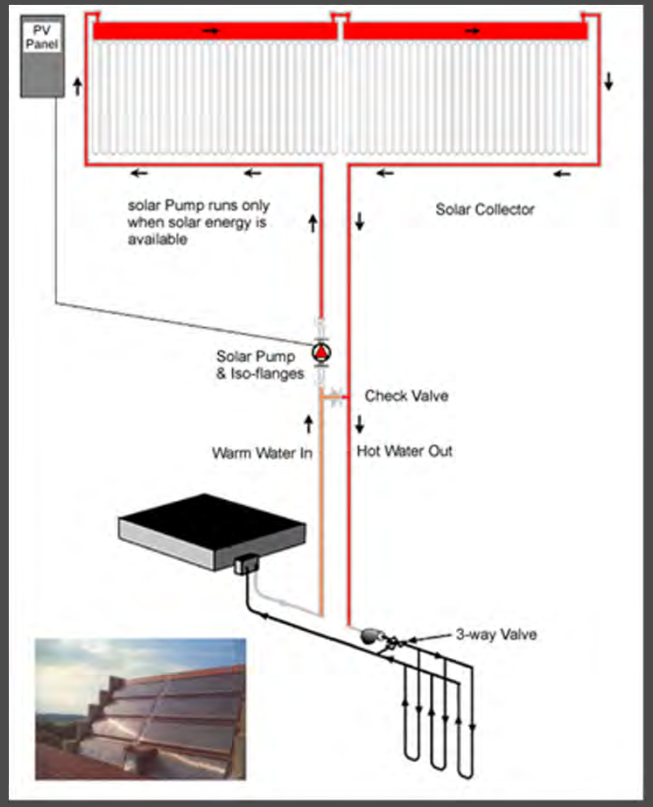
Closed Loop

- **Fluid transfers heat as it is pumped around :**
  a piping system buried in the ground, or
  immersed under water
- **Down hole heat exchangers**
- **Geothermal Heat Pump**



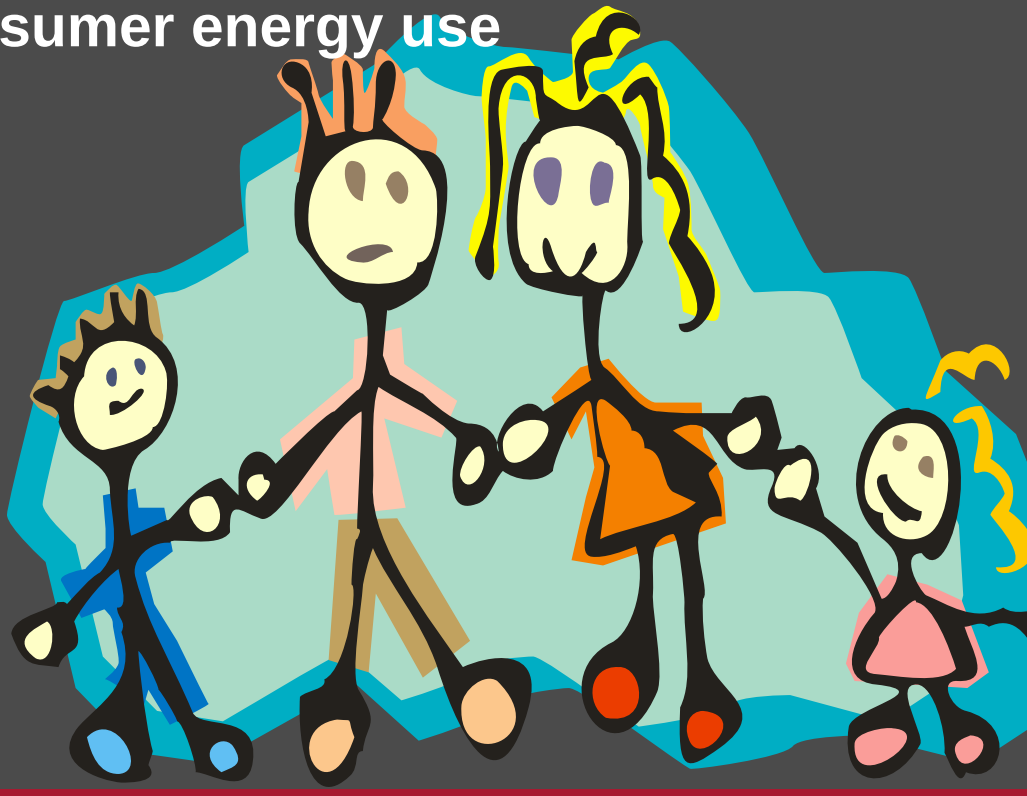
Watch Hybrid Technologies Develop

- Very energy effective
  GHP and solar systems
- **Coefficients of performance of 6**



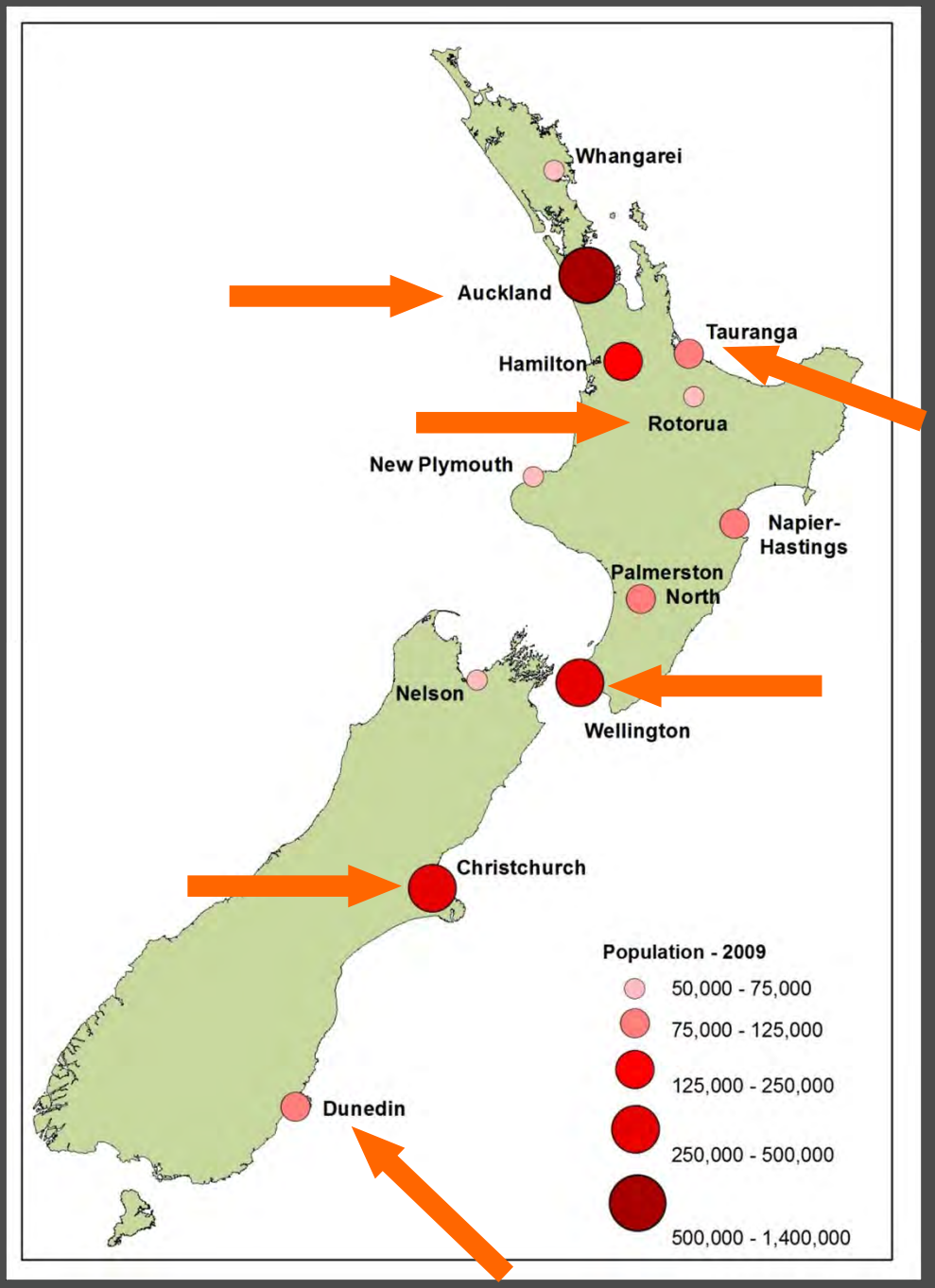
Social Understanding - Survey

- **Examine public knowledge and understanding of Low Temperature Geothermal**
  - Including Geothermal Heat Pumps
- **Behavioural drivers - consumer energy use**
- **Residential Focus**



Quantitative Survey

- Qualitative - Interviews
- Quantitative Survey
  - 3500 Random Households
- 716 returned



Residential householders' heating and cooling practices report

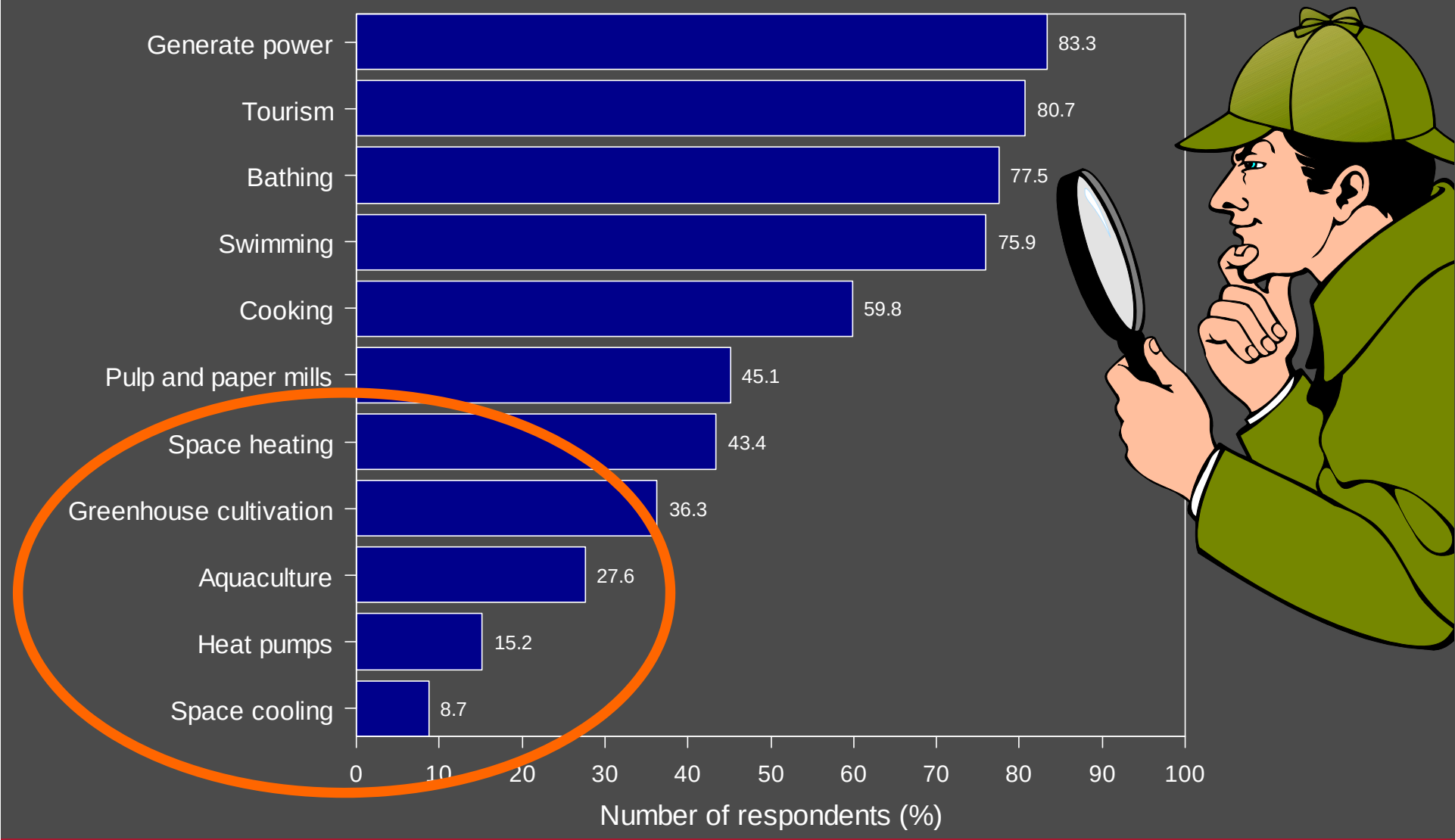
Have a read

Brendan Doody + Julia Becker

Low Temperature Geothermal

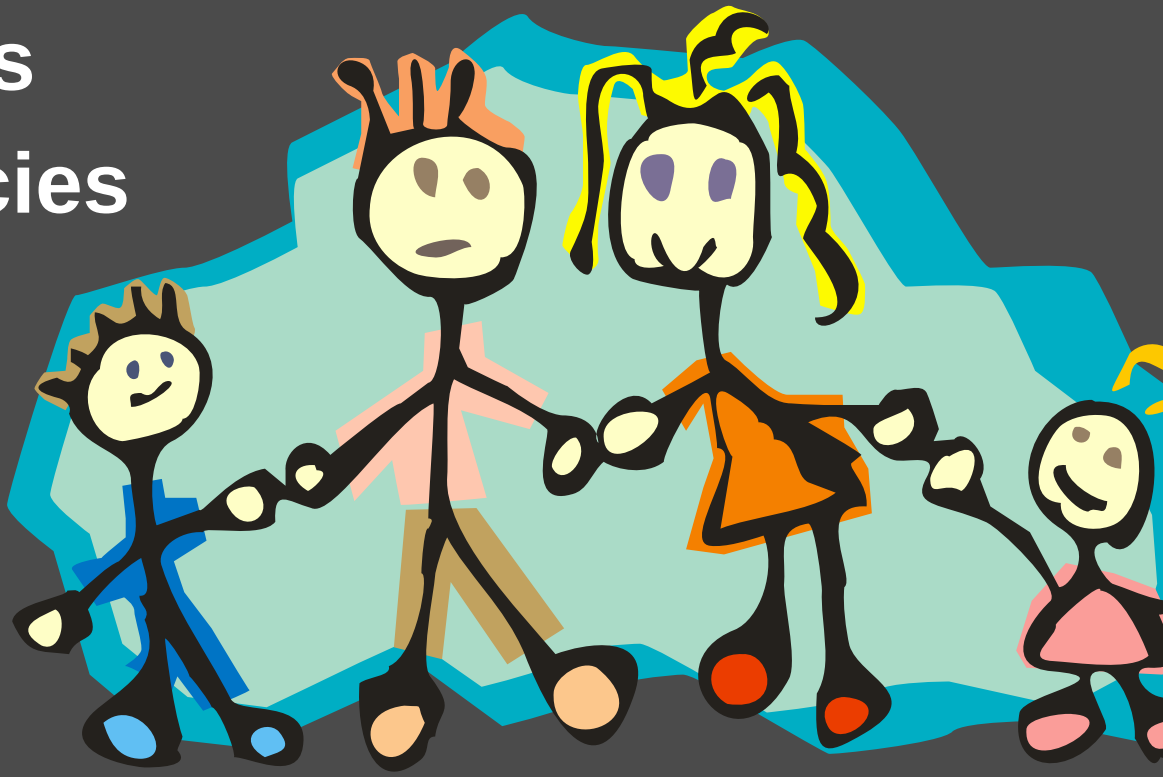
- **Low level of understanding**
- **Most people unaware**
  - "Never heard of it".
- **Some offered suggestions:**
  - "Not very hot steam".
  - "Using geothermal services which aren't quite [at] as high temperatures […] Maybe it's using the residual energy and hot water that's coming out of a power plant"

Geothermal Energy Use Perceptions

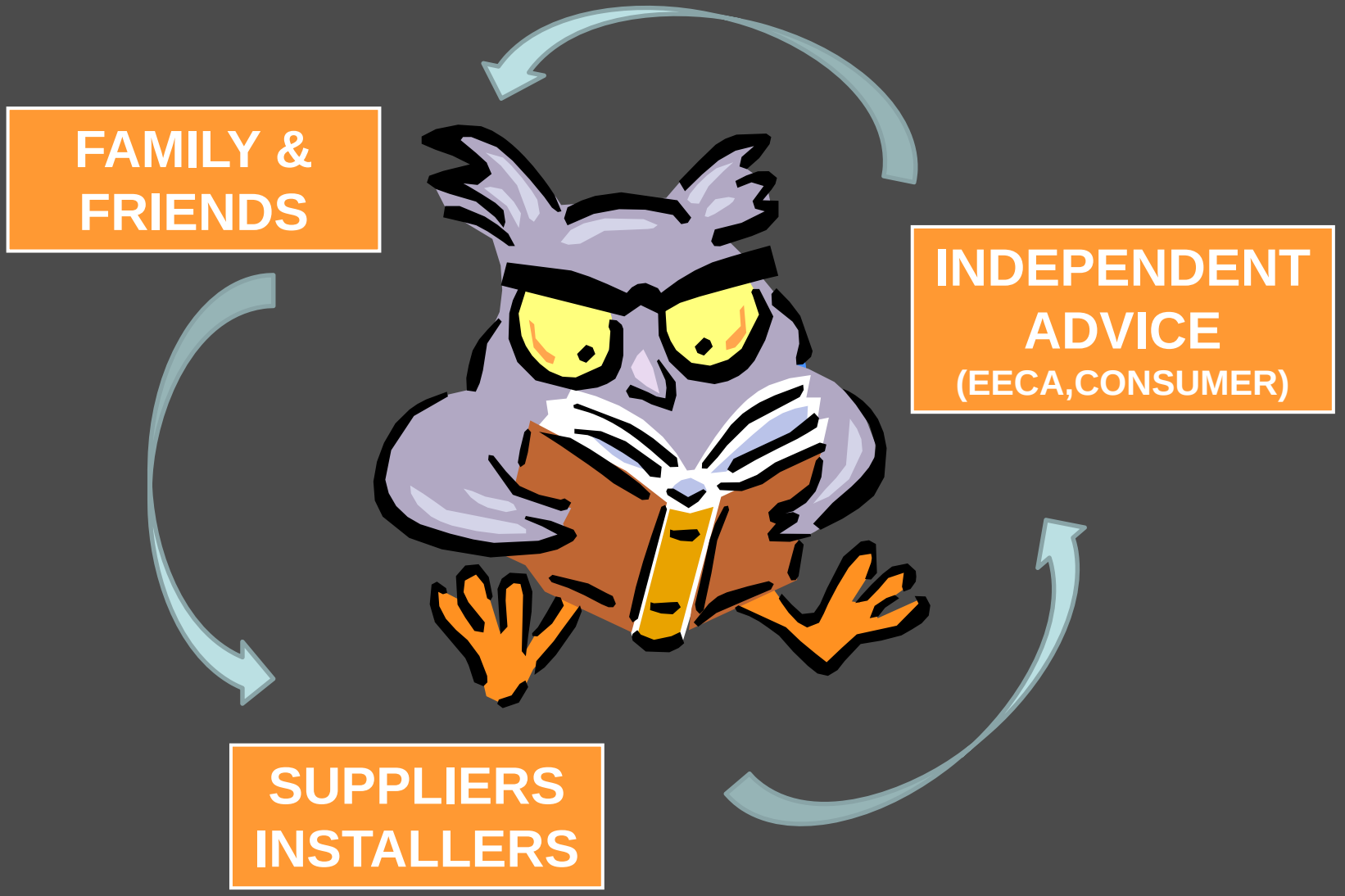


Technology Transfer

- Social Process
- Trusted agencies



Decision making on Technology is a social process!



Heating and Cooling Energy Growth to 2025

- **Report**

  Energy Demand estimation for cooling and heating in NZ

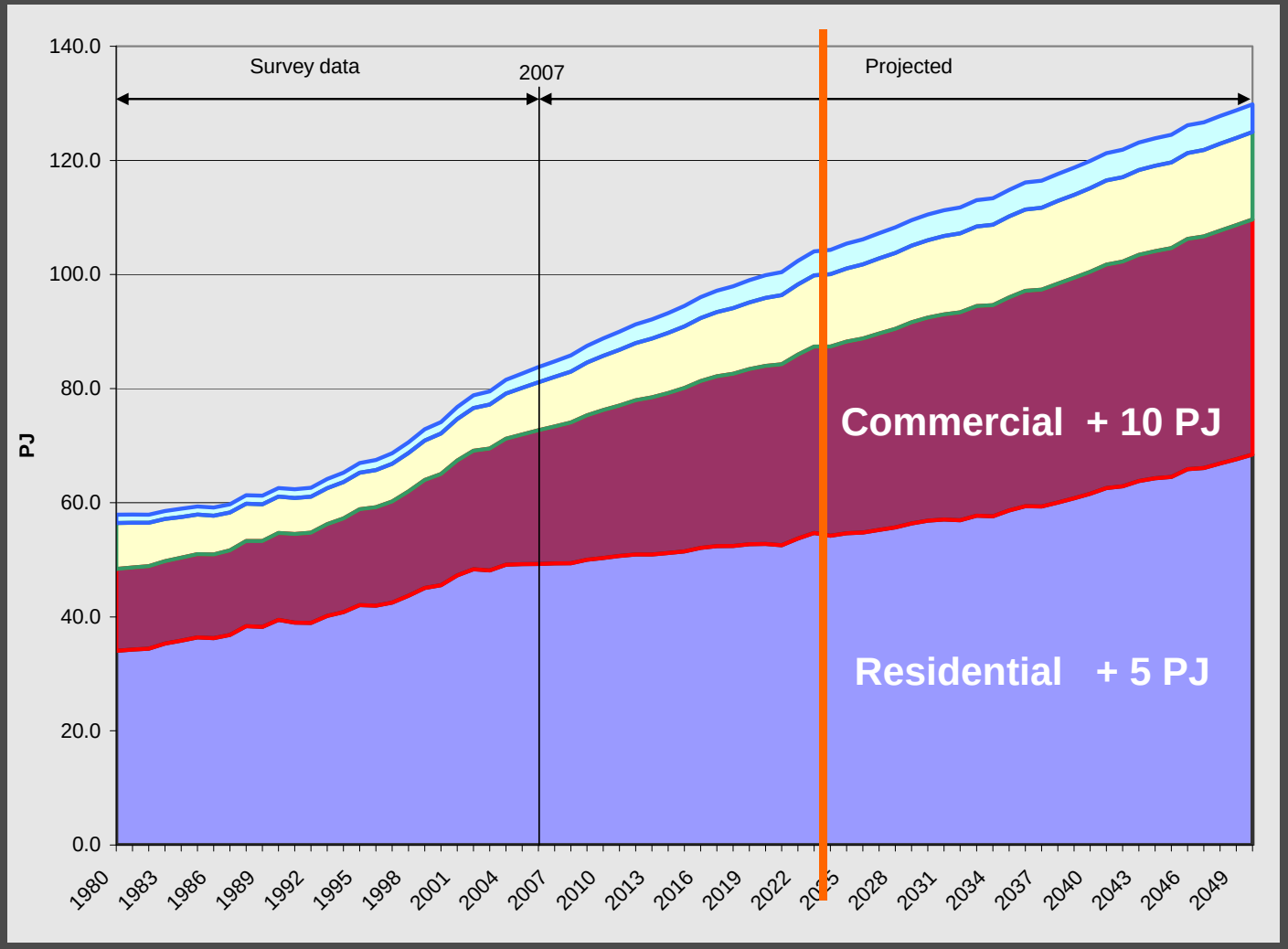
  Pieter Rossouw + Lisa Lind 2010

- **Historical data – 2007**
- **Demand predictions - 2025**
  - By sector
  - By temperature range

    < 100 ^{o}C

    < 150 ^{o}C

< 100°C H+C Energy Demand Growth – 20 PJ

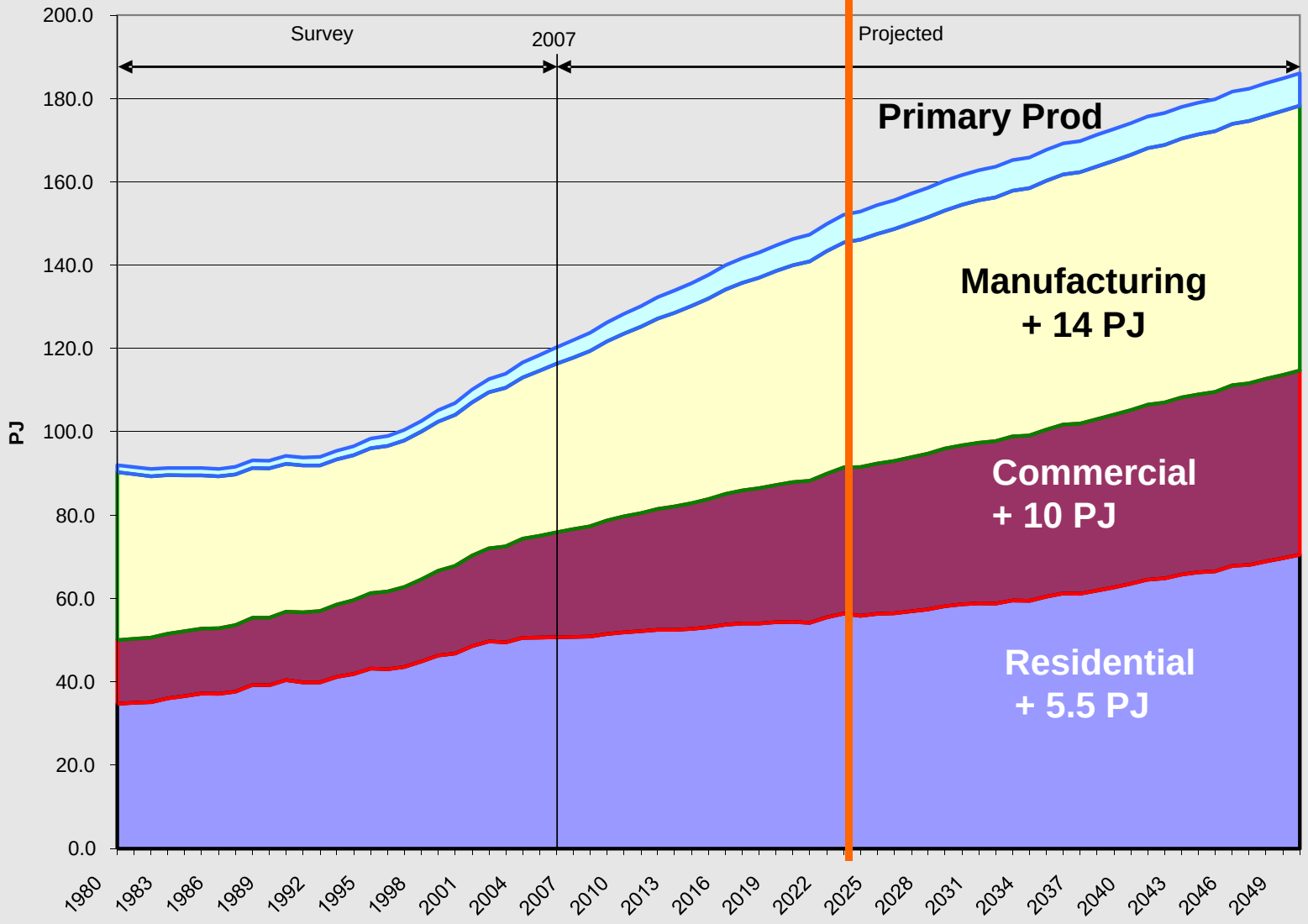


Primary Prod

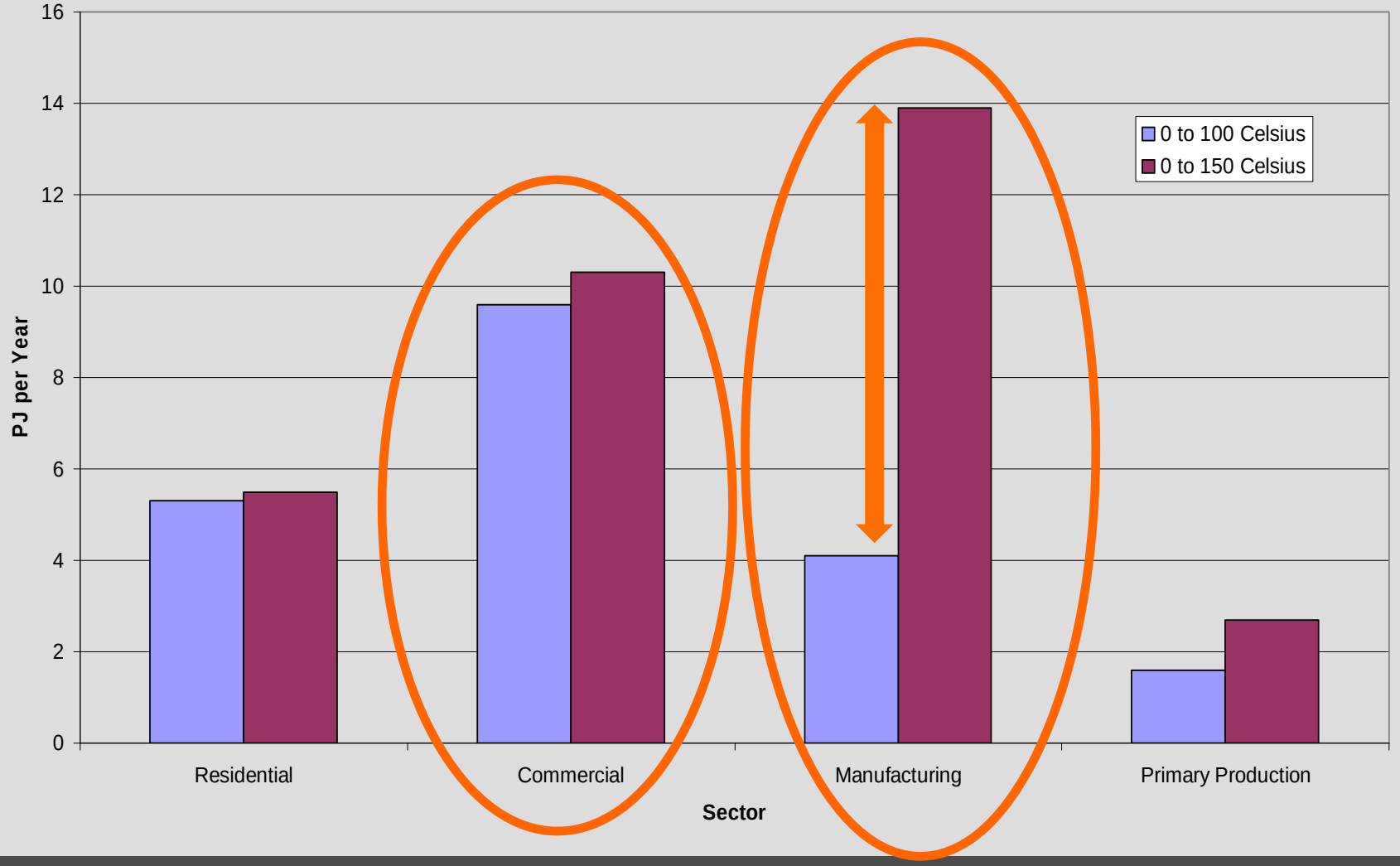
Manufacturing

+ 4 PJ

< 150°C H + C Energy Demand Growth – 32 PJ



Focus on largest sector growth increase by 2025



Two Sector Focus

- **Manufacturing 100 ^{o}C to 150 ^{o}C**
  - Taupo Volcanic Zone and
  - Possibly natural thermal gradient for larger size installations
- **Commercial < 100^{o}C**
  - GHP's - space conditioning and water heating ?

Challenge - Grow Geothermal Direct Use

- How do you do this ?
- Available and trusted energy advice
- The right technology in the right place
- Sound Practise
- Show casing
- Communicating and celebrating

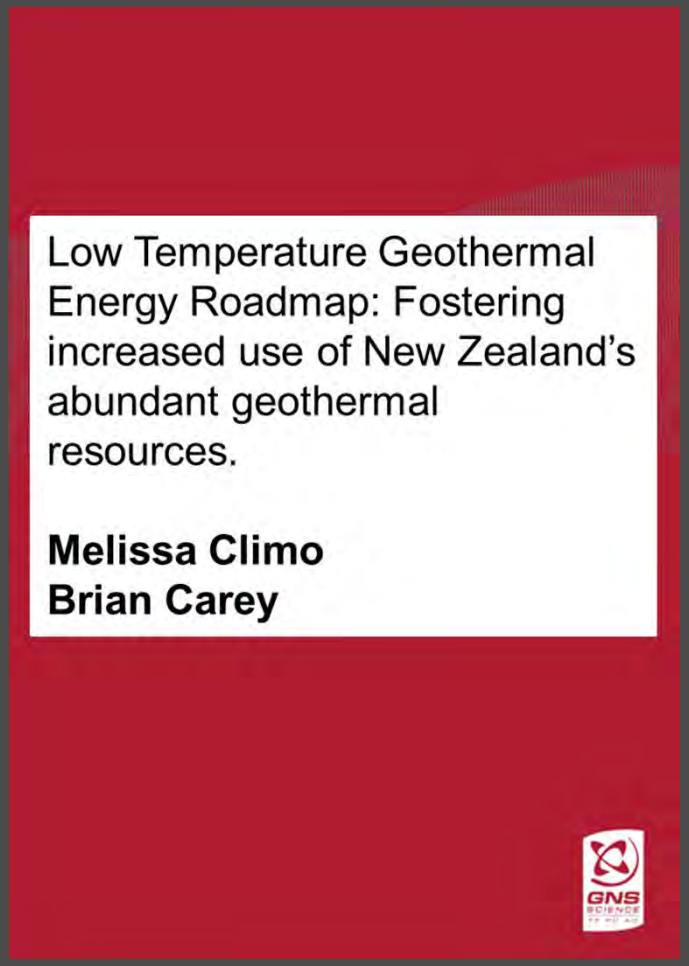
Developed a Roadmap

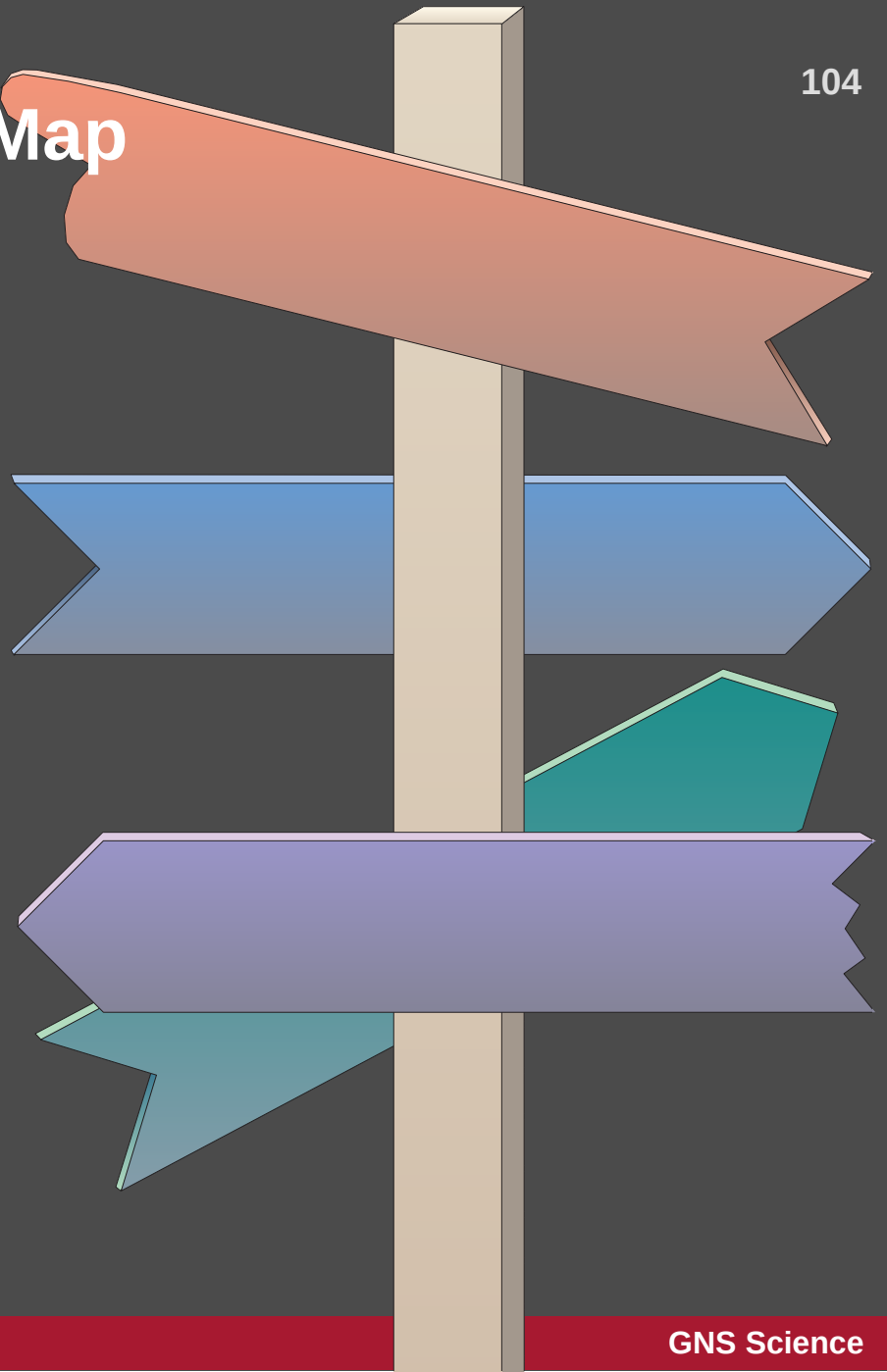
- **Much broader than GNS Science**

- **Road to follow seeking the**
  - long-term, wider spread development of low temperature geothermal resources in New Zealand

- **How do we get there expeditiously ?**
  - Actions and initiatives

Low Temperature Road Map





Low Temperature Geothermal Road Map

Forward Initiatives

- Communications
- Case Studies
- Fact Sheets
- Interagency Collaboration
- Studies

Geothermal Case studies – 20

earth energy: accessible; reliable; renewable

case study 1

Tenon's Earth Energy Solution

By Lisa Lind (GNS Science), Libby O'Brien and Jo Bell

Tenon's timber drying kilns at its Taupo plant use earth energy from low temperature geothermal sources.

Harnessing a naturally occurring energy source has proved a big plus for Tenon's wood processing plant on the Tauhara Geothermal Field near Taupo.

The move to eco-friendly and renewable geothermal energy for heating their nine timber-drying kilns has proved beneficial in terms of economics as well as productivity, says Darryl Robinson.

"Previously we burned natural gas to generate the heat required for the kilns. The geothermal steam is passed through the heat exchangers which heats the kiln's internal pressure system, in turn heating the kilns to dry the wood ready for further processing."

Darryl says an increase in cost of natural gas encouraged Tenon to look for alternative ways to heat the kilns.

With a natural resource right under its feet, Tenon moved to geothermal energy in 2006 after discussions with Contact Energy. Geothermal fluid is piped 1.5 km from the Tauhara Geothermal Field into heat exchangers on the Tenon site. The project design was carried out by Dobbie Engineers of Rotorua.

Key Benefits:

- Reduced running costs
- Increased productivity
- Renewable and eco-friendly
- Easy to operate
- Reliable

Key Features:

- Geothermal heat plant with an installed capacity of 27 MW to heat 9 timber drying kilns
- Commissioned in 2006

earth energy: accessible; reliable; renewable

case study 4

Geothermal Energy Helps to Grow Prawns

By Lisa Lind (GNS Science), Libby O'Brien and Jo Bell

Malaysian Freshwater Prawns (*macrobrachium rosenbergii*) are farmed in 27°C–31°C ponds at Huka Prawn Park.

The only geothermally heated prawn farm in the world is right here in New Zealand and it harnesses renewable earth energy as a secret to its success.

The Huka Prawn Park, near Taupo, was built in 1987. Current managing partner, Richard Klein, took over the project in 1991 and began to turn the park into an aquaculture tourism venture.

"Contact Energy owns the Wairakei Geothermal Power Station situated next door to the park, and we've been able to make an arrangement to make use of discharge water from the station. The discharge from the Ormat Binary Plant sits between 66°C to 98°C with a flow rate of 450 tonnes per hour in winter when night time ambient temperatures may fall to - 2°C. This arrangement provides us with access to low cost and environmentally friendly heated water."

The geothermal fluid is passed through a heat exchanger to heat water for grow-out ponds and tanks in the hatchery and nursery as part of the process of growing prawns for the on-site restaurant. The park has 11 prawn production ponds and 2 dedicated prawn fishing ponds that remain between 27°C to 31°C.

The design for the park was completed in-house with engineers only required for the initial stages of building the system. A small number of staff look after the system which supplies a sustainable and eco-friendly 7.8 tonnes/year of prawns from 2.75 hectares of the ponds to the park's restaurant. The park is working towards automation utilising "kiwi ingenuity".

Key Benefits:

- Easy to meet required temperature
- Controlled optimal growth temperature
- Economically viable

Key Features:

- Founded in 1987
- Aquaculture tourism venture uses geothermal waste heat from adjacent geothermal power station
- Supplies an eco-friendly 7.8 tonnes of prawns produced from 2.75 hectares of ponds to the park restaurant

earth energy: accessible; reliable; renewable

case study 8

Geothermal Hot House for Gerberas

By Lisa Lind (GNS Science), Diane Bradshaw (GNS Science) and Jo Bell

PlentyFlora's gerberas are grown with the help of geothermal energy utilised to heat the greenhouse.

For Rotorua gerbera growers, Harald and Connie Esendam of PlentyFlora, making use of the area's geothermal energy is key to offsetting the harsh winter conditions.

"To grow gerberas successfully for a commercial operation a main requirement is to avoid too many, or too fast, fluctuations in temperature. Gerberas are a sub-tropical plant from South Africa so creating a similar climate in the greenhouse is vital."

"We are fortunate to have ready access to geothermal energy which assists in creating the right environment for the flowers," says Harald.

Commercial gerbera growing operations are mainly in Auckland and while Harald says they too require heating, there it is not as cold as in Rotorua.

"The majority of other gerbera glasshouses around New Zealand would use waste oil as the source for their heating requirements."

PlentyFlora's greenhouse is heated by geothermal energy from two shallow geothermal bores.

The original, older bore produces 100°C geothermal fluid. This fluid is fed through a heat exchanger, heating water that is circulated through small iron pipes adjacent to the plants in an internal closed heating system.

The new bore, drilled two years ago, produces 65°C geothermal fluid that is used directly in the greenhouse, predominantly for air heating in an overhead system. Cooled geothermal water is then injected back into the shallow geothermal reservoir.

In addition, a bio diesel peak-heating system on a fan coil unit forces hot air on the plants when needed.

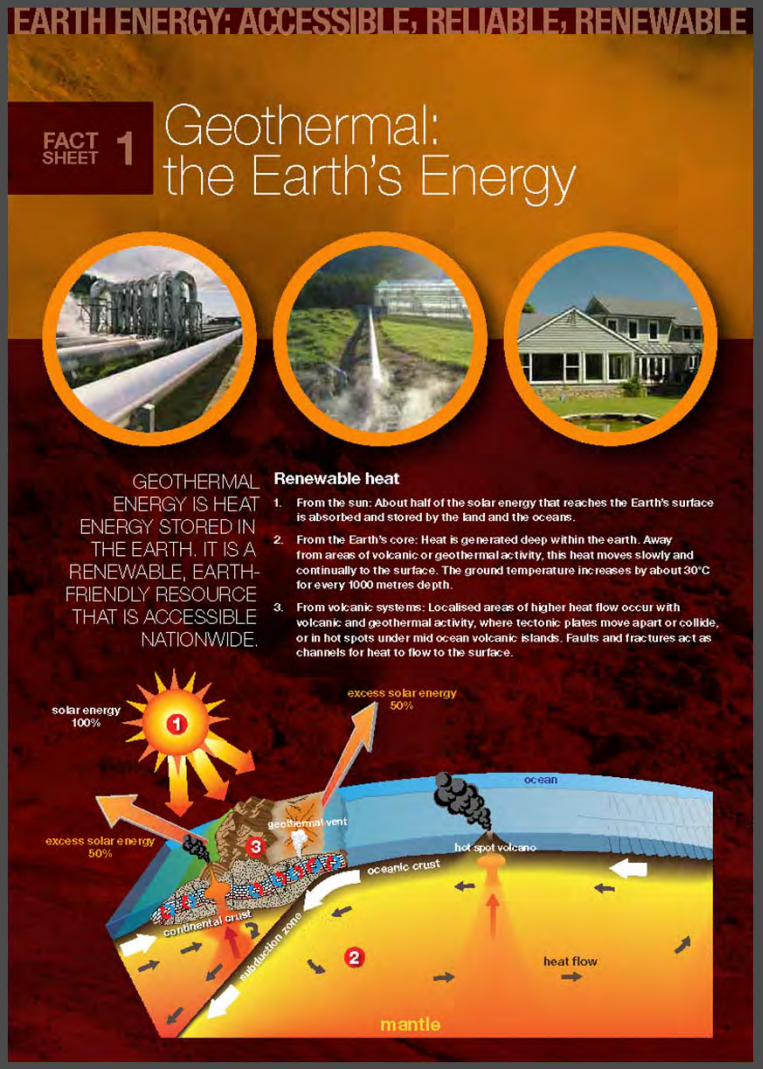
Key Benefits:

- Geothermal energy provides heat to keep the temperature above the minimum essential temperature of 14°C
- Reduced cost for heating requirements

Key Features:

- More than 600,0000 gerberas grown annually at PlentyFlora
- Two geothermal bores are the main heat source for glasshouse all year round

Fact Sheets - 4



Geothermal Heat-pump Association of NZ

- **Formed in 2012**
- **Charter**
- **Amalgam of parties**
  - Interested in developing a quality geothermal heat pump sector for NZ
- **Web presence** www.ghanz.org.nz

Agencies - working together

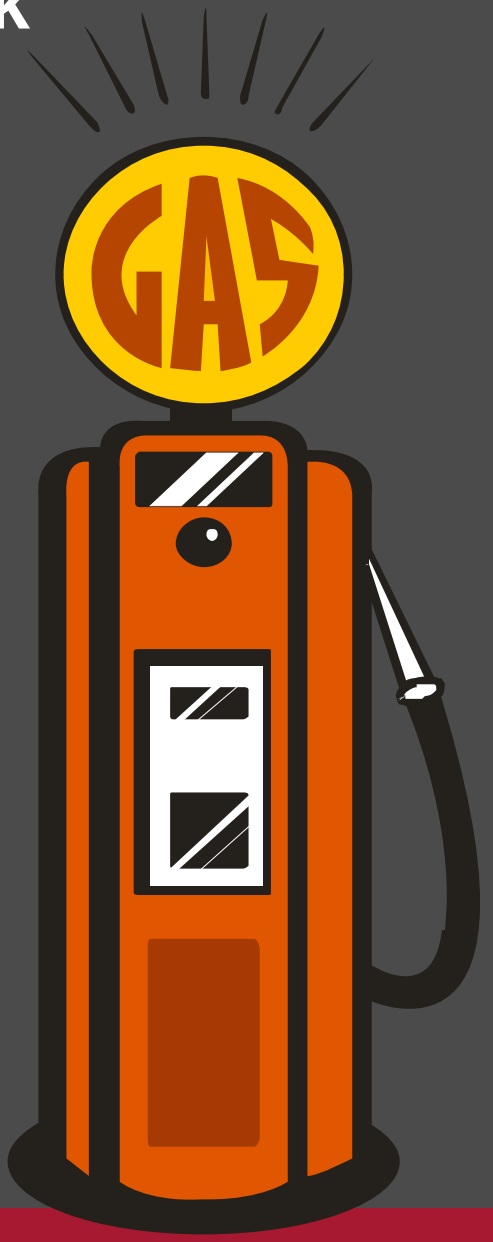
+ Industry
+ Others

Critical steps for informed decision making on low temperature geothermal

1. Increase awareness of resources, applications and technologies
2. Develop educational, technical and marketing collateral
3. In sync planning and policy regime
4. Focus in high and growing energy demand areas
5. Showcasing

Lots more heat in the NZ tank

Get Into it



Renewable Energy Feasibility Study Grants

- **Funding available for feasibility studies**
  - that investigate direct use of bioenergy or geothermal energy
- **EECA – 2 funding rounds through**
- **Funding for 40% of the cost of a study (EECA funding capped at $20,000)**
- **Programme rolled up into the industrial feasibility study grants**

Industrial Feasibility Study Grants

- **Funding available for feasibility studies**
  - For 40% of the cost of a study with EECA funding capped at $20,000

www.eecabusiness.govt.nz/content/feasibility-study-grants

Got questions or to discuss a particular project please email business@eeca.govt.nz or call 0800 358 676

Join the New Zealand Geothermal Association

- NZGA
- Membership application

www.nzgeothermal.org.nz/about.html#application

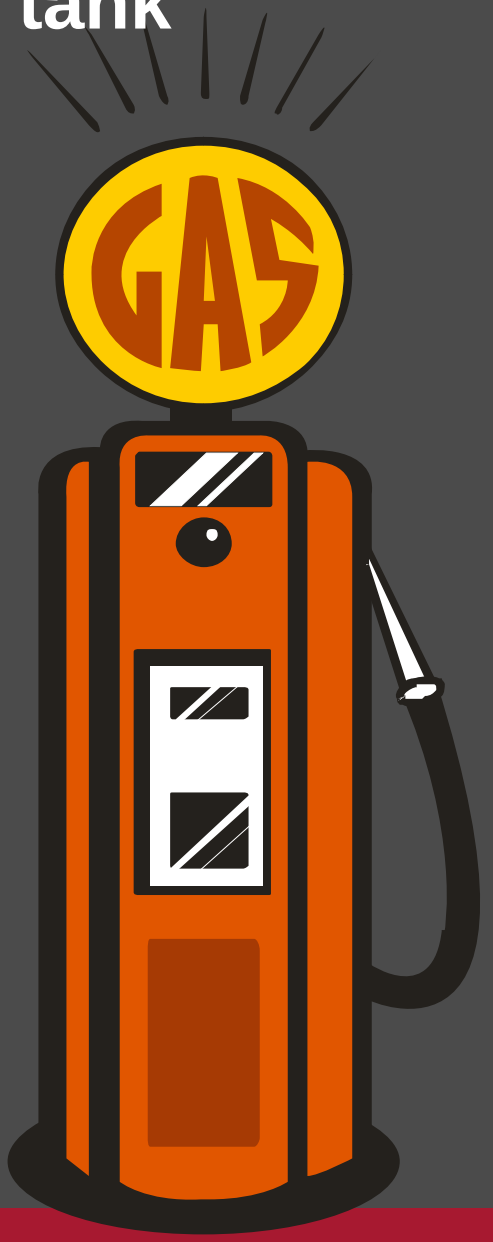
- GHANZ
- Membership application

www.nzgeothermal.org.nz/GHANZ/documents/NZGA_Membership_form.pdf

And tick the heat pump box at the bottom of the application form

Lots more heat in the Pacific tank

Get Into it



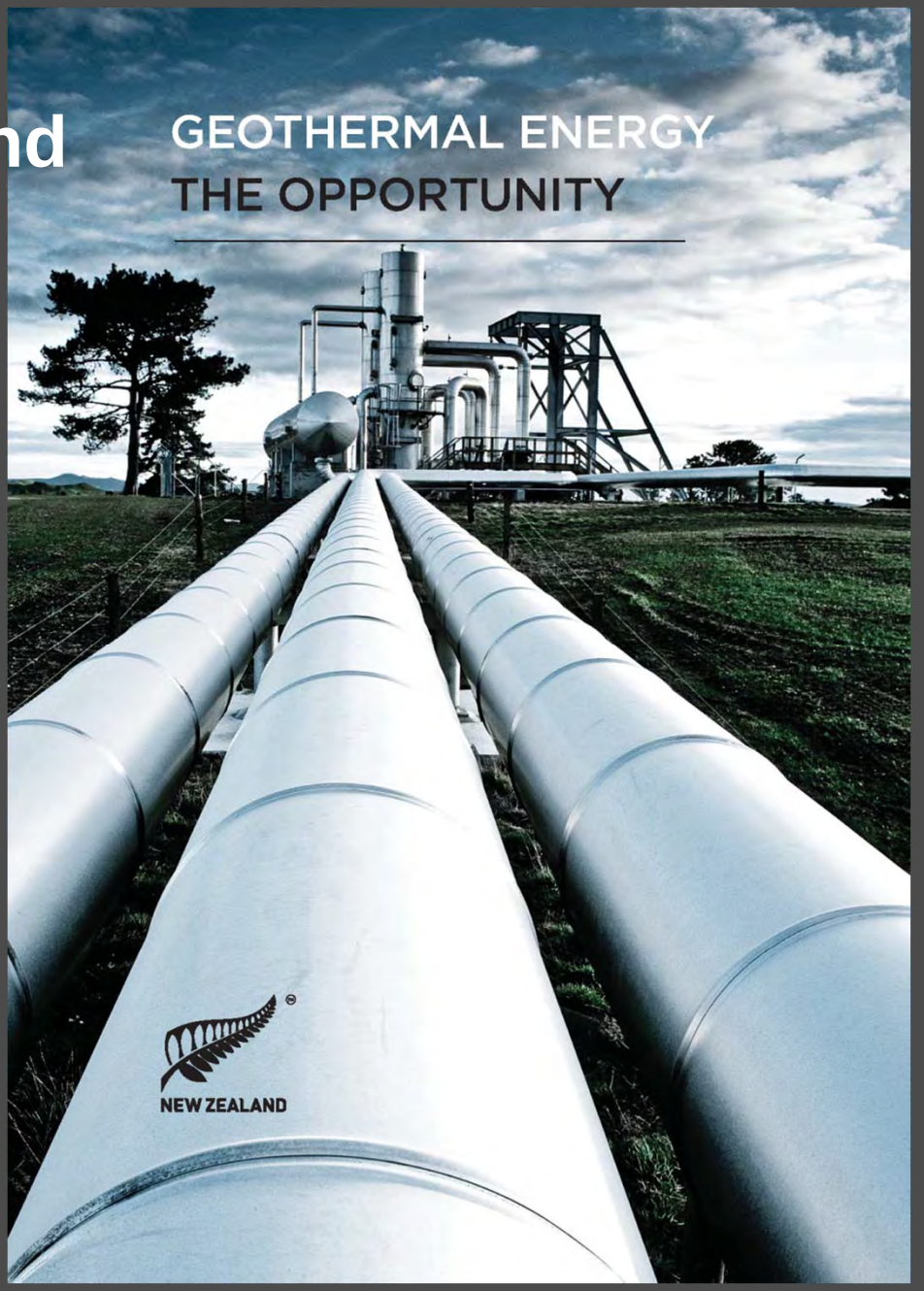
Geothermal New Zealand

- **NZ Industry and expertise penetration**
  - Pacific market
  - Indonesia
  - Chile
  - Japan

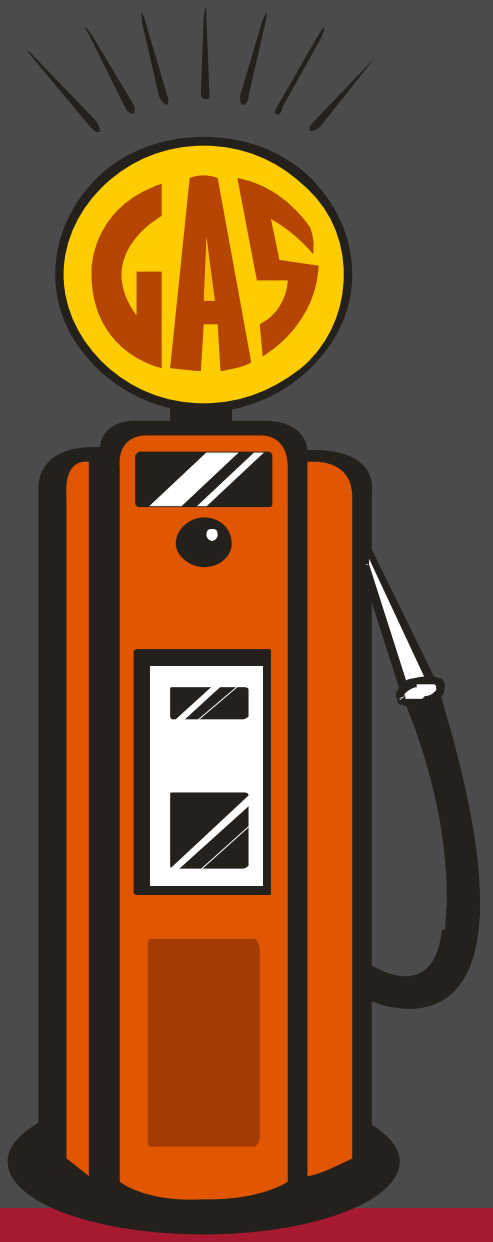
  www.geothermalnewzealand.com
- **Mike Allen**

  Steering Group Chair

  mike.allen@geothermalnewzealand.com
- **Chris Mulcare - NZTE**



Get Into it



Thank You