Earth Sciences
New Zealand

Ground-sourced heat for horticulture: can it add up? Exploring the barriers to uptake

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Covered cropping Mini Confernece
August 8, 2026

Earth Sciences New Zealand

Overview

- Geoheat tool (Helen)
- How to use ground sourced heat (Yale)
- Discussion - tell us the barriers

Geoheat is everywhere - and always there

Questions

1. What is your top-of-mind issue when considering using geoheat?

2. How could that be addressed?

Decarbonising the covered crop industry with Geoheat

1. Interactive resource map
2. International case studies
3. Financial assessment tool

Project Goals

- Raise **awareness** of opportunity
- Support early stage **decision making**
- **Showcase** case-studies
- Bring information to the **end-user**

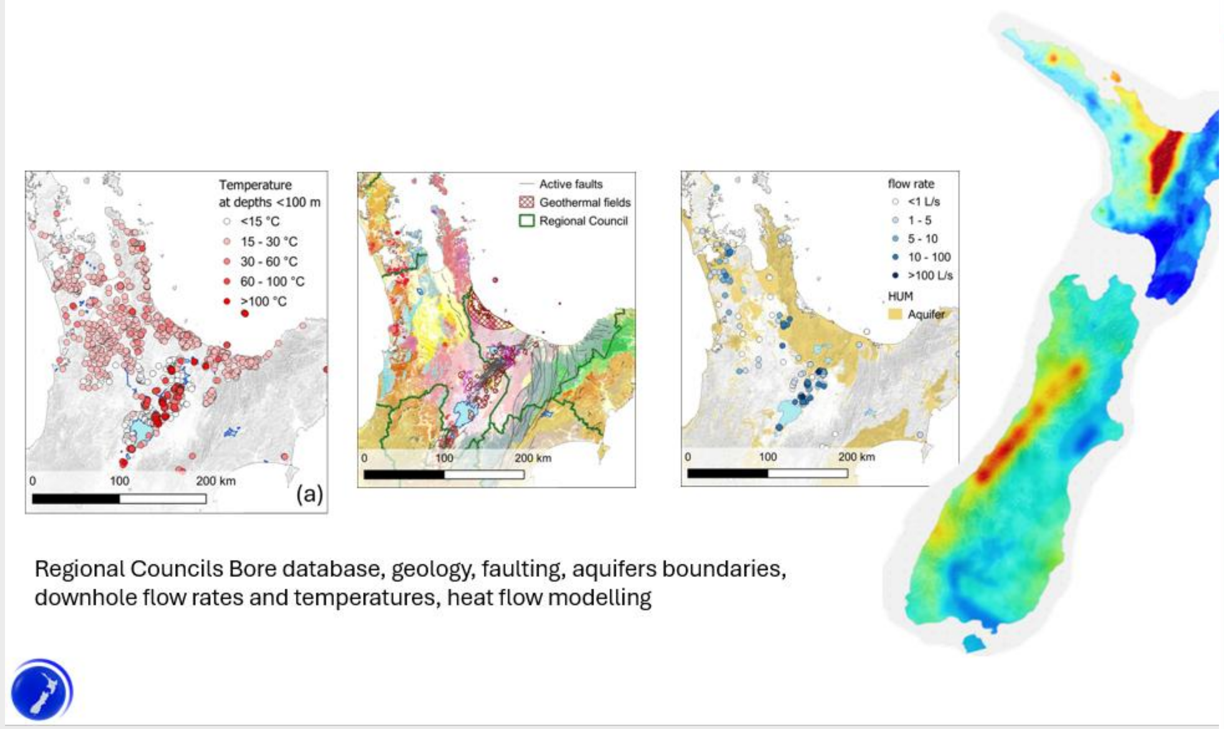
Ministry for Primary Industries
Manatū Ahu Matua

Vegetables NEW ZEALAND Inc

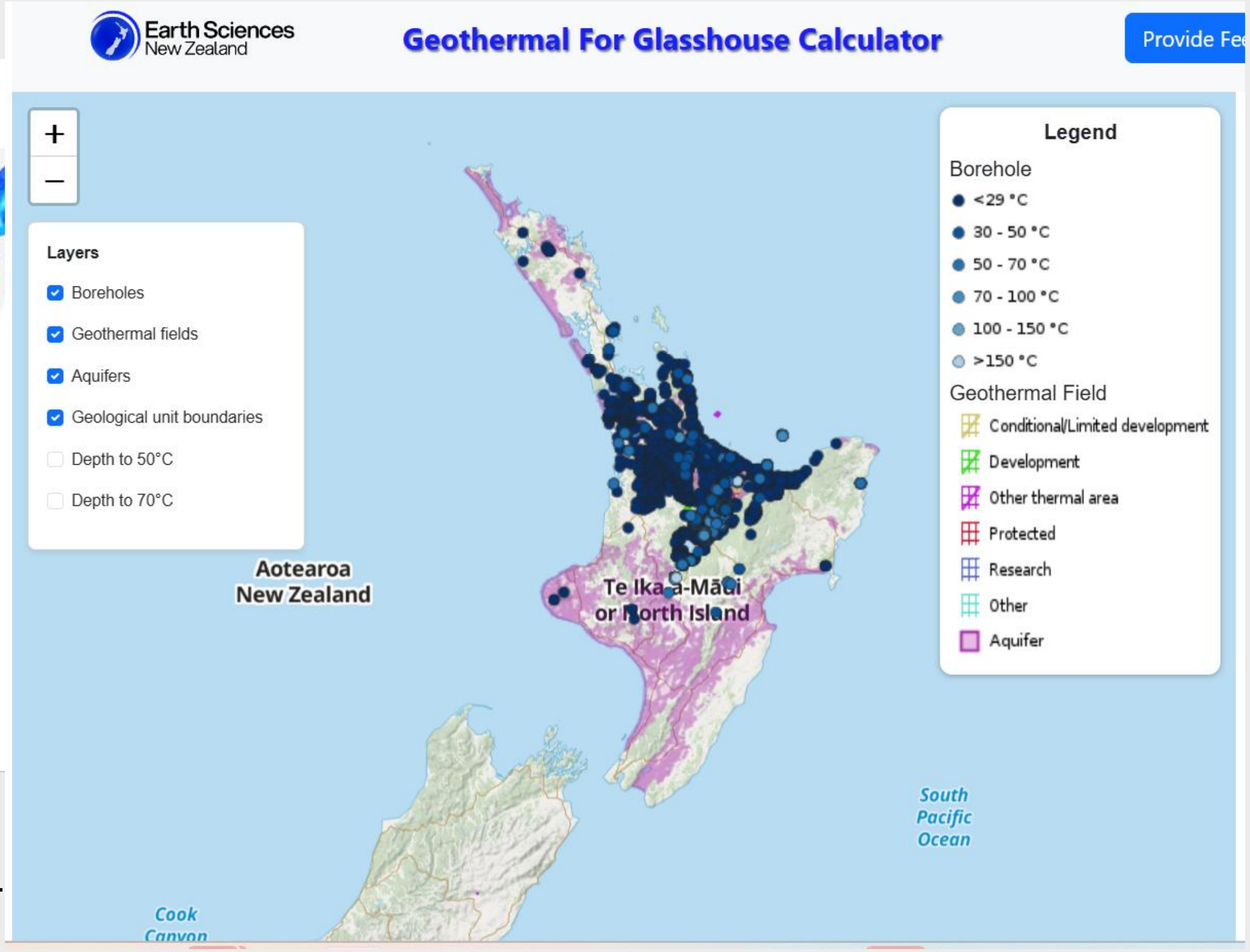
GeoExchange NZ

TomatoesNZ

Interactive resource map

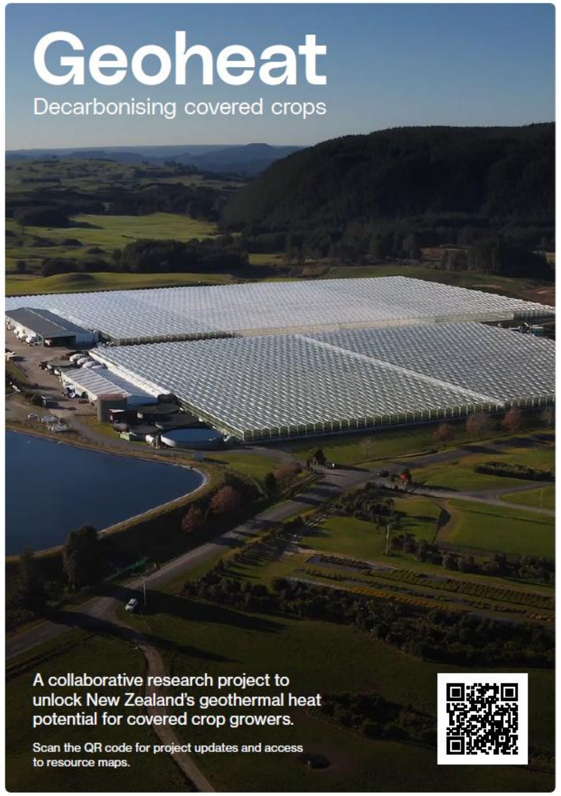


Regional Councils Bore database, geology, faulting, aquifers boundaries, downhole flow rates and temperatures, heat flow modelling



https://www.gns.cri.nz/research-projects/decarbonising-covered-crops-with-low-temperature-geothermal/

International examples

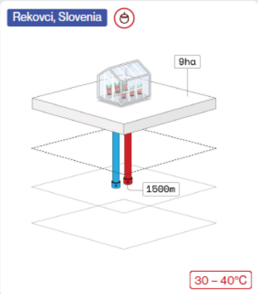


International examples of geothermal greenhouses

These examples are applicable to many areas of New Zealand, with temperatures potentially found at shallower depths.

Lušt Tomatoes

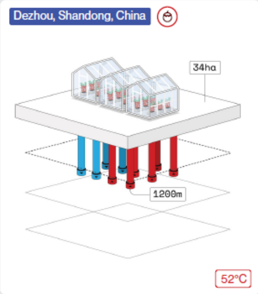
Until 2018 Lust's greenhouse supplemented geothermal groundwater (30-40°C from a 1,500m well) with gas. Rising gas prices and environmental demands led to their decision to replace the gas boiler with a 2000 kW ground source heat pump. This conversion delivers 65-80°C at a 72% operational savings and 50% lower CO_2 emissions. The system paid for itself in <1yr thanks to re-purposing the existing well. The system paid itself off with energy savings in under a year, helped by the geothermal well already existing on site. Lust's ground source heat pump doubles savings because it both heats the greenhouse and cools tomatoes in storage.



Example using existing warm groundwater source at 1.5 km

Caijin Smart Agricultural Industrial Park

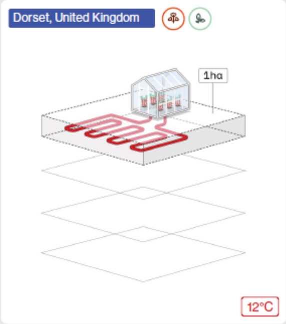
In an established growing region of Shandong, Caijin Smart Agricultural Industrial Park specialises in growing a variety of tomatoes. The park covers an area of 34ha and uses 52°C geothermal water from 1,200m deep wells to replace fossil fuel burning. It uses 4 extract wells and 6 return wells and it has added high-temperature ground source heat pump technology to operate an energy station. The total heating capacity is about 21,712kw. The smart agricultural greenhouse saves operating costs and reduces CO_2 emissions by 24,000 tons.



Example using a well field with moderate temperatures.

Stewarts Garden Centres and Nursery

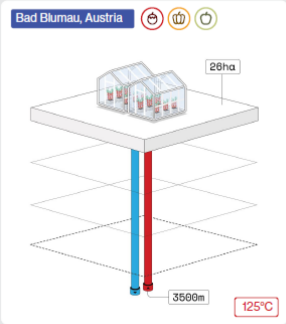
In 2020, Stewarts' dramatically changed its 280-year-old operation model to reduce costs and environmental impact. Inspired by Dutch growing facilities, they installed automated thermal screens and a 500kW ground source heat pump to replace an oil boiler. The system draws heat from a shallow closed-loop network of horizontal pipes that capture stable ground temperatures. The system has performed strongly, delivering annual savings of approximately 450 tonnes of CO2, equivalent and reducing electricity costs significantly.



Example using ambient ground temperatures.

The Frutura Group

From 2016, Frutura began growing organic fruits, tomatoes and capsicums with geothermal energy. Geothermal water with a temperature of 125°C is pumped to the surface from a depth of 3,500m to heat 26ha of greenhouses so that produce can be grown all year round without any additional heating source. Compared to fossil fuel heating, 28,000 tons of CO_2 are saved per year. Frutura estimates that each year between October and March, 1 Million km of transport per truck can be avoided because of locally grown produce in geothermal greenhouses, further reducing CO_2 emissions and increasing food security.



Example of high temperatures from deep wells (> 3km).

Global Use of Geothermal Heat for Covered Crops

This selection of global examples includes the full geothermal spectrum, from facilities that use ambient groundwater with ground source heat pumps, to those that have drilled to greater depths to directly use >80°C. In each scenario, the use of geothermal has displaced fossil fuel use and enhanced regional food security.

Bananas, coca dragon fruit	Flowers	Capsicum	Strawberries
Cucumbers	Fresh herbs	Salad greens	Tomatoes
Edamame Beans	Organic fruit	Seedlings	Various

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Local case studies

Earth Sciences New Zealand
GeoExchange NZ

Case Study 1:

Energy Economics of Geoheat Use in Known Geothermal 'Warm Zone'

Location:

Paengaroa, Western Bay of Plenty

The site is located within the Tauranga Geothermal System (TGS). A review of nearby bores reveals that groundwater temperature in the order of 30 to 40°C are available 150 m below ground surface. Based on expert resource assessment, warmer temperatures are estimated to be available at greater depths and have been included in this analysis.

Earth Sciences New Zealand
GeoExchange NZ

Case Study 2:

Energy Economics of Geoheat Use in a Non-geothermally Influenced Region

Location:

Waiuku, South Auckland

The site is not located within a known geothermally enhanced zone; a natural thermal gradient of 25°C/km has been modelled (Kirkby et al, 2025).

Data availability in this area is limited, although some warm shallow temperature anomalies have been recorded. Further resource exploration and data collection may refine or alter the thermal gradient profile for this location.

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GeoExchange NZ

Case Study 3:

Energy Economics of Geoheat Use in High Temperature Geothermal System

Location:

Reporoa, Waikato

Reporoa sits within the Reporoa Caldera, in the proximity of numerous high temperature geothermal systems, within the Taupō Volcanic Zone.

Based on expert resource assessment, hot temperatures are available at relatively shallow depths and have been included in this analysis.

Early engagement with Waikato Regional Council is recommended for anyone considering development here.

GEOEXCHANGE

REGIONAL ENERGY TRANSITION ACCELERATOR (RETA),
BAY OF PLENTY REGION
WHAKATANE GROWERS
WHAKATANE

Report ID: GXA23-NZ-03-R02

Prepared For:
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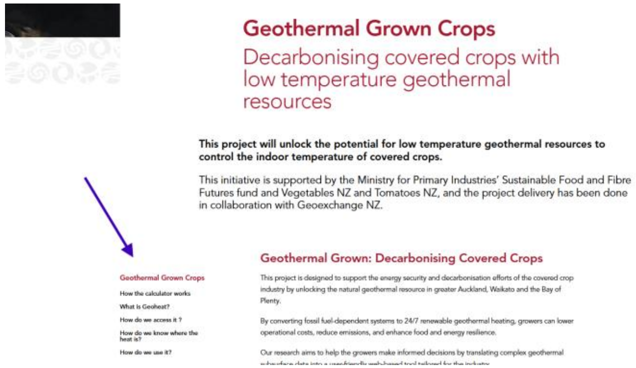
Supporting information



Geothermal Grown Crops

Decarbonising covered crops with low temperature geothermal resources

This project will unlock the potential for low temperature geothermal resources to control the indoor temperature of covered crops.

This initiative is supported by the Ministry for Primary Industries' Sustainable Food and Fibre Futures fund and Vegetables NZ and Tomatoes NZ, and the project delivery has been done in collaboration with Geoexchange NZ.

Geothermal Grown Crops

How the calculator works

What is Geoheat?

How do we access it ?

How do we know where the heat is?

How do we use it?

Geothermal Grown: Decarbonising Covered Crops

This project is designed to support the energy security and decarbonisation efforts of the covered crop industry by unlocking the natural geothermal resource in greater Auckland, Waikato and the Bay of Plenty.

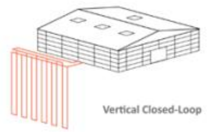
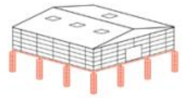
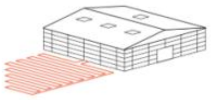
By converting fossil fuel-dependent systems to 24/7 renewable geothermal heating, growers can lower operational costs, reduce emissions, and enhance food and energy resilience.

Our research aims to help the growers make informed decisions by translating complex geothermal

What is Geoheat?

Geothermal Temperature Range	Category	Key Points
12–18 °C	Ambient Groundwater	• Range depends on geographic location and closely reflects the average annual air temperature. • Useful thermal source for standard Ground Sourced Heat pump (GSHP). • Lower temperatures can be used for direct cooling.
18–29 °C	Geothermally Enhanced Groundwater	• This is fresh groundwater that is warmed by a higher-than-normal subsurface heat gradient but does not reach 30 °C (RMA definition of geothermal water). • These enhanced temperatures boost GSHP efficiency for heating.
≥30 °C	RMA-defined Geothermal Water	• The temperature threshold that requires geothermal consent under NZ law.
30–150 °C	Low-Temperature Geothermal (in NZ)	• The geothermal industry classifies this temperature range as 'low temperature geothermal' or 'low enthalpy'. • Useful for heating directly or heating indirectly when combined with a GSHP
>150 °C	High-Temperature Geothermal	• Power generation and heavy industrial direct heat applications. • Site specific, e.g. 215-350°C is used by industry for direct heat use at Kawerau.
> 350 °C	Superhot / Supercritical Geothermal	• The new frontier of geothermal energy. Supercritical fluids can carry up to 10 x more energy than traditional high temperature fluid

How do we access it?

Closed Loop		Closed, vertical GHXs are typically installed in boreholes 50–200 m deep but could be deeper in certain applications. These systems use a polyethylene (PE) pipe filled with a water-antifreeze or brine mixture that by circulating around either absorbs heat (heating) from or rejects heat (cooling) to the ground. A GSHP then delivers heating and/or cooling as required by the application. Similar designs can be used for direct heat use if sufficient heat is available in the subsurface.
		Vertical, closed-loop systems can also be installed in the existing building infrastructure and integrated into building piles. Often called *energy piles*, these systems are generally only able to cover some of the building's heating and cooling requirements. The performance of these systems is determined by the soil moisture and whether the piles are in the groundwater zone. The advantage of these systems is that they can be installed at relatively low additional cost if a foundation is required anyway. In addition to the building, the base plate and earth-covered side walls can also be thermally activated.
		A closed horizontal GHX is typically installed at a depth of 1–2 m. Types include *surface*, *trench* and *spiral* collectors. They utilise the seasonal temperature fluctuations in the ground and are suitable for areas with plenty of space, such as rural residential areas. They work best in clayey, moisture-rich soils that allow for optimal heat transfer and regeneration. They can be a capital cost effective heating and cooling solution for rural residential properties that have suitable areas of land available.

How do we use it?

Technology Type	Geothermal Temperature Source	Technology Temperature Delivery Range	Best Use Cases
Direct cooling	<15°C	<15°C	Chillers and space cooling
Direct use of geothermal heat	~30–150°C +*	~30°–150°C +*	Space heating, domestic hot water, baseload industrial heating, and industrial processes.
Standard GSHP	10–40°C	Up to ~65°C	Primarily used for domestic and commercial space heating, domestic hot water and low-temperature industrial processes.
High-temperature GSHP	10–75°C	~65°C to ~90°C	Low-temperature industrial processes, hot water, heating, drying.
Very high-temperature GSHP	10–50°C (requires two-stage heat pump) Or 50–100°C (one-stage heat pump)	Up to ~160–180°C	Medium-temperature industrial processes, steam, heating, drying.
Absorption chillers	70°C +	-5 to 10°C	Type of cooling system that uses heat energy instead of electricity for cool stores, cold water or buildings.
Electricity generation	130°C +	NA	Binary, Dry and Flash electricity generation depending on fluid state available.

The Geothermal Spectrum

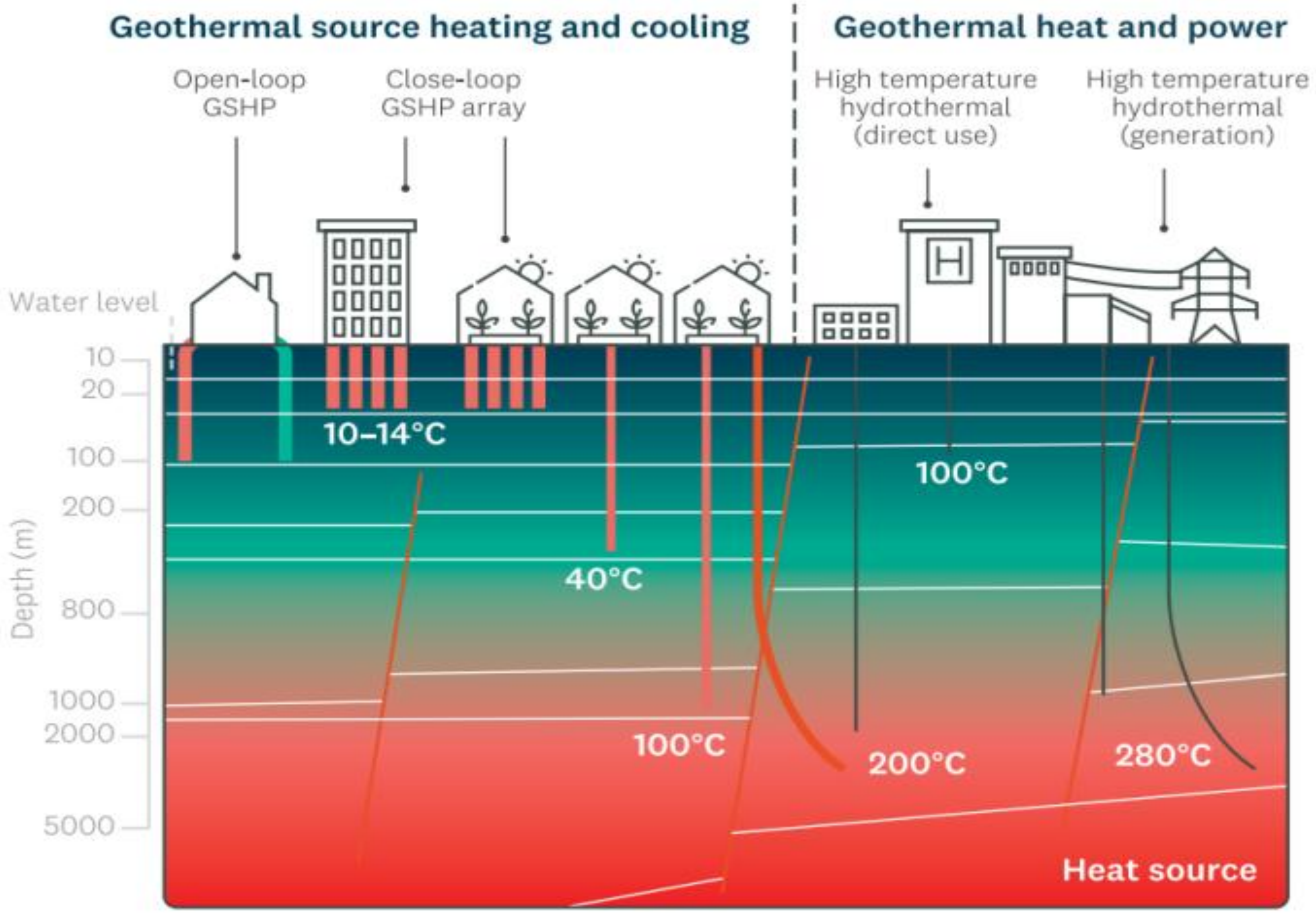


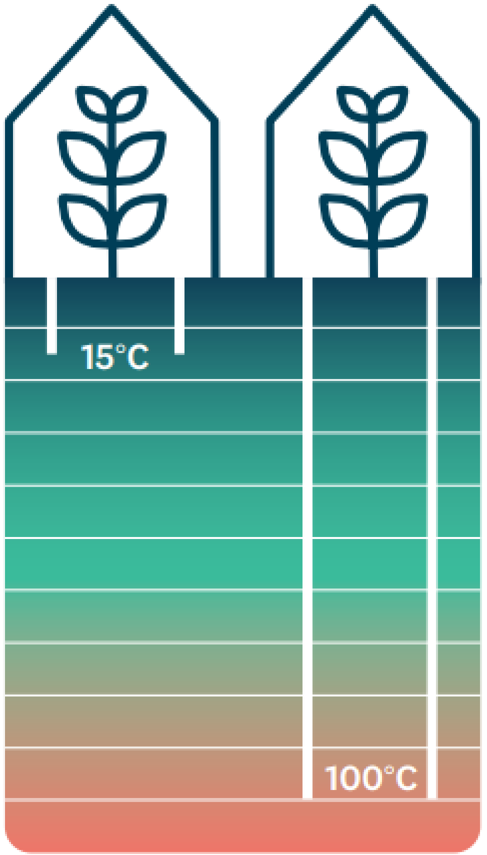
Figure 8: Example of Connection Between Various Geoheat Sources and Above Ground Applications.
Source: GNS Science from EECA (2024)

Defining Geoheat

- They don't need to be geothermally enhanced – ambient temperatures are great!
- Resource Management Act defines Geothermal as >30°C
- Geoheat systems are either:
  - Direct Use: Use available geoheat directly (eg a geothermal pool); or
  - Indirect Use: Require a boost (eg heat pump) to modify the source temperatures to meet output requirements.

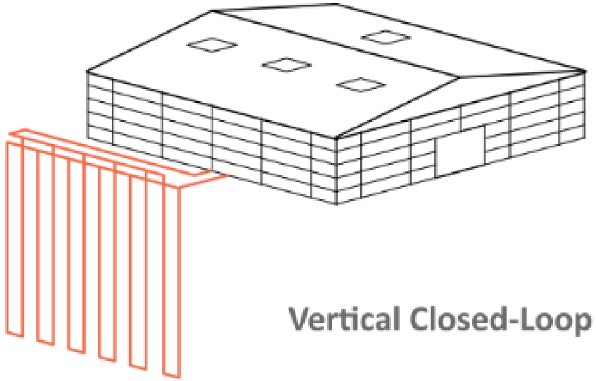
<u>BUT</u>

- **<u>Always site and application specific:</u>**
  - Eg 50°C source could be
    - Direct use if low temperature heat pipes; or
    - Indirect use (boosted) if higher temperature heat pipes.

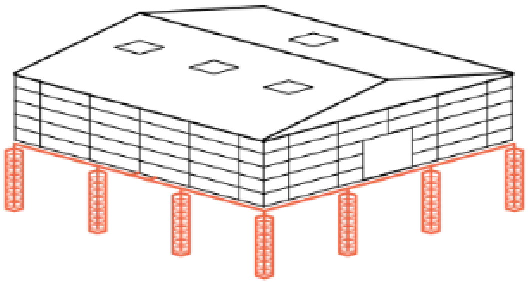


Accessing Geoheat

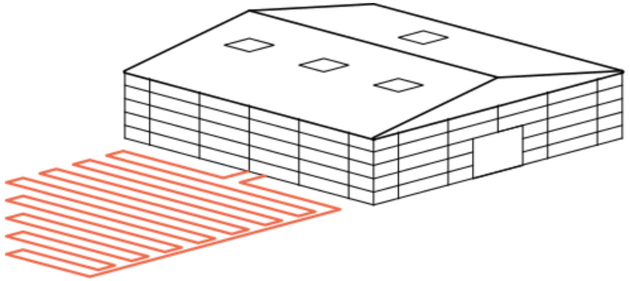
Closed Loop Systems



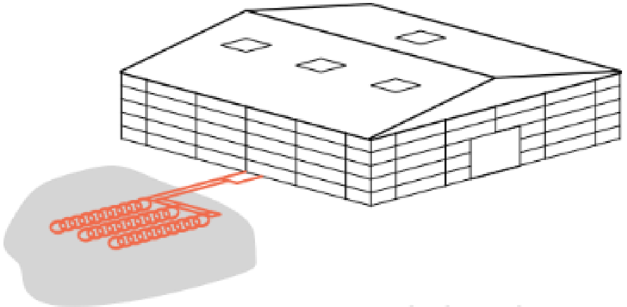
Vertical Closed-Loop



Closed Loop Building Piles

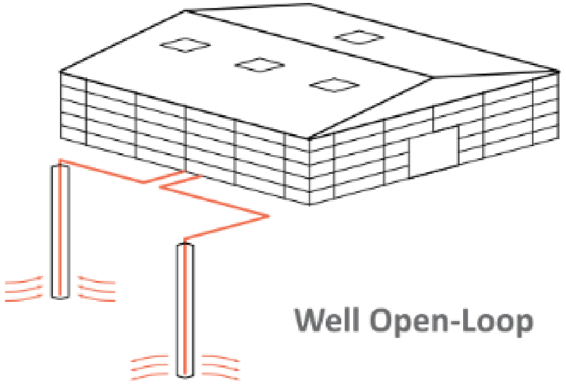


Horizontal Closed-Loop

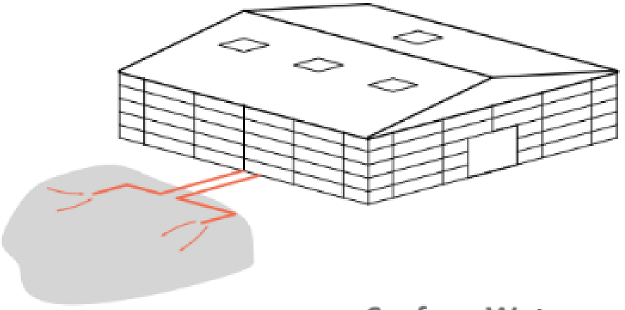


Pond Closed-Loop

Open Loop Systems



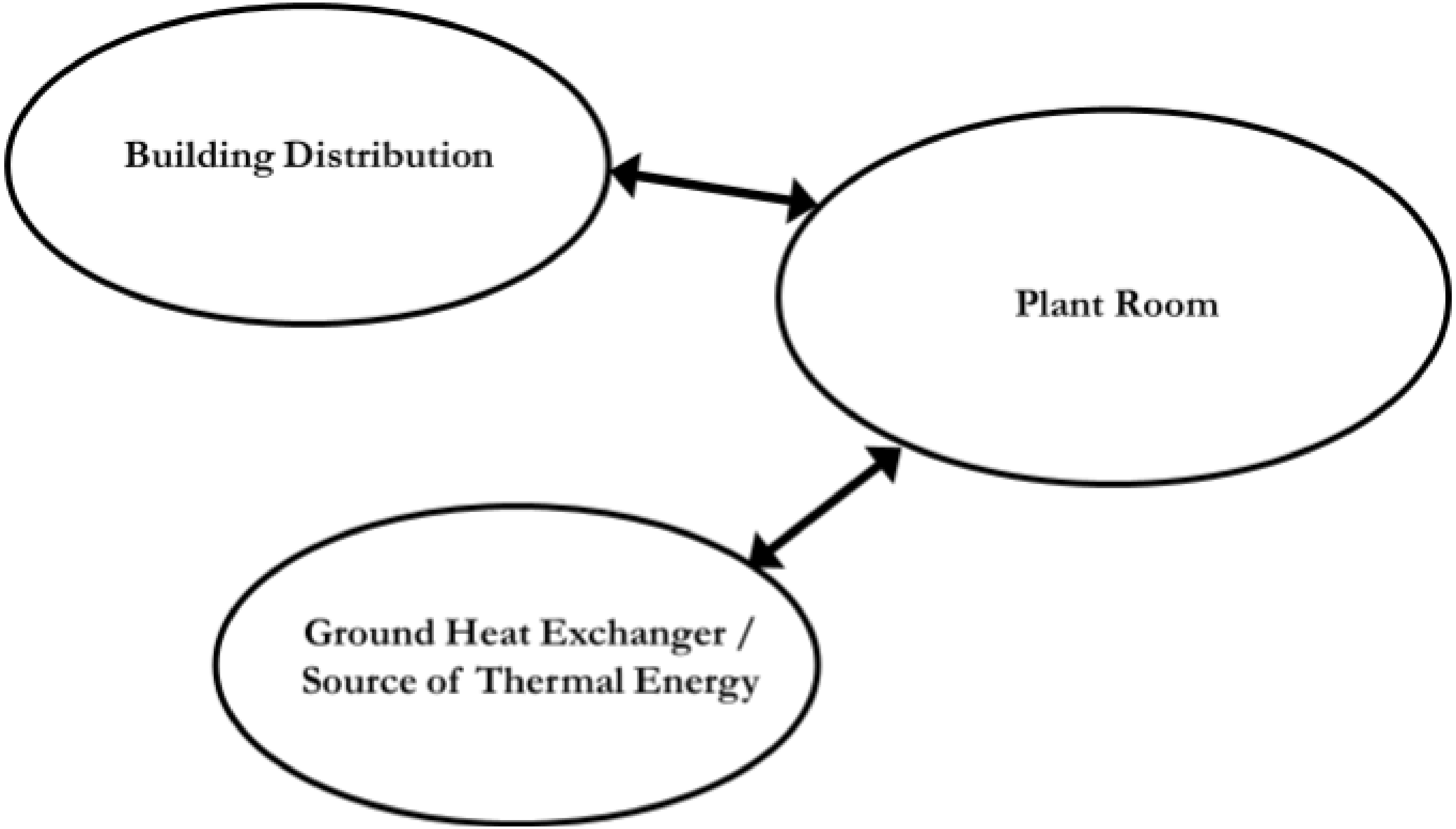
Well Open-Loop



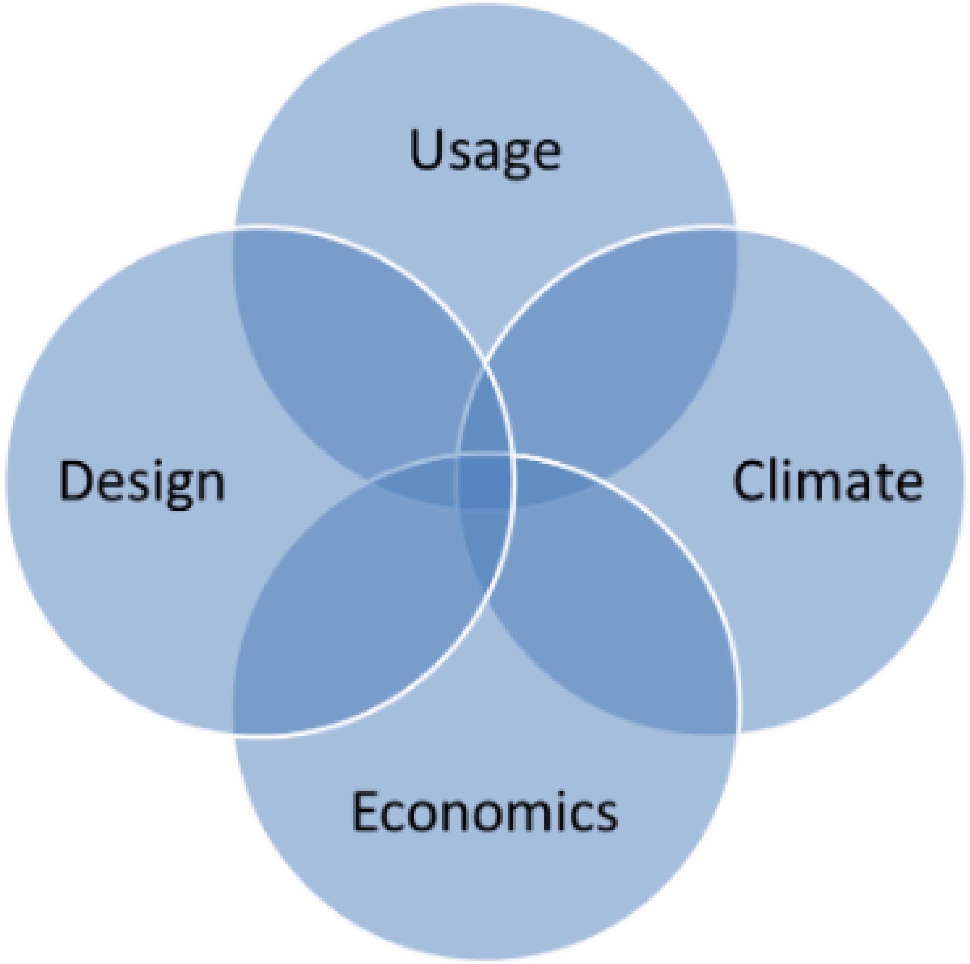
Surface Water

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

System Components



Is there a Sweet Spot?



- **Usage**
  - Run time of HVAC systems
  - Mix of heating and cooling
- **Climate**
  - Local climate with relative extremes
  - Mix of heating and cooling
- **Finance**
  - High energy costs (electricity and gas)
  - Cost of heat exchanger – can vary widely
  - Building owner invested in operating costs
  - Revenue generating option / thermal utility
  - Carbon credits
- **Practicalities / Design**
  - Suitable location for the GHX
  - Other benefits associated with building (cost, acoustics, space, structural, rooftops etc)

It All Comes Down to the Bottom Line...

GeoExchange NZ

Commercial greenhouse using the Tauranga Geothermal System

	Capital Cost	Annual Energy Use (kWh)	25 Year Opex	Levelised Cost of Heat (kWh)	Simple Payback (Years)
Gas heaters	$580,000	1,350,463	$4,050,000	**$0.17**	**--**
Air Source HP	$1,050,000	544,998	$3,733,236	**$0.20**	**7.5**
Ground Source HP (20 °C)	$1,300,000	350,025	$2,397,671	**$0.12**	**6.4**
Direct use (50°C)*	$1,750,000	7,455	$51,067	**$0.06**	**4.5**
Direct use (70°C)	$1,470,000	7,455	$51,067	**$0.05**	**3.8**

* Capital cost is more expensive even though the bore is shallower, reason being is additional pipework is required to distribute lower heat internally to achieve set point temperature.

....and energy security

Discussion

1. What is your top-of-mind issue when considering using geoheat?
2. How could that be addressed?


RESEARCH PROJECTS

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Thank you

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GeoExchangeNZ

04 August, 2026

How can we support early energy decarbonising decision making?

Opportunity awareness

Resource Understanding

Economics

Technology

Funding

Examples

Early adopters

Risk identification