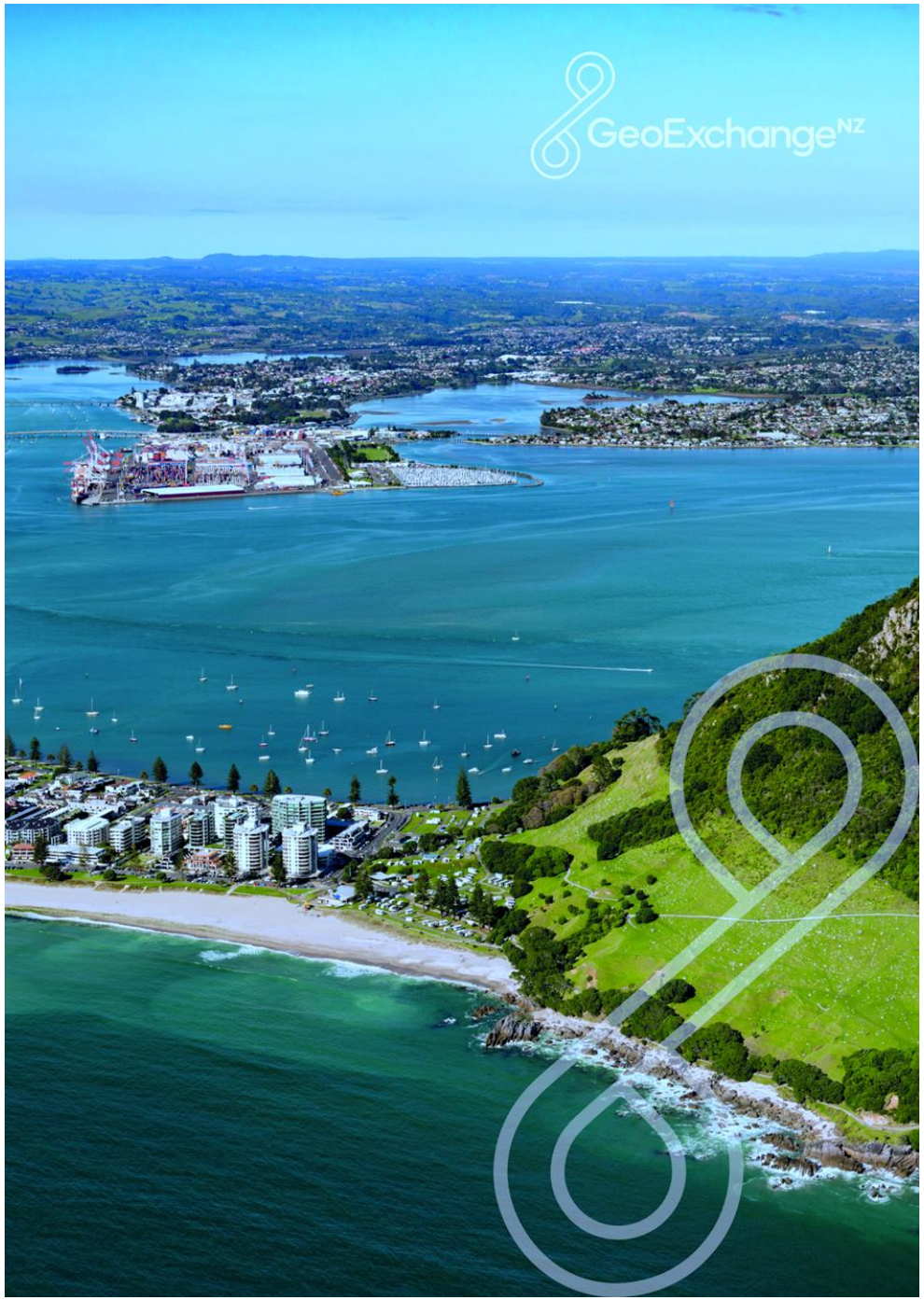


Investigating the Geoheat Potential of the Tauranga Geothermal System

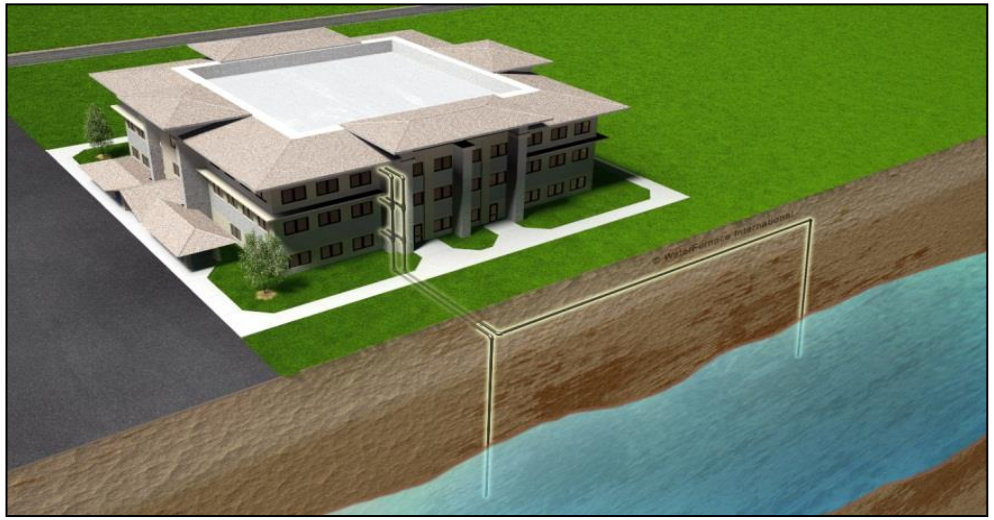
Authors: Y. Carden, C. Wells, L. Wolpmann, P. Doorman, D. Howie

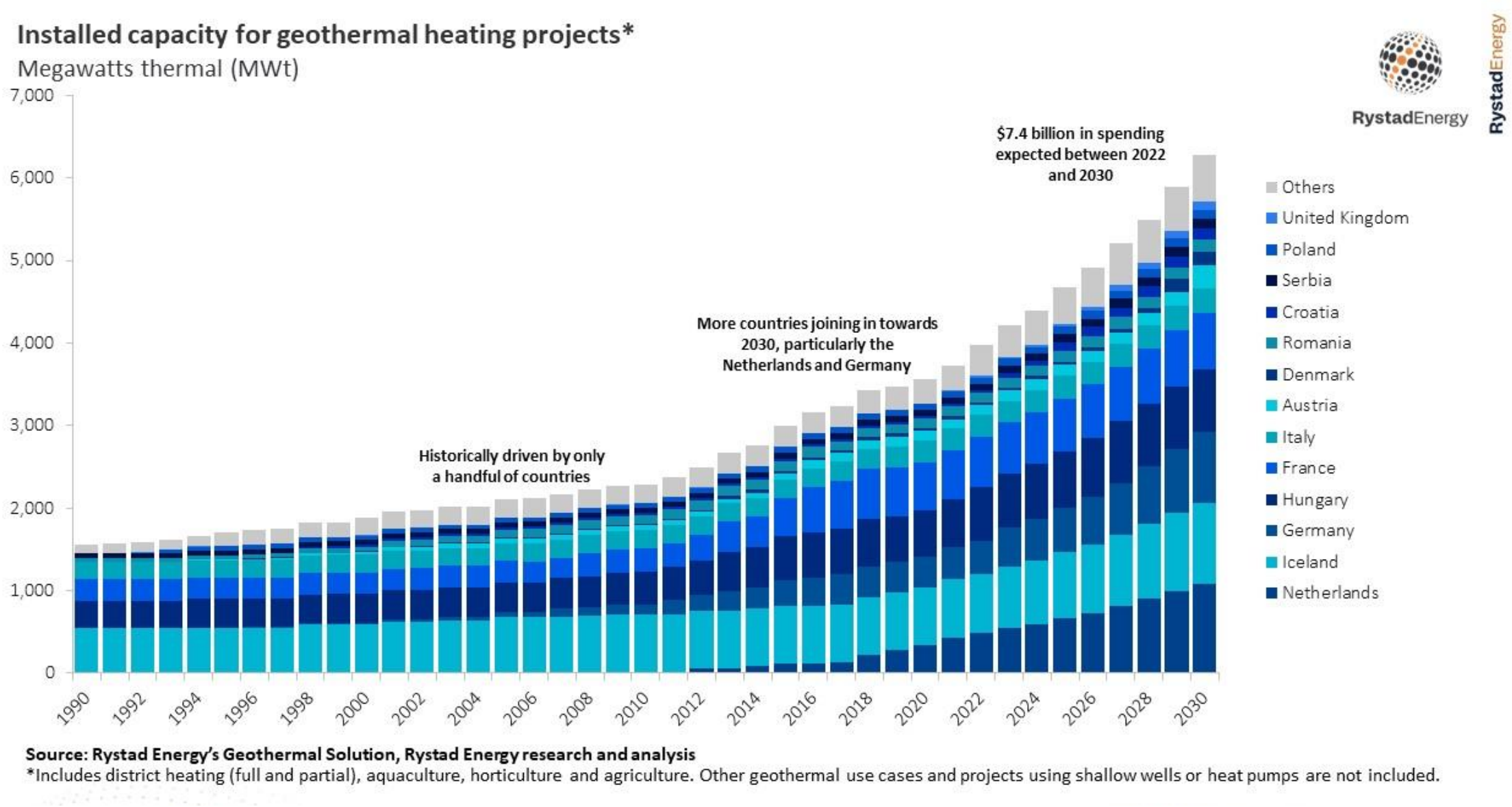
20 November 2024

Prepared by Yale Carden and Celia Wells

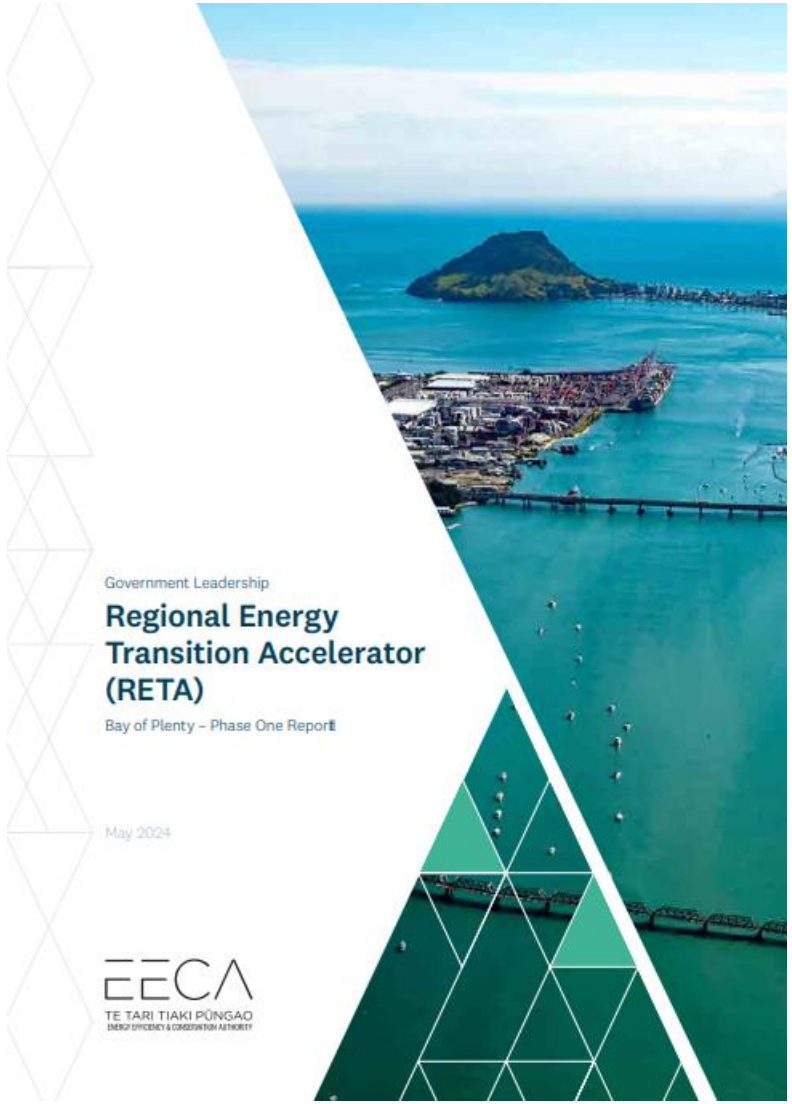
Geoheat and Geothermal

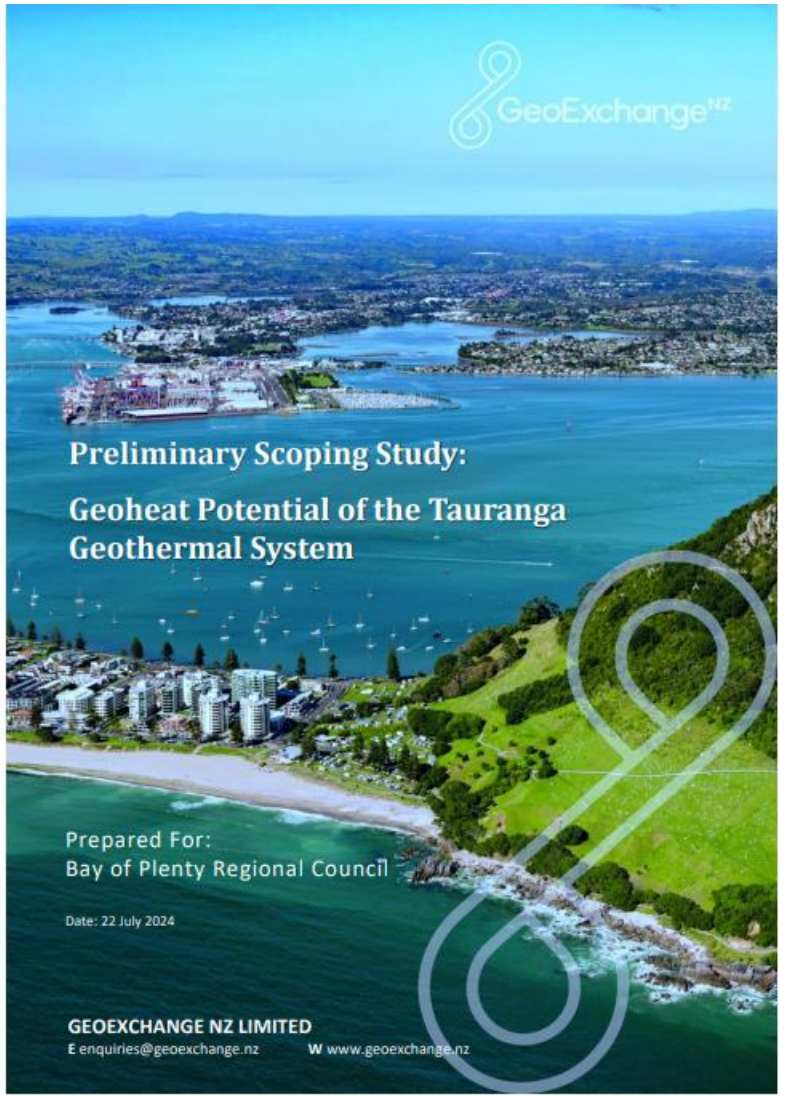
Geothermal is both energy supply (electrical) and demand reduction (thermal)





Europe to spend $7.4 billion on geothermal heating by 2030 with capacity to reach 6.2 GWt





Geothermal for Greenhouses

Ministry for Primary Industries
Manatū Ahu Matua

Sustainable Food and Fibre Futures
Te anamata o ngā kai me ngā weuweu toitū

Vegetables NEW ZEALAND Inc

TomatoesNZ

The TLDR Version

There is a really good low temperature geothermal resource present

Most people are not aware of it

Those that are aware of think that it is only suitable for heating pools

Project Scope

- Geothermal resource characterisation;
- Review of technologies suited to the TGS (eg direct / indirect and open / closed loop);
- Regional opportunities and constraints;
- Stakeholder consultation: District Councils, Priority One, consent holders;
- Resource management implications; and
- Recommendations.

Asking Questions

Could the western Bay of Plenty use its comparatively shallow low temperature geothermal resource to its strategic advantage as the region develops?

AND

Importantly, how can this be done sustainably?

Defining Geoheat

- Geoheat systems are either:
  - Direct Use: Systems that use available geoheat directly (eg a geothermal hot pool); or
  - Indirect Use: Systems that require a heat pump to modify the source temperatures.
- Defining direct use as possible from >30^{o}C as per Resource Management Act;

BUT

- **Always site and application specific:**
  - Eg 50^{o}C source could be
    - Direct use for a pool; or
    - Indirect for industrial heat using a high temperature heat pump;

Defining Geoheat

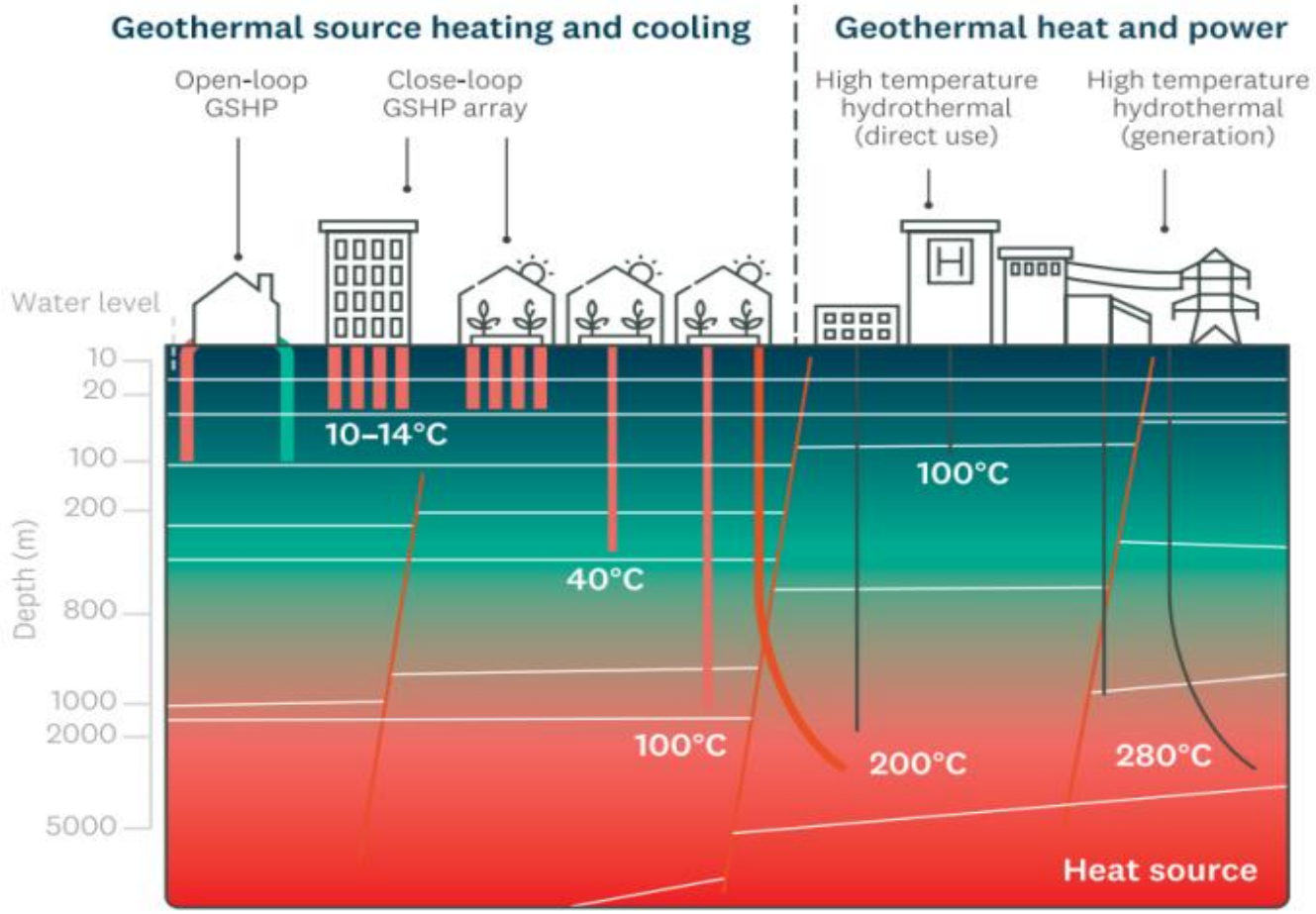
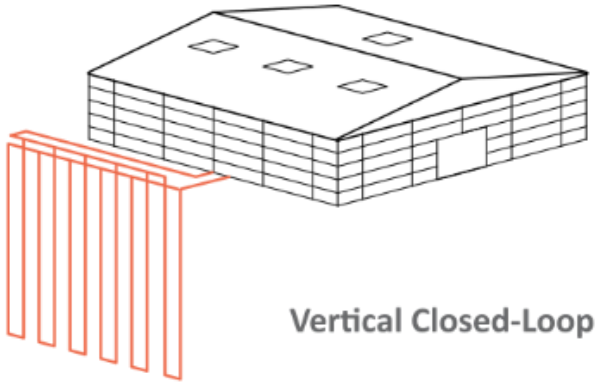


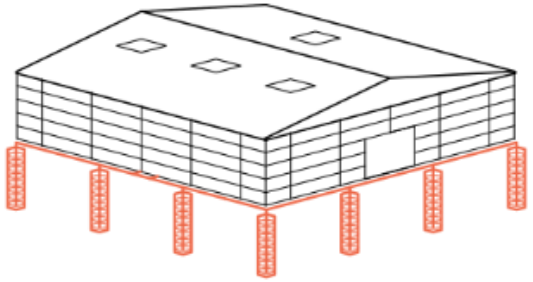
Figure 8: Example of Connection Between Various Geoheat Sources and Above Ground Applications. Source: GNS Science from EECA (2024)

Accessing Geoheat

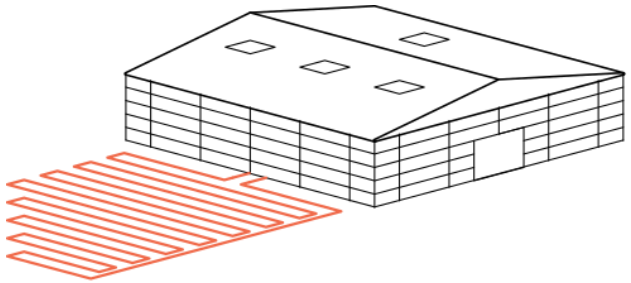
Closed Loop Systems



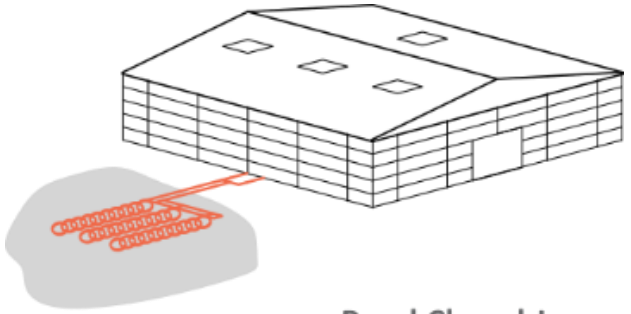
Vertical Closed-Loop



Closed Loop Building Piles

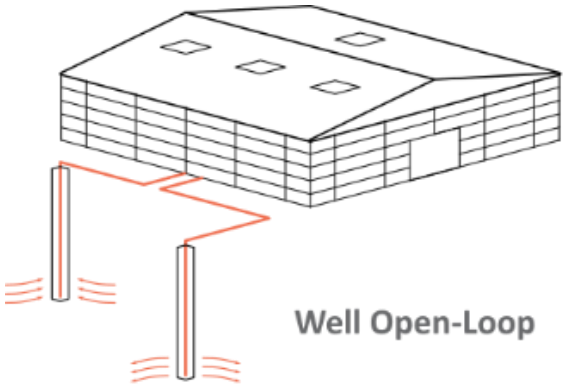


Horizontal Closed-Loop

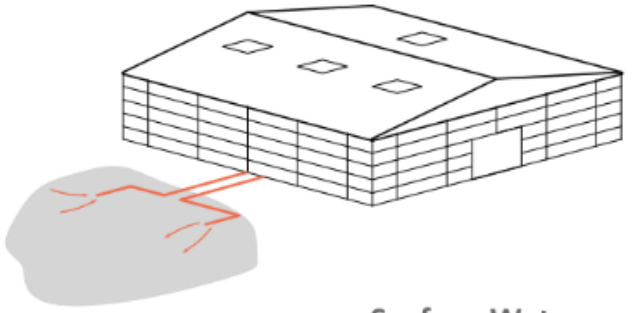


Pond Closed-Loop

Open Loop Systems



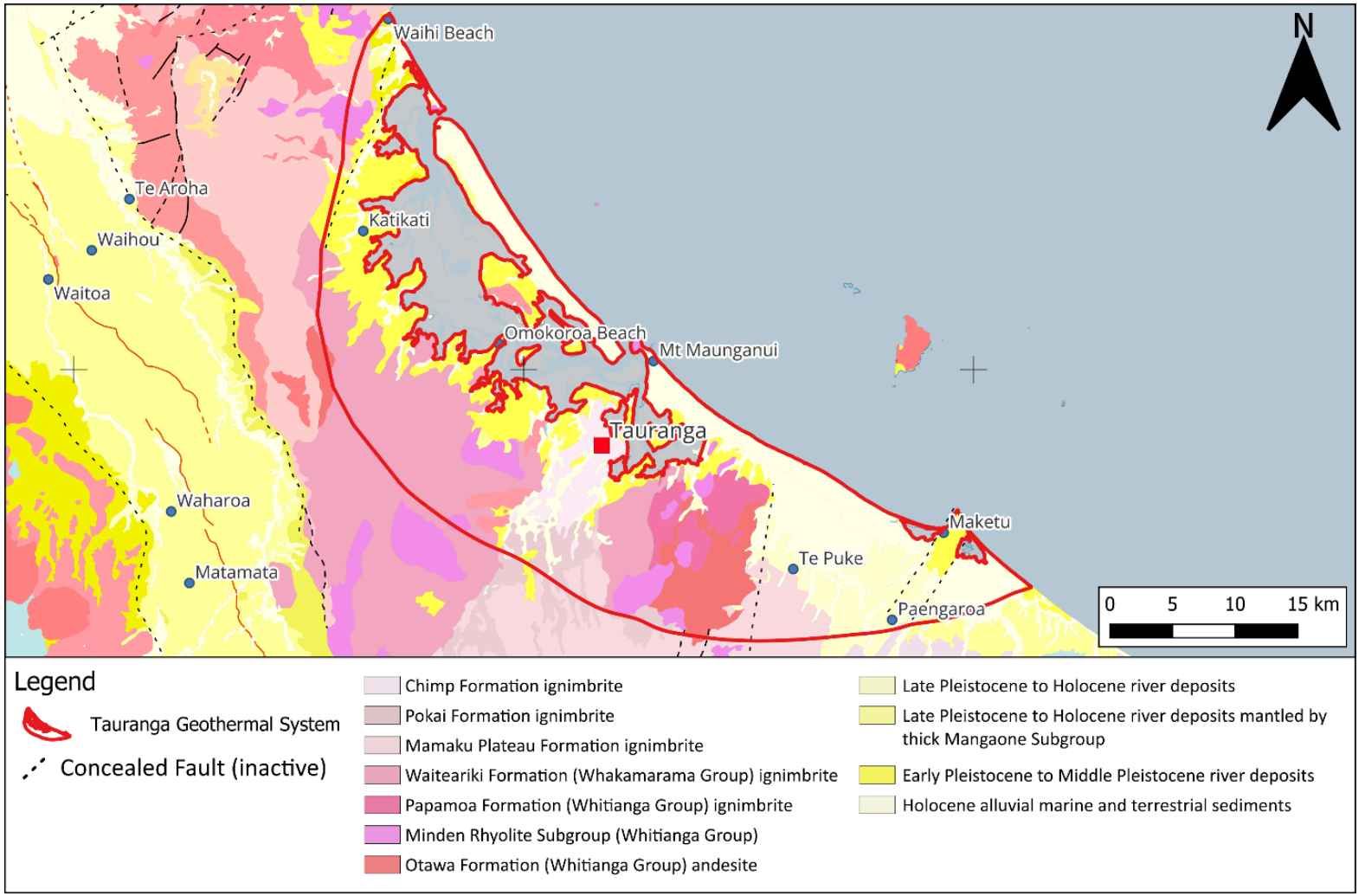
Well Open-Loop



Surface Water

Both loop types can be direct or indirect (with heat pump) depending on temperatures

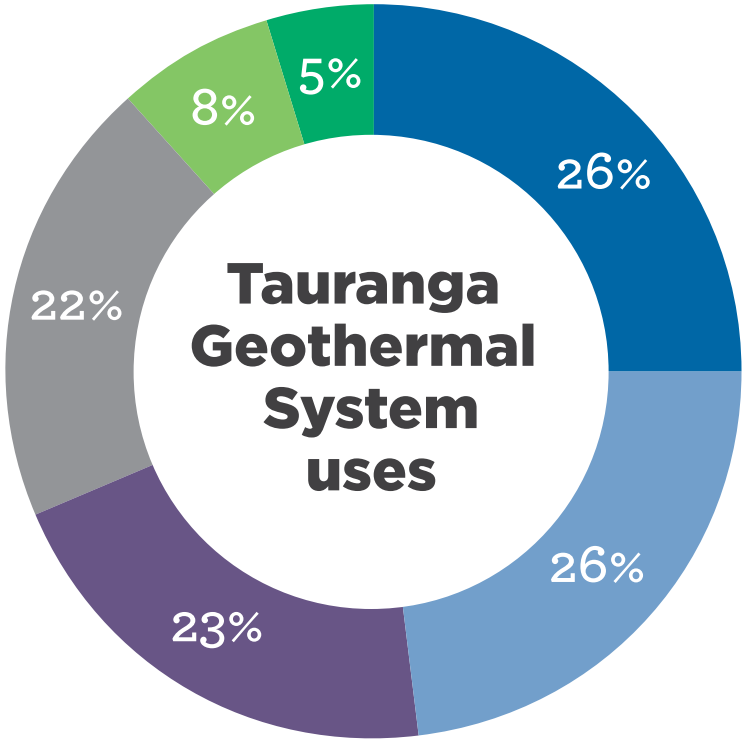
The Tauranga Geothermal System

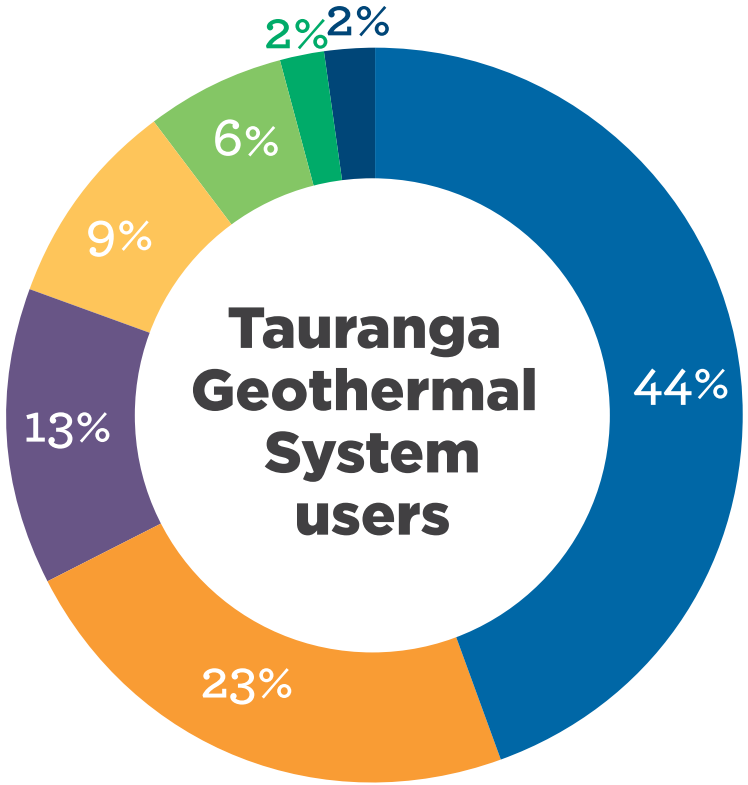


The Tauranga Geothermal System

- A groundwater system warmed by underlying geothermal conditions
- Maximum recorded temperature: ~70^{o}C at 707mbgl
- Geothermal consented: 9.5 million m^{3}
- Groundwater consented: 53 million m^{3}
- Deepest well: ~920 mbgl

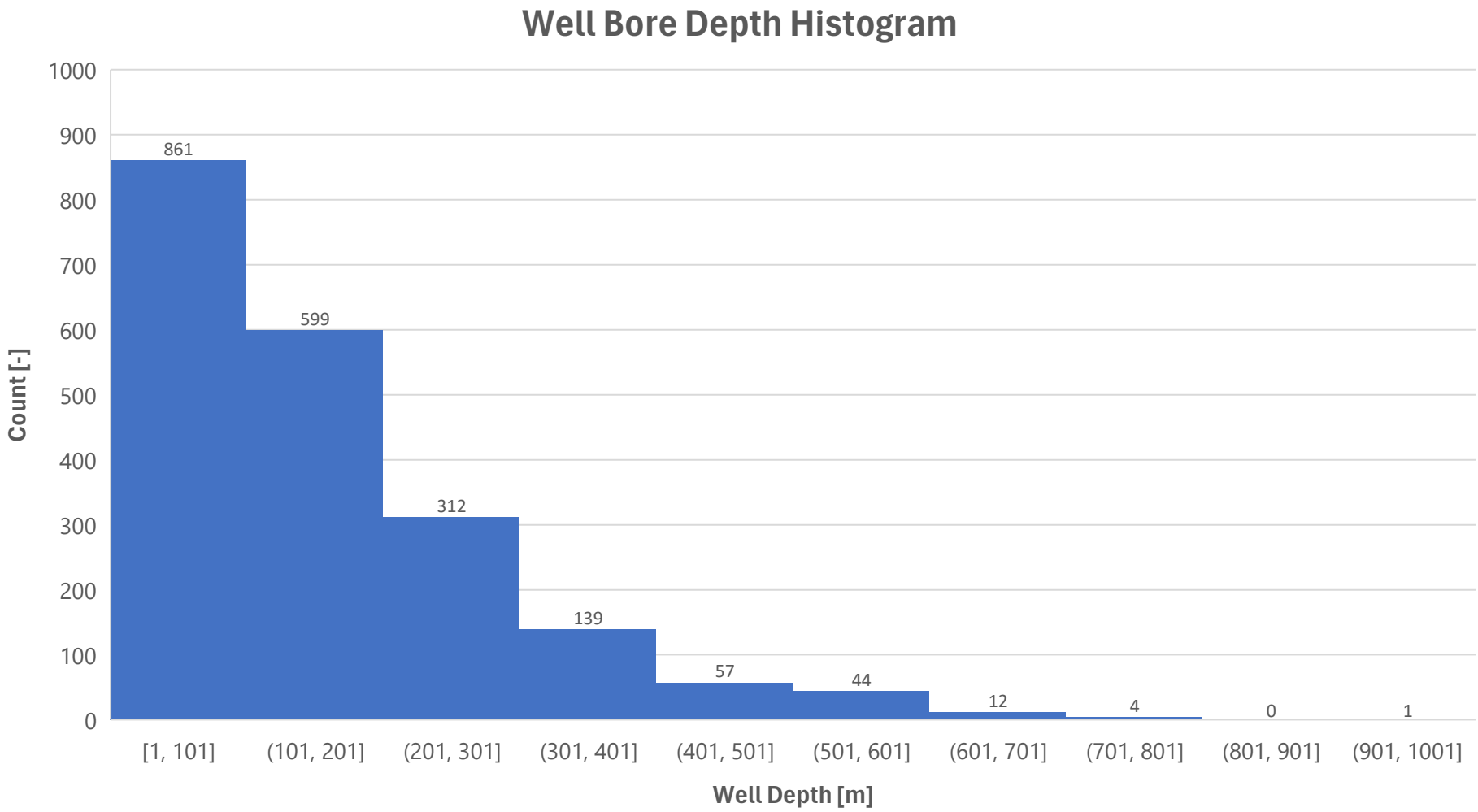
TGS: Uses and Users



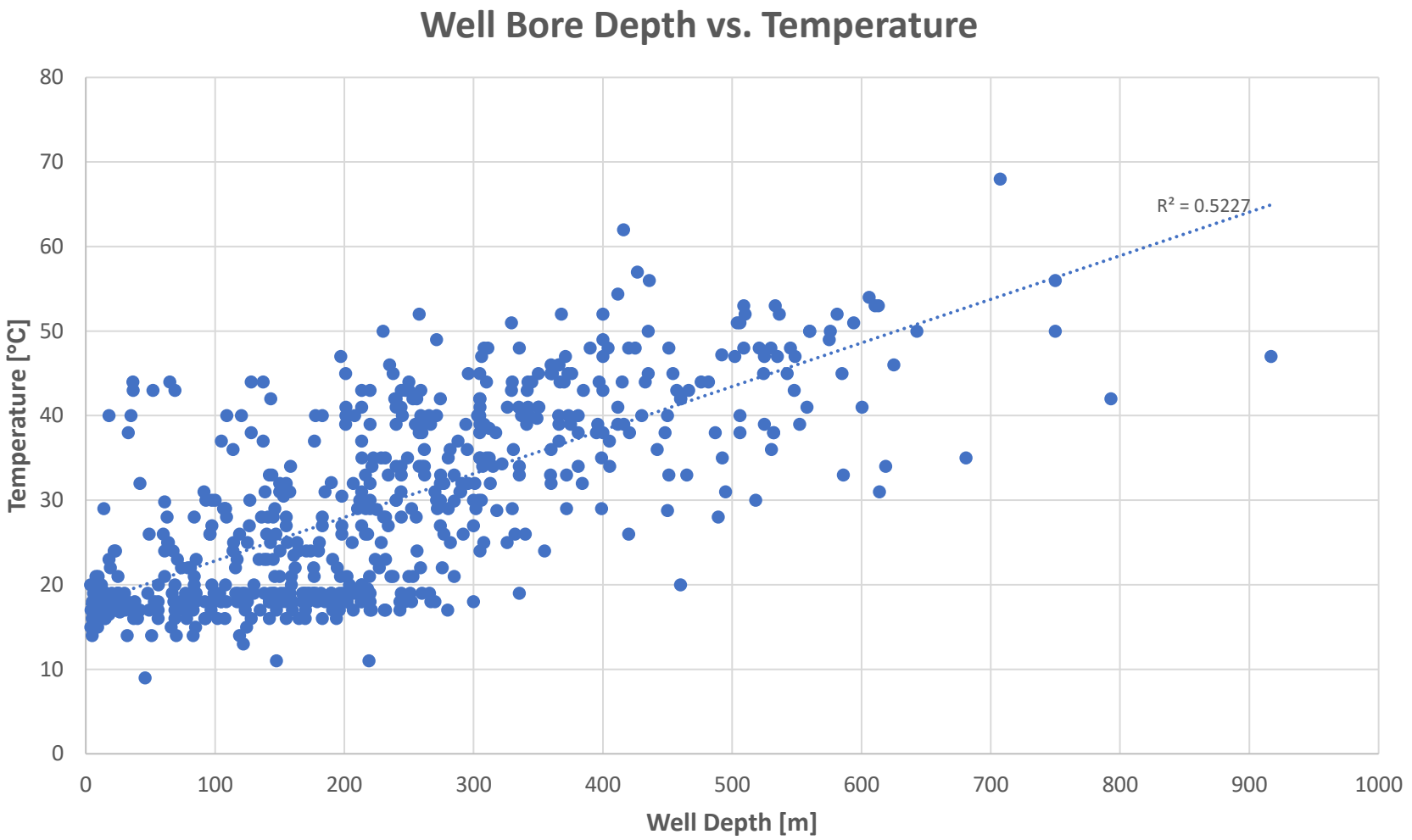


- Water and space heating
- Mineral pool and heating
- Mineral pool
- Water heating
- Space heating
- Other
- Community facilities
- Private use
- Body corp, retirement village
- Tourism
- Horticulture
- Private horticulture
- Other

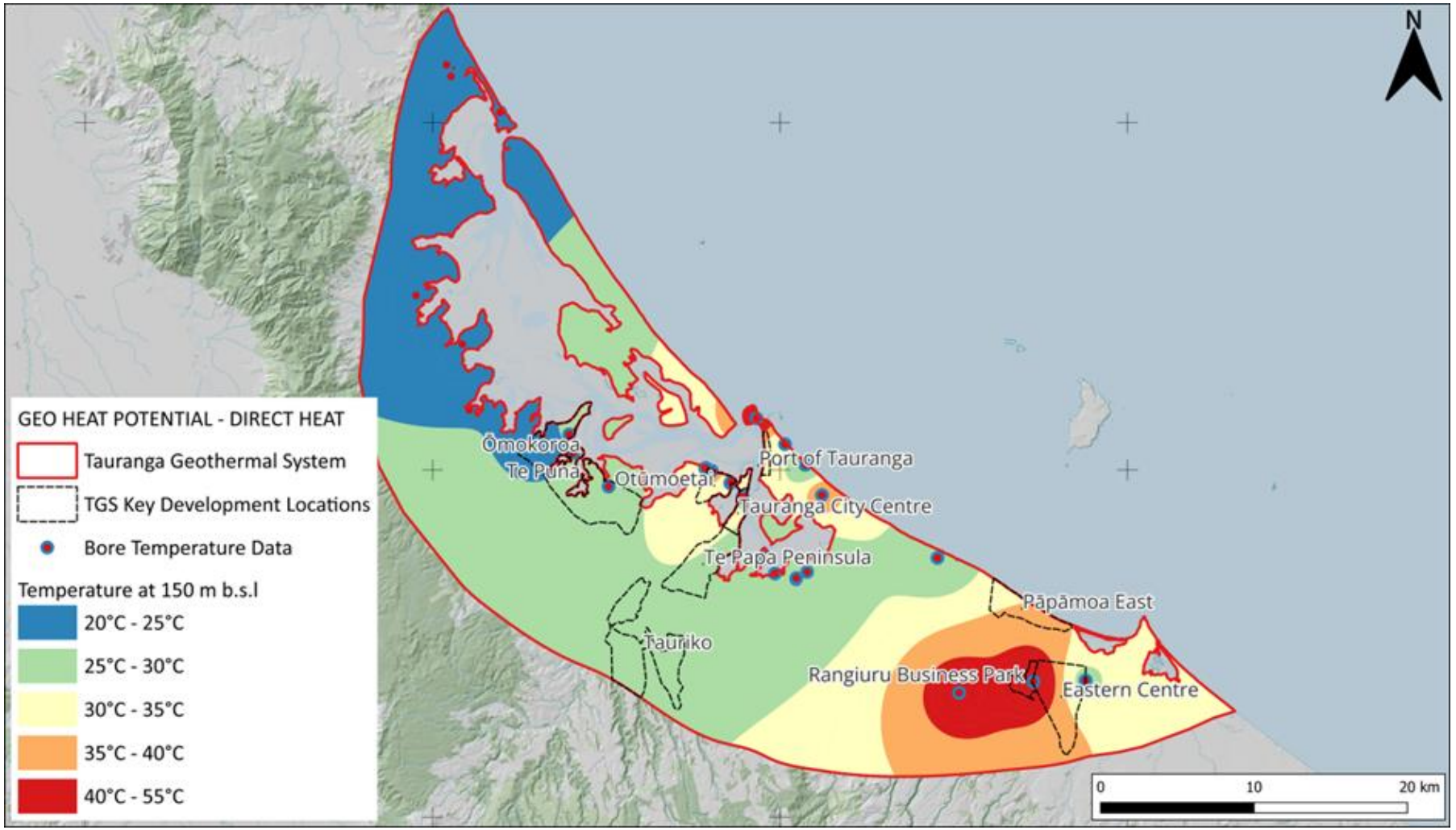
TGS: Well Depth Histogram



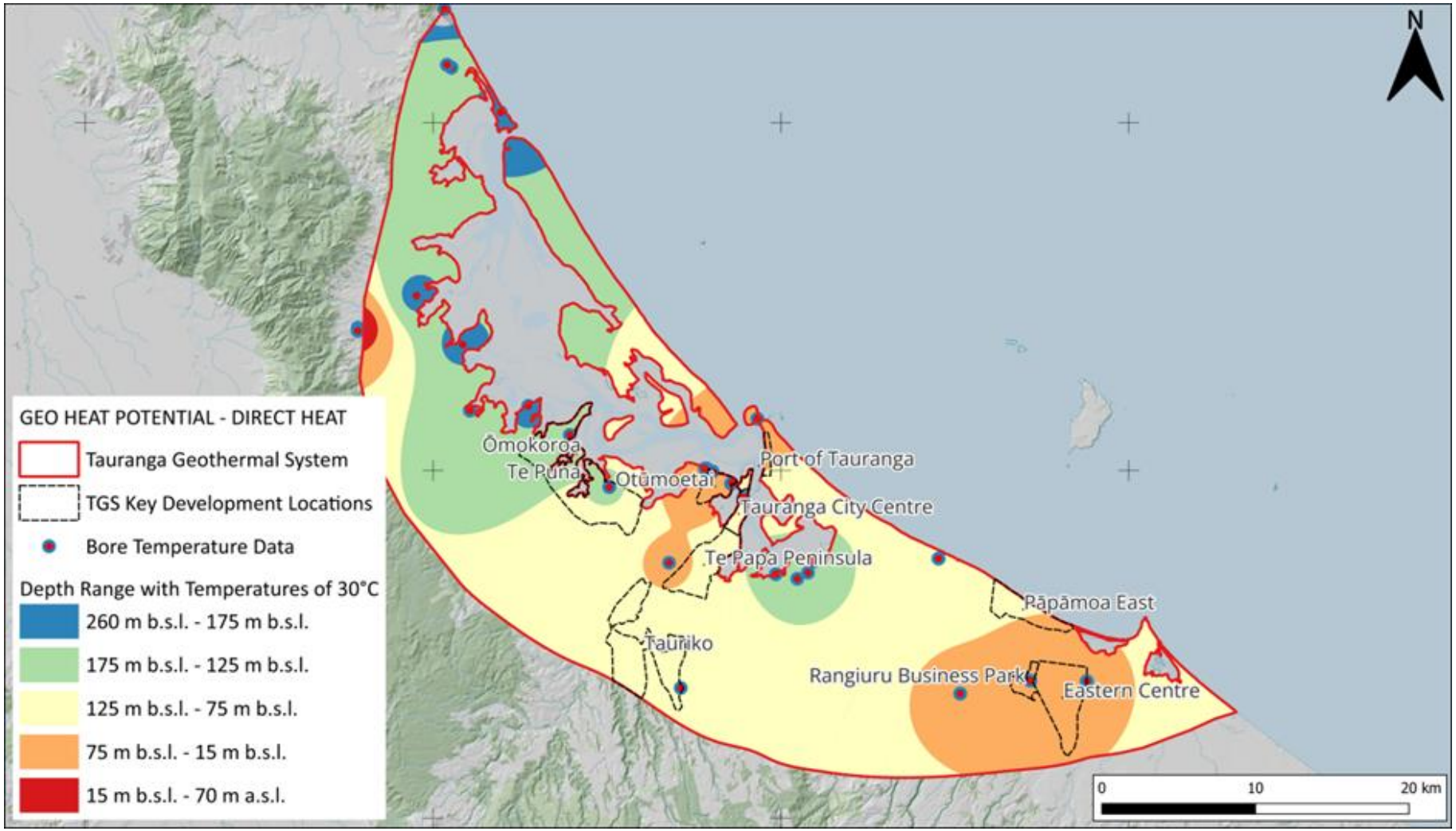
TGS: Well Depth vs Temperature



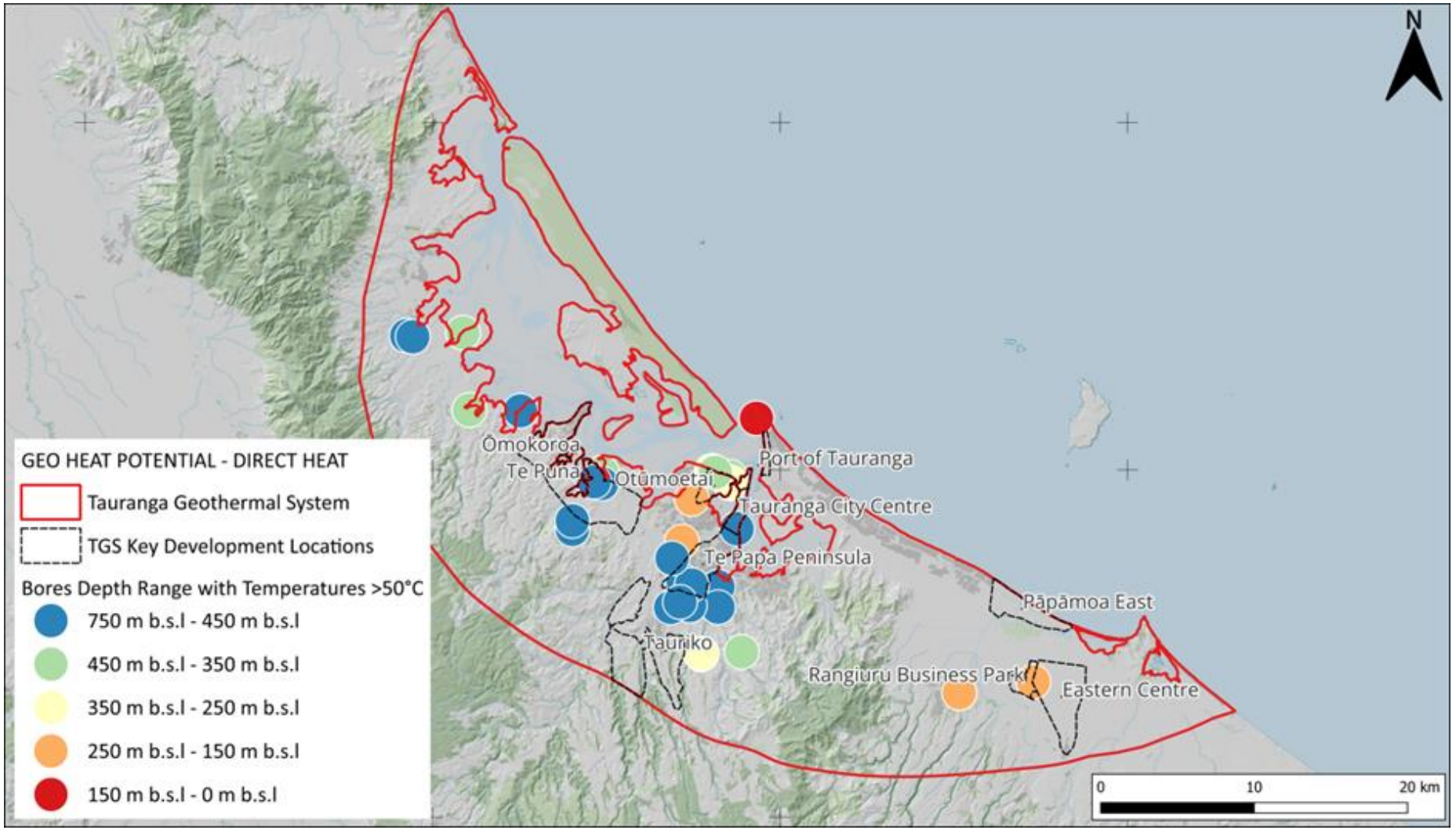
TGS: Temperature at 150m bsl



TGS: Depth of Temperatures >30°C



TGS: Depth of Temperatures >50°C



TGS: Potential Development Zones

Depth Range of Ground Temperatures Underlying the Potential Development Zones			
Potential Development Zone	**Land Use Zoning**	**Depth Range Encountered**	
		30°C	**50°C**
Port of Tauranga	Industrial	<125 m b.s.l	<500 m b.s.l
City Centre	Mixed Use: Residential / Commercial	<125 m b.s.l	<500 m b.s.l
Te Papa Peninsula	Mixed Use: Residential / Commercial	<125 m b.s.l	<600 m b.s.l
Tauriko	Residential	<125 m b.s.l	<700 m b.s.l
	Industrial		
Rangiuru Business Park	Industrial	<75 m b.s.l	<200 m b.s.l
Eastern Centre	Residential	<75 m b.s.l	<200 m b.s.l
Ōmokoroa / Te Puna	Residential	<175 m b.s.l	<500 m b.s.l
	Industrial		
Otūmoetai	Residential	<75 m b.s.l	<450 m b.s.l
Pāpāmoa East	Residential	<125 m b.s.l	>150 m b.s.l
Note: Anticipated average depth range in which the temperature value was measured within the potential development zone.			

Strategic Relevance of Geoheat

- Regional Economic Growth (SmartGrowth, 2024)
  - Affordable housing
  - Emissions reduction
  - Liveable and Resilient Cities
- Resilience and Stability of Energy Supply

Regulatory Framework

- Regional Policy and Rules for Geoheat (see following Table)
- Significant Geothermal Features
- Environmental Best Practise
- Drilling Installation
- Data Collection
- A Dynamic Resource with Temperature and Flow Rate Variations

Regulatory Framework and Rules

Example Regulatory Policies and Rules that are Relevant to Geoheat			
GHX Type	**Source Temperature**	**Resource Consents that may be Required**	**Note**
Closed Ground Loop (vertical) (heat take only)	Geothermal water (>=30oC)	Landuse consent for drilling Consent to take heat from geothermal water	Heat only take, no take of geothermal water.
	Non-geothermal water (<30 oC)	Land use consent for drilling	Likely permitted where meets individual's reasonable domestic needs. Consent to take heat may be required for large takes to manage effects on the aquifer.
Open Groundwater Loop (water and heat)	Geothermal water (>=30 oC)	Land use consent for drilling Consent for take and discharge of geothermal water	Discharges may be to land via soakage, to groundwater via reinjection, to surface water or to stormwater or wastewater network.
	Non-geothermal water (<30 oC)	Land use consent for drilling Consent for take/use/diversion and discharge of water	Permitted activity for water takes less than 35m3/day, and heat takes to meet reasonable domestic needs. Permitted activity rule and standards may apply for discharges.

Future Opportunities

- Existing Applications / Future Opportunities
  - Pools;
  - Horticulture
  - Public Buildings
  - Key Future Development Areas / Growth Zones (see following Table)
- Investment, Ownership and Innovation
- Enabling Future Opportunities
  - Data Accuracy and Geoheat Maps
  - Resource Consents
  - Developing an Industry Ecosystem

Geoheat Potential of Future Development Zones

GeoExchange NZ

Potential Development Zones	Geothermal Characterisation					Regulatory Status	Geothermal Application Suitability Assessment					
				Depth Range Encountered[2]			Indirect Heating and Cooling			Direct Heating		
	Land Use Zoning	GNS Aquifer Potential[1]	Geology	>30°C	>50°C	Consent for Groundwater Take for Consumptive Use[3]	Closed Loop System	Open Loop System	District Heating and Cooling	Closed Loop System	Open Loop System	District Heating
Port of Tauranga	Industrial	Good	Sediments over volcanites	<125 m b.s.l	<500 m b.s.l	May not be available reinjection may be required	✓	o	✓	o	o	✓
Tauranga City Centre	Mixed Use Residential/Commercial	Good	Sediments over volcanites	<125 m b.s.l	<500 m b.s.l	Available	✓	✓	✓	✓	✓	✓
Te Papa Peninsula	Mixed Use Residential/Commercial	Good	Sediments over volcanites	<125 m b.s.l	<600 m b.s.l	Available	✓	✓	✓	✓	✓	✓
Tauriko	Residential	Good	Volcanites	<125 m b.s.l	<700 m b.s.l	Available	✓	✓	✓	✓	✓	✓
	Industrial						✓	✓	✓	o	✓	✓
Rangiuru Business Park	Industrial	Good	Sediments over volcanites	<75 m b.s.l	<200 m b.s.l	Available	✓	✓	✓	o	✓	✓
Eastern Centre	Residential	Good	Sediments over volcanites	<75 m b.s.l	<200 m b.s.l	Available	✓	✓	✓	o	✓	✓
Ōmokoroa / Te Puna	Residential	Good	Sediments over volcanites	<175 m b.s.l	<500 m b.s.l	Available	✓	✓	✓	✓	✓	✓
	Industrial						✓	✓	✓	o	✓	✓
Otūmoetai	Residential	Good	Sediments over volcanites	<75 m b.s.l	<450 m b.s.l	Available	✓	✓	✓	✓	✓	✓
Pāpāmoa East	Residential	Good	Sediments	<125 m b.s.l	>150 m b.s.l	Available	✓	✓	✓	✓	✓	✓
[1]Note: New Zealand Aquifer Potential Map Version 1.0, https://www.gns.cri.nz/data-and-resources/new-zealand-aquifer-potential-map-version-1-0/ [2]Note: high uncertainty due to the limited data available, especially when localising the areas with temperatures above 50 °C. [3]Note: BOPRC							✓	suitable	o	partly suitable		

Answering Questions

Could the western Bay of Plenty use its comparatively shallow low temperature geothermal resource to its strategic advantage as the region develops?

YES

AND

Importantly, how can this be done sustainably?

See the Recommendations

Recommendations

- Develop a Regional Vision and Strategy for Geoheat in terms of:
  - Decarbonisation;
  - Energy Security; and
  - Regional economic growth
- Be open to geoheat applications:
  - Pools…and more;
  - Industry;
  - Buildings – commercial and residential;
  - Horticulture; and
  - Future versions of Te Keteparaha Mo Nga Papakāinga Māori Housing Toolkit
- Data, data, data: Research and metering;
- Consenting: Balancing supportive uptake and sustaining the resource; and
- Public education efforts on opportunities and benefits

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