Ground Water
Heat pumps for heating, cooling and hot water

Submission to Ecan hearing

The aim of this presentation is to tell you who we are, why heating is important in Christchurch, the solutions we provide and why ground source heat pumps that use ground water as the heat source are an important option.
Install and sell equipment for hydronic central heating
Based in Christchurch
Started 2002
30 employees
Leading specialist central heating company

Who are we?
Why is heating so important in Christchurch? Because it is so cold. According to the New Zealand Building Code any month when the average temperature is below 14°C is considered a heating month; this is April to November inclusive.
Central heating aims to provide adequate heating in all rooms of a house to agreed temperatures at agreed times. Although this is common in other parts of the world it is still unusual here, but growing rapidly.
Pipes carrying hot water set into a floor slab is the most common way to do provide central heating as shown in this picture, but largely limited to new houses though is possible for retrofits. (Pipes tied to mesh prior to concrete being poured.)
Radiators are not as popular as underfloor but still commonly used. European immigrants would mostly be used to radiators which are the standard method of heating with gas boilers in most of northern Europe.
Hydronic central heating uses water to transfer heat from one central heat source to heaters usually in every room of the building. As water has a very high heat capacity it is possible to move large amounts of heat through relatively small pipes. It also means heat can be directed to where it is needed using automated valves and pumps.
Heat sources include boilers that burn fuel, gas and diesel are commonly used in Christchurch even though they are not as cheap as heat pumps to run. Log boilers are difficult to install due to emissions regulations. Air to water and ground source heat pumps are growing in popularity every year.
Ground source heat pumps have the cheapest running costs but capital costs are high.
Heat pumps

- An appliance that uses a small amount of electrical energy to produce a larger amount of heat energy i.e. 1kW electricity in & 3kW heat out.

  1kW electrical energy

  Heat pump

  2kW low temperature heat

  Low temperature heat source

  3kW high temperature heat

  Heat pump efficiency and heat output is reduced by lower heat source temperatures

Higher temperature heat output

A heat pump extracts large amounts of low temperature heat from the environment and concentrates it into a smaller amount of high temperature heat. Underground it is warmer in the winter than above ground where the air can be freezing, reducing efficiency and requiring defrost with reduces heat output of air source heat pumps.
Air source are cheaper to install, but
- Are less efficient in colder weather – ground source not effected
- Produce less heat in colder weather – ground source not effected
- Need to defrost in cold weather – ground source doesn’t
- Can be a noise nuisance in certain circumstances
- Can be a visual intrusion
Pipe loops buried in the ground at a depth of 2m is the most common form of ground source heat pumps.
Sufficient land area needed for this method – most commonly used, but difficult in urban areas.

This has a cost to dig the hole, the cost of the pipes and laying them out and most of all you need space. This pit is in urban Christchurch and is now a tennis court. This was part of a brown field development but most people don’t have this much room or wouldn’t want to dig up their whole garden.
A variant of buried pipes it to put them in vertical bore holes which uses less land area but is expensive as the bores are 100m deep.
Bore hole installation in Queenstown.
Using ground water is more cost effective as long pipe loops are eliminated and the groundwater is at a constant temperature of 10°C to 12°C.
Some groundwater installations take the ground water from an aquifer and dump it into a drain or soak pit.
In the PLWRP taking from an aquifer and re-injecting at the same depth is regarded as non-consumptive and for domestic applications is a permitted activity provided the conditions are met.
A potential problem is that if the bores are too close together the ejected water can circulate back to the extract well and reduce the efficiency of the heat pump.
One answer to this, particularly in an urban environment is to have the water re-injected to a different depth.
There are other methods including taking, and rejecting to, rivers and lakes of which there are a few examples in New Zealand.
Bore consent conditions.

- Bores need to be reasonably far apart.
- So may end up being near boundaries.

Standard bore conditions such as being 20m from a boundary can be hard to meet in an urban environment.
- Being able to combine extraction water bore with domestic water take bore saves money.
- 3 bores would be considered a permitted activity but combining bores would stop heat pump use being non-consumptive.

Being allowed to use the extract bore for domestic permitted water take instead of having to a third bore reduces the overall costs which are important in residential heating applications.
An example of a ground water heat pump being used to heat a house in Canterbury, including the domestic hot water.
Examples of wells, the right hand picture shows the extract well being drilled for Central Heating New Zealand’s new offices which are heated and cooled by a ground water heat pump.
Small commercial heating and cooling

Underfloor and radiator heating

CHNZ's new offices with the
Ground source heating for Christchurch

- The most efficient and low cost form of heating – and low carbon
- Most suitable form of ground source heating in an urban environment
- Christchurch has vast resources of water at easily accessible depths
Groundwater ground source heating is:

- Very efficient
- Considered renewable
- No visual and no noise impact on the local environment
- Emits no pollution other than cooling the water by a few degrees – usually about 5°C
- Meets central government, ECan and CCC policy objectives
- And is consistent with Tangata Whenua values
Support policy and rule making domestic non-consumptive use of water for heating a permitted activity

This avoided compliance cost is very significant for the overall cost of residential scale projects

Bore consent conditions have to be workable

Allowing domestic water to be taken from the extraction well would further improve the attractiveness of this technology for some people