WATT? A GEOHEAT STRATEGY FOR NEW ZEALAND

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ABSTRACT

Geothermal energy is a vital component of New Zealand's energy scene. The development of a geoheat (earth energy) strategy for New Zealand will create opportunities for increased use of geothermal energy. This is particularly relevant in the current context of long term increases in energy costs, changing social views towards energy use, substitution opportunities for CO_2 rich fuels, future growth in energy demand and government strategies promoting renewable energy.

Electricity generation from geothermal resources is well-established; New Zealand is internationally recognised for our experience and expertise. Conversely, we are lagging behind in the use of geothermal resources for direct use applications and for heating and cooling using geothermal heat pumps.

A geoheat strategy could assist in driving the uptake of direct heat and geothermal heat pump use in New Zealand. A robust strategy will be a growth enabler with associated economic, social and environmental benefits.

To succeed, this strategy will require a common vision, collaboration and leadership. The New Zealand Geothermal Association has a key role to play.

This paper discusses the development of a New Zealand geoheat strategy to further empower uptake of geothermal energy.

A strategy developed and owned by the geothermal community will inspire New Zealand to reach beyond business as usual.

1. WHY A GEOHEAT STRATEGY?

A geothermal heat strategy provides a mechanism for a coordinated approach to increasing the use of geothermal resources in New Zealand. The strategy would embody the principles, shared visions and goals of a range of stakeholders that are interested in promoting geothermal energy use whether it be electricity generation, direct use or geothermal heat pump technologies. It would provide opportunity for further uptake of renewable energy, economic growth, regional development, healthier homes, and much more.

There are a range of reasons why the New Zealand geothermal community (in its broadest context) would benefit from such a strategy.

A geoheat strategy would support:

- Increased use of renewable energy
- Increased energy supply security
- The promotion of effective green technology
- Reduced carbon based energy use
- Regional development
- New business opportunities
- Economic growth
- Energy efficient heating/cooling
- Healthier living and working environments
- Sustainable environmental energy use

A geoheat strategy, developed and owned by the geothermal community, becomes a document that will influence government policies, and national, regional and local effort. It would assist in the implementation of central government energy strategies, as well as planning and decision making in local regulatory agencies. This has roll-on effects for influencing funding decisions (e.g. research funding, feasibility grants, prioritising of regional council spending, industry co-funding etc).

A geoheat strategy would also bring together various agencies to promote, support and advance geothermal projects. Examples might include:

- Industrial conversions to geothermal energy supply;
- Regional development – attracting industry to a renewable source of heat;
- City and district heating/cooling opportunities; and
- NZ deep geothermal drilling project.

A geoheat strategy will build on the significant body of research that has been undertaken to date on the use of geothermal resources in New Zealand.

2. NZ GEOTHERMAL ENERGY USE

Over the next thirty years substantial increases in oil and gas prices can reasonably be expected, with reducing availability of fossil fuels and increasing demand for energy.

Geothermal resources are a vital component of New Zealand's energy scene, capable of providing an even greater contribution to electricity generation, as well as industrial, commercial and residential heating and cooling into the future.

The New Zealand Government is committed to accelerating the use of renewable low carbon emission energy (including geothermal energy). It has set national targets for an increase in the use of renewable energy for both electricity and direct use.

2.1 Electricity generation

Electricity generation from geothermal resources is well-established, and is the most publically recognised industrial use of geothermal resources (Becker and Doody, 2011). Geothermal energy currently provides 13% (19 PJ) of New Zealand's annual electricity supply (144 PJ) from a 2012 installed capacity of ca. 760 MW. New Zealand is number six in the world for installed geothermal electricity generation capacity (Bertani 2010), and is internationally recognised for our experience and expertise in this area.

The NZ Energy Strategy (2011) sets the Government's target of 90% of New Zealand's electricity from renewable energy sources by 2025. In 2011 renewable energy sources supplied 76% of New Zealand electricity, of which geothermal energy accounts for 13% (Figure 1, data from MED 2012).

Geothermal is expected to make a significant contribution towards achievement of the 90% target. A number of geothermal projects have received resource consents, some of which are currently under construction (Figure 2). The commissioning in 2013 of Te Mihi (110 MWe increment), Ngatamariki (80 MWe) and Kawerau (20 MWe) and the future commission of Tauhara II (250 MWe) would increase the installed geothermal electricity generation capacity to about 1200 MWe (>30 PJ, >20% electricity supply). Additionally other proposed geothermal projects (e.g. Taheke, Rotoma, Tikitere) and the development of deep geothermal resources (4-7 km) could reasonably increase this contribution even further (Bignall and Carey, 2011).

2.2 Direct heat use & geothermal heat pumps

The technology, reliability, economics and environmental benefits of direct geothermal use are well demonstrated both domestically and internationally.

New Zealand is well endowed with high temperature geothermal systems and low temperature geothermal opportunities. Geothermal heat use may seem more relevant to colder climates, but in warmer climates geothermal heat is useful for industrial, commercial and agricultural applications. There is also potential for cooling applications.

In addition to electricity generation, geothermal resources are used, mainly in the central North Island, for direct heat use applications in the timber and tourism industries, and for commercial and domestic heating and cooling, including geothermal heat pumps (GHPs). Globally New Zealand is not at the forefront in these areas.

In 2010, direct heat use applications used 10 PJ/yr (Bromley and White, 2010). Approximately 55% of this was industrial use at Kawerau (i.e. timber drying and paper processing). The balance is in bathing and space heating facilities, milk drying, kiln drying facilities, geothermal tourism, horticulture and aquaculture.

Conductive and solar energy stored in the ground, groundwater or surface water can be accessed for heating and cooling using GHPs. GHPs are gradually becoming established in New Zealand, especially in colder climate regions in the South Island. They amount to some 100 known domestic installations to date, plus a number of large-scale commercial installations, such as airports, a town-hall, a conference facility and a hotel. Systematic tracking of new installations is yet to occur, so these numbers may be higher. The 2010 estimated net use from GHPs in New Zealand was ca. 11 GWh/yr (0.04 PJ) (Bromley and White, 2010).

In 2005, direct geothermal energy use was ca. 9.5 PJ (Figure 3, MED 2012). The NZ Energy Efficiency and Conservation Strategy (NZEECS, 2011) has set a target of, by 2025, utilising an additional 9.5 PJ per year of energy from woody biomass or direct use geothermal additional to that used in 2005. GHPs are categorised as a direct use of geothermal energy, and represent an opportunity to assist to meet direct use targets. In early 2012, the New Zealand Geothermal Association hosted the formation of the Geothermal Heat-pump Association of New Zealand (www.ghanz.org.nz).

Direct use technologies can utilise high and low temperature resources. Heat can generally only be used where there is demand in the vicinity of the resources, as transport of heat over longer distances has economic limitations. However, this may open up opportunities for enhanced local/regional economic development around geothermal heat.

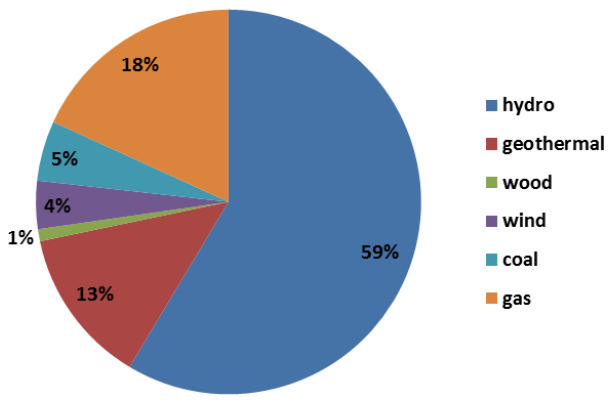

Figure 1. 2011 sources of electricity generation in New Zealand (MED 2012).

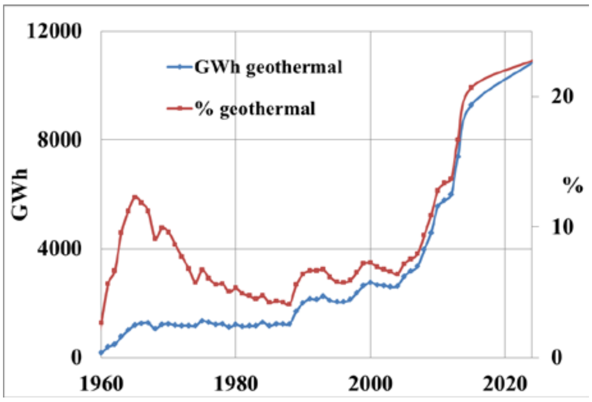

Figure 2. Historic and projected growth in New Zealand's geothermal electricity generation.

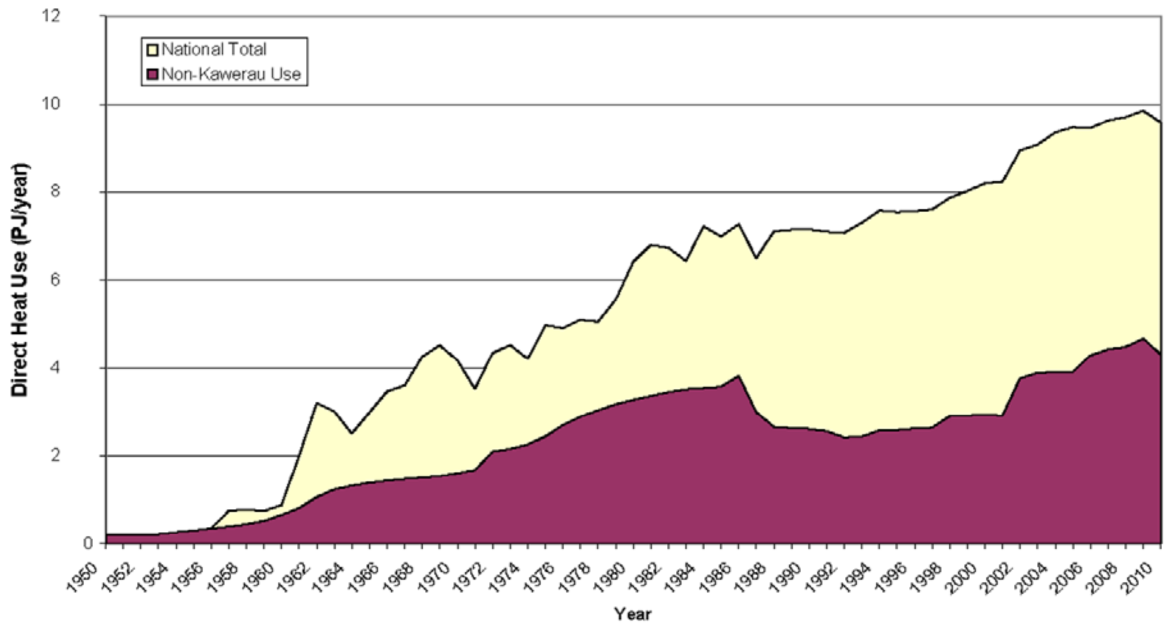

Figure 3. New Zealand growth in direct geothermal heat use (White, 2011).

GHPs are not location specific and can be effective anywhere in New Zealand, where more conventional geothermal energy use requires the presence of shallow volcanic activity, such as that found in the Taupo Volcanic Zone (TVZ).

In addition to the direct use of hot water or steam, the potential for maximum energy extraction and economics might be realised through combined heat and power arrangements and cascaded use. There is an array of proven technologies available with applications including kiln drying of timber, clean steam generation, direct process heating and absorption cycle refrigeration.

The forecasted growth in energy demand by 2025 (Rossouw and Lind, 2010) provides insight into areas where growth in heating and cooling demand might be satisfied by direct geothermal heat use and/or GHPs.

i. Some of the predicted 10PJ per year demand growth in the manufacturing sector in the 100-150°C range is suited to direct geothermal use from higher temperature resources in the TVZ and Ngawha, and possibly using GHPs for larger size installations outside of the TVZ.

ii. Some of the predicted 10PJ per year demand growth in the commercial sector in the less than 100°C range and some of the predicted 4PJ per year demand growth in the manufacturing sector in the less than 100°C range is suited to GHPs.

iii. Some of the predicted 5PJ per year demand growth in the residential sector in the less than 100°C range might be suited to GHPs. There is the possibility for the development of GHP networks or direct geothermal use to supply space heating/cooling for residential networks (e.g. district heating, subdivisions).

2.3 Barriers

Accessing geothermal energy provides a range of benefits from increased energy efficiency and reduced energy costs for individual consumers, through to macro benefits for the energy market. Geothermal energy is a renewable and reliable resource that is available throughout New Zealand's varied geology, hydrogeology, and climate.

Growth in geothermal electricity generation is being driven by an established, world-leading industry and favourable economics, underpinned by robust geothermal technology, research and supportive government policy.

Conversely, direct heat use and GHP markets are in the early stages of development in New Zealand, though the technologies are mature overseas. Common to other countries, primary New Zealand market barriers are 1) high capital installation cost, 2) absence of market infrastructure, 3) lack of widespread consumer awareness, and 4) consumer confidence.

Arguably, awareness is the largest barrier to increasing the diversification of geothermal resource use in New Zealand. A study of New Zealanders' perceptions of geothermal energy use applications showed that generating power was the most commonly understood use of geothermal resources, but less was known of the direct heat use or GHP opportunities (Figure 4, Becker and Doody, 2011).

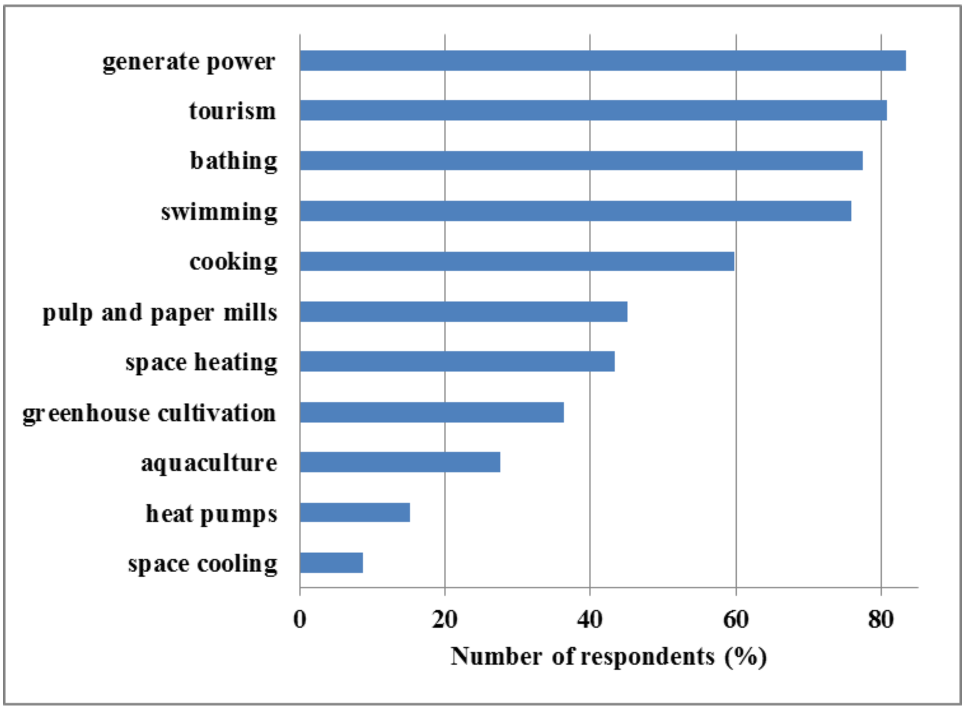

Figure 4. New Zealander's perceptions of uses for geothermal energy.

Potential initiatives to overcome barriers to increased use could include (Climo and Carey, 2011; Lind, 2011; EMS, 2011):

- Increased awareness of resources, applications and technologies
- Communicating and showcasing installations
- Availability of trusted energy advice
- Sound practise and quality standards
- The right technology in the right place, both market and location
- Focussing on high and growing energy demand areas
- Inter-agency collaboration
- Harmonised planning and policy regimes
- Collaboration with international organisations
- The development of a geoheat strategy that pulls all these elements together

3. DEVELOPING A GEOHEAT STRATEGY

There are a number of published international geothermal energy roadmaps which could inform the development of a geoheat strategy/roadmap for New Zealand (e.g. IEA, 2011; MIT; 2006; EREC, 2010). There is some international commonality in the barriers to growth of geothermal energy, and possible useful actions and angles to consider.

3.1 Scope and Structure

The authors propose that the New Zealand geoheat strategy be structured into four key areas (Figure 5):

1. Industrial use (large scale industrial processing, heating and cooling)
2. Electricity generation
3. Direct use (smaller scale heating/cooling) and tourism
4. Geothermal heat pumps

Industrial waste heat would not be included in the strategy. The focus of the document would be heat from the earth ("earth energy") and its use.

While each area will have its own aspirational targets, underpinning the strategy will be a shared vision across all sectors.

The proposed structure of the strategy is to develop a big picture forward plan for each of these four areas, broken down into shorter term (5 years), medium term (5-10 years) and longer term (10-30 years) initiatives to drive market development and growth. The big picture strategy document would be supported by a series of action/implementation plans.

It is not expected that the strategy for each area will follow the same format. Due to the differences in maturity of each area in New Zealand, different strategies and actions will be needed.

3.2 Key participants

The authors propose that the New Zealand Geothermal Association (NZGA), representing the broader New Zealand geothermal community would be the appropriate agency to lead the development of a New Zealand geoheat strategy. The four areas proposed align with NZGA special interest groups who could take the lead on developing a forward path for each area and coordinating consultation (Figure 5).

Participants and stakeholders could include:

- New Zealand Geothermal Association
- Geothermal generators / power companies
- Central government agencies (e.g. MBIE, EECA, NZTE)
- Geothermal New Zealand Inc.
- Regional and city/district councils
- regional development agencies
- Researchers
- Iwi / hapu
- Large scale industrial heat users
- Geothermal tourism operators
- Geothermal heat pump designers and installers
- Geothermal Heat-pump Association of New Zealand

4. CONCLUSION

With expected increases in energy costs, growing energy demand, social change towards energy and a drive towards climate-friendly renewable energy sources, a sound opportunity exists for increasing geothermal energy use in New Zealand.

The development of a geoheat strategy will bring together a range of agencies and stakeholders to advance the development of geothermal resources in New Zealand. The authors propose that a strategy be developed to guide shorter, medium and longer term developments in four key areas:

(i) industrial use,

(ii) electricity generation,

(iii) direct use and tourism and

(iv) geothermal heat pumps.

Economic, social and environmental benefits will follow from catalysed growth of geothermal resources in New Zealand.

The challenge is there for the New Zealand Geothermal Association to champion the development of a geoheat strategy for New Zealand. The next step is for a draft document to be prepared with the New Zealand Geothermal Association special interest groups having a key role.

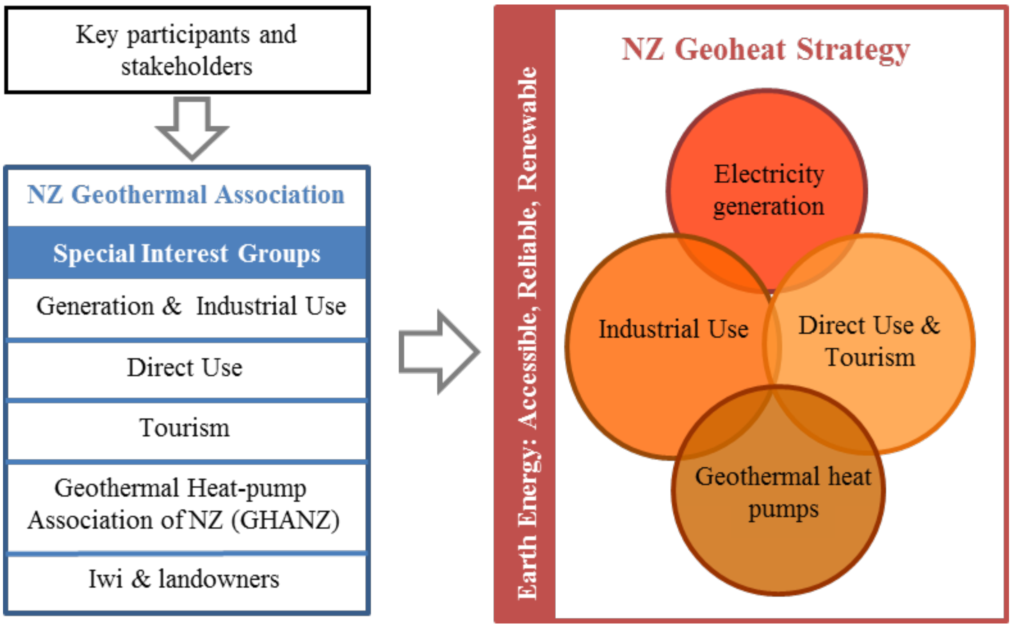

Figure 5: Proposed consultation and development process for a New Zealand geoheat strategy.

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