# Reducing the demand on the electricity grid in a carbon-neutral NZ: The opportunity for ground-source heat pumps in smart building designs

Anya Seward[1], Celia Wells[1], Yale Carden[2], Sophie Pearson-Grant[1]

*[1]GNS Science, New Zealand ; [2] GeoExchange Australia Pty Ltd, NSW*

As New Zealand transitions away from burning fossil fuels for space heating and cooling, more demand will be placed on the electricity grid. With smart use of the earth's natural heat resources these demands can be greatly reduced. Geothermal or ground-source heat pump (GSHP) technologies take advantage of this freely-available, naturally occurring underground heat, and can reduce electricity demand by up to 50%.

GSHP can offer both heating and cooling at virtually any location, with great flexibility to meet any demand. They utilise ground-loops to circulate fluid through stable subsurface temperatures. These temperatures are relatively warm in the winter months compared to air temperatures and relatively cool summer months. Using these temperatures can reduce energy consumption by between 30 and 50%, when compared to air-sources systems. GSHP technologies are widely used overseas, for residential, commercial and district heating regimes, however, are under-utilised in New Zealand, with only ~200 known installations throughout the country.

Over 30-50 years of R&D in both Europe and USA have paved the way for efficient and sustainable installation of these systems, including for schools, warehouses, sporting arenas, shopping malls, office buildings, residential dwellings, and district heating systems. Ground loop design vary on the location, local geology, climate, and available resources and include shallow (< 10 m) and deep (20-120m) ground, subsurface aquifers, and surface water (lakes, ponds, sea water) sources.

An increase in installations of these systems was seen in the wake of the 2011 Christchurch earthquake when several large commercial buildings adopted GSHP technology. These included the Justice Precinct, Council offices, bus exchange and art centre, which extract groundwater from the underlying aquifer systems at constant year-round temperatures, to circulate through the heat-pump systems, before reinjecting the water back into the aquifer system.

Recently a feasibility case-study for a district heating scheme for 2,200 housing development in Taupo was undertaken. It investigated the options for using the shallow ground and groundwater resources, in addition to the potential of placing heat exchangers in the lake. It was found that by adopting an open ground water loop (where water is extracted from and reinjected into the subsurface aquifers), the installation costs were paid back within 4 years, with the potential savings for the residents of ~$2,000 per year on electricity costs, when comparing to air-sourced heating and cooling alternative.

This paper will showcase and highlight the benefits of utilising the near-surface geothermal resources present throughout New Zealand, to provide warm, efficient, sustainable, healthy living and working environments.