East Harbour Management Services Ltd
PO Box 11-595, Wellington
New Zealand
Tel: 64-4-474-2187
Fax: 64-4-473-9930
E-mail: brian.white@eastharb.co.nz
www.nzgeothermal.org.nz

1. Do you agree with the Commissioner's goal (for a fully renewable and efficient electricity sector) for New Zealand's electricity future? Is it achievable?

Firstly, we agree that "renewable" and "efficient" are words describing attractive features of a system, and many would want to identify with these.

The New Zealand Geothermal Association has not fully reached a consensus on "renewable" energy versus "sustainable" energy, particularly with respect to our geothermal resources.

Traditionally and legally, geothermal energy is counted as a renewable energy form, and on a long enough time scale there is no doubt that it is fully renewable. The PCE may have some difficulty with extraction of fluid at greater than initial recharge rate (and this is discussed later). The situation is moving closer to resolution with acceptance in the guiding Regional Policy Statements and Plans that use at greater than the short term recharge rate is appropriate, provided projects meet suitable sustainability criteria. In any case, the desire of all New Zealand geothermal developers is that resources be developed in a sustainable manner.

The following paragraphs are extracted from Environment Waikato's Regional Policy Statement reflecting the balance between geothermal energy's renewability and the position on sustainable management: "*Section 2 of the RMA defines energy produced from geothermal sources as renewable energy and section 7(j) requires particular regard to be had to the benefits to be derived from the use and development of renewable energy. These benefits include a reduction in the use of fossil fuels for electricity generation and hence a reduction in greenhouse gas emissions and its reliability independent of climatic conditions.*

Most energy sources generally classed as renewable are either essentially unaffected by use (solar, wind, wave, tidal) or take no more than a few years to recover their energy-producing capacity (hydro, biomass). However, extraction of the fluid and energy in a geothermal system beyond the natural rate of discharge depletes the usable resource found within the upper aquifers. Recovery of a severely depleted aquifer by the replenishment of fluid and energy from lower depths to a point where production can be resumed is expected to take tens or hundreds of years.

Extraction of energy from a geothermal system at a rate at which the energy source is renewed on a timeframe similar to that of biomass and hydro-electricity would mean that only extremely small developments could proceed. Much of the resource would therefore not be available for extractive use by current generations and the next few generations. Such a restrictive management regime would not promote sustainable management of the Regional Geothermal Resource.

However, the principles of sustainable management applied to the geothermal resources of the Region take into account a great deal more than the ability to extract

particular amounts of heat and fluid over a particular period, from a single system. From a Regional perspective, sustainable management can be promoted by balancing resource demands across the Region to provide for social, economic and cultural well being whilst avoiding, remedying, or mitigating adverse effects. Some systems will be allocated for efficient energy use and development whereas other systems will be protected from large scale use and development. This is the approach of this Section of the Regional Policy Statement, which sets out a range of classifications for geothermal systems."

We support the use of renewable/sustainable energy resources where these are cost competitive, and currently there is a considerable quantity of resources in this category. We do not necessarily support the goal of a fully renewable electricity sector if it would mean that we

a) are having to pay a premium (not reflective of costs including externalities) because of the non-use of thermal alternatives, or

b) face shortage because we do not want to invest in cheaper thermal options.

Electricity is a facilitator of industry and commerce. Shortage is unacceptable, as is excessive price for some energy intensive industries.

The term "efficient" is also up for discussion and is a relative term. The following paragraph is extracted from Environment Waikato's Regional Policy Statement: "*Efficient use of energy, as required by section 7 of RMA (1991), includes several dimensions: productive efficiency (output at a low cost); allocative efficiency (allocating resources to production that society values the most); and dynamic or innovative efficiency (where technological change is encouraged and used to produce productivity gains). Wasteful take and discharge lead to greater loss of heat and fluid than is required for the purpose. This is inconsistent with sustainable management and the principle of productive efficiency. Wasteful use can also occur, with geothermal resources being used in the place of more appropriate sources of heat, water, or minerals. This can deprive current and future generations of the ability to use the resource appropriately, and is inconsistent with the principle of allocative efficiency."*

Ideally, companies will use resources available to them as efficiently as their investment criteria will allow. In weighing up development options there will be tradeoffs between cost and performance (productive efficiency). It is not appropriate to aspire to choosing the highest performing plant at the cost of productive efficiency.

When weighing thermodynamic efficiency between differing technologies some are inherently inefficient. Often, with geothermal electricity generation, 1st law utilisation efficiency may be around 10 - 15% (i.e. 10 - 15% of incoming energy, neglecting the energy content in fluid reinjected, is converted to electricity output). This is in large part due to the relatively low temperature of geothermal resources, say compared to temperatures experienced in a boiler. As a result, the thermodynamics limits achievable efficiency (according to the Carnot Law). A simple move towards high generation efficiency would favour thermal generation over geothermal or solar generation, and the NZGA would not favour that.

Developers will always be looking for ways to improve productive and dynamic efficiency. It can be difficult to gain access to new resources, and it can be cost effective to look for further efficiencies in the process to gain more from the resource already accessed. Efficient use will be a goal within any ongoing development. This is typified by Wairakei where, after an initial development, flash plants were added, various minor refinements followed including replacement of some pressure reducing

valves with a steam turbine, and most recently binary cycle plant has been added to make use of some of the waste water.

We are supportive of moves that will maximise renewable or sustainable energy usage, including geothermal energy for both electricity generation and heating, and that will encourage appropriate investment in efficiency improvements (both demand and supply side), where these initiatives are economically justifiable.

As for the achievability of the "goal", we are doubtful.

Dealing with efficiency first, at what point would you say that we now have an efficient system? There will always be older portions of a system that could be more efficient. You cannot arrive at an "efficient" end point. Efficiency improvement is a continuing process and not a goal.

Where is the end point for renewability? If our thermal stations were shut down the result would look right in terms of the PCE goal. But there is value in having a diversity of supply for our security's sake. Similarly there is value in the option of firing up diesel generators in emergencies. Would having these on standby and occasionally being used count as having arrived at a renewable future?

In a comparison with other countries, we are already well down the renewable energy track, especially in the electricity generation sector. Current prices favour ongoing investment in renewable generation, including significantly more geothermal generation over the coming decades. The very low running costs of renewable energy forms means that these are not easily squeezed out of the system if thermal fuel prices were to drop significantly. Every new investment in renewable energy offsets thermal generation at least for the life of the renewable station.

2. **If not, can you explain why?**
   What aspects do you disagree with?
   Do you think that there should be another goal?

   See above.

   Perhaps the goal should be to ensure that all costs (including externalities) are fairly reflected in costs faced by generators and consumers.

3. **If you agree, would you say that you/your members operate in line with such a goal currently, are you/they working towards it or would you/they like to?**
   If you agree, but are unable to operate in such a way, what is it that is preventing you from doing so?
   Is it cost, availability, knowledge, other priorities?

   Most of the NZGA members would count geothermal energy as a form of renewable energy and are seeking opportunities to maximise its use.

   As outlined above, major developers are always looking at efficiency of use with a view to identifying easy gains from better use of hard-won resources.

   Much of the current focus is on electricity generation, but geothermal energy can also contribute on the demand side. A small number of members are now focussing on the direct use of geothermal energy.

While conversion efficiency for electricity generation is of the order of 10-15%, the conversion efficiency for direct use is around 50%. When geothermal heat pumps are considered (and these can be installed almost anywhere) then around 7 units of heat can be generated from 1 unit of electricity.

Difficulties with direct use are focussed on knowledge gaps. There are no current costed case studies. There are no comparative studies between geothermal options and competing technologies. There is no network of users. People do not know who can install these systems. Few of the low temperature geothermal areas (outside the Taupo Volcanic Zone) have been accurately quantified in terms of capacity.

As geothermal heat pumps are essentially another variant on solar heating (working with a mean ambient condition), we would hope that these systems are eligible for solar incentives. That does seem to be the intention, at least for the purposes of heating water, though heat pumps would normally be considered for space heating.

Overall, geothermal direct use systems are capital intensive, and this can be discouraging without incentives. New Zealanders are not used to investing for the long term. Many New Zealanders occupy their homes for around 7 years so would not consider an investment with a payback period of that length or longer. If the value of energy investments were captured and turned into capital value through a recognised home rating system then that could provide an incentive towards long term investment.

Is there a market model that would facilitate domestic investment in efficiency or renewable energy based on the hurdle rates and periods considered by utility scale investors? Is there room for service companies to install equipment in a host site in return for an agreed payment over the life of that asset? Maybe this service company model should be a state-owned and operated venture until the private sector recognises the value.

4. **From your perspective or that of the organisations/individuals that you represent, what would have to change at a national level to enable you/them to support the goal?**

Renewable/sustainable energy will be installed nationally when the price is right, and it currently is right – for the better geothermal, wind and hydro sites. It seems that funding for various projects (particularly smaller projects of a distributed generation nature) could be easier if there were authoritative views on future price path sufficient to give bankers confidence to provide project finance.

At the direct heat level, we receive numerous queries about incentives available for demonstration projects – currently there seem to be none.

There are conflicting views on the Resource Management Act. One major developer is very comfortable with the current practice. Others see room for improvement in the process as they regard it as causing unacceptable delays – the statutory timetable is rarely met for major projects. Some NZGA members have expressed dissatisfaction with the resource allocation mechanism as they perceive it discourages new entrants. Unlike the case for minerals, the lack of prospecting and exploration licences for geothermal leads to reluctance on the part of generation companies to undertake research or to make information publicly available. There is concern that another developer is free to apply for resource consents for the resource, freeloading on the prospector, whereas for minerals, the prospector has exclusive rights for some time.

All parties recognise that reasonable controls on emissions are required and the aims of the RMA are not disputed.

Obviously some form of carbon charge would benefit renewables (including geothermal energy) in terms of possibly extending the period before new thermal stations are needed through bringing more renewables under the hurdle price. Geothermal stations will be penalised by such a tax, to a greater or lesser extent depending on their specific gas emissions (which cover a wide range per MWh), but NZGA members are prepared to accept a carbon tax as an equitable mechanism and we have previously made submissions as to how it should be applied to geothermal. However, all consumers will face a higher electricity price reflecting the fact that thermal generation will still be required and will remain part of the energy mix, at least over the next few years.

5. **From the perspective of a user, (personally or on behalf of the organisations you represent) do you feel that you/your members have an ability to choose your/their electricity and energy options?**
   If not, why do you think that this is the case?
   How could it be changed?

   As a user, we have to accept whatever electricity is flowing through the lines. We recognise we can switch retailers. Switching from one retailer to another changes nothing directly in terms of the generation mix, in the absence of some differential pricing depending on source.

   Similarly, we recognise that there are alternative forms of energy, say for space or water heating, which can be accessed through considerable capital expenditure.

6. **The so-called 'demand side' is often the forgotten half of the Supply-Demand equation that balances our energy market. As a user (or a representative of users) in this 'demand side', what potential role do you see from demand side measures, such as load management and improved end use energy and electricity efficiency, for supporting a transition to fully renewable and efficient electricity sector?**
   What incentives would it take, do you think, for you/your members to adopt demand side measures?

   The major demand side measure that is appropriate in this context is to favour direct use of geothermal energy where possible.

7. **Several aspects of the goal already appear to be operational internationally (see attached information). What is it in your view that seems to be stopping New Zealand from actively pursuing operational strategies now?**
   How could this change?

   Some renewable energy investment is happening now because the price is right. A large quantity is expected to be priced below a hurdle price set by an Otahuhu C combined cycle plant.

   Investment in improved efficiency is happening now.

   However, it is true that other countries are doing much more than New Zealand to support renewable energy, through:

   - Mandated preferential power purchase prices and other market mechanisms

- Mandated renewable targets
- Carbon emission taxes or trading
- Direct subsidies
- Tax concessions
- Drilling success guarantee programmes
- Streamlined planning and permitting procedures
- Research funding
- Direct support to promote investment through collation and promotion of resource information, such as is currently being done by Crown Minerals for petroleum and minerals but not geothermal
- Support for industry associations, information and training
- Support for international technical linkages

Some geothermal and other renewable energy will happen without such incentives, but adoption of a number of these could facilitate earlier development.

8. Are there other issues in relation to an environmentally sustainable energy/electricity future that you would like to raise? If so, please provide them here.

See comments above.

We are concerned about what could be inferred from the statement in your letter "An environmentally sustainable electricity sector must be based on renewable sources of energy managed within their natural rates of replenishment".

In the case of geothermal resources, there are natural levels of recharge. Systems start in a state of equilibrium. The process of development disturbs the geothermal reservoir and creates a new level of natural recharge. In the case of Wairakei the drawdown of pressures over the early years is well known. However, various studies have shown that a new level of mass balance was achieved after a period. The natural rate of replenishment adjusts to new pressures within a reservoir[1].

As yet, after nearly 50 years of operation at Kawerau and Wairakei, there is still no case of fields being run to exhaustion. There have been operational difficulties at Ohaaki, but the field is not exhausted and is now being managed in a way that ensures ongoing operation at a sustainable level. Some thoughts have been developing around the long term management of fields, say with a view to resting fields for similar periods to which they have already been used. While fields will never be exactly the same as they were (geothermal fields are dynamic in nature anyway) pressures and temperatures are expected to return asymptotically towards their original condition over this sort of period.

To restate these two points, geothermal resources can be operated sustainably at greater than initial natural replenishment rates:

- Because their disturbance induces a new sustainable replenishment rate, and
- Because long term cycling can restore near-original conditions in historic rather than geologic time.

There is also a need to balance renewable energy options with environmentally responsible actions. As an example, the Ohakuri hydro development was a

[1] Some people are uncomfortable with reference to this as natural recharge, seeing it as induced recharge. We concede that the reservoir will be disturbed, but the source of recharge is from the natural environment.

renewable energy project, but resulted in the drowning of many of the Orakei Korako geothermal features. Admittedly, this sort of action would not be allowed today, but there may be times when it is preferable, and environmentally responsible to have a thermal power station than face losses to our natural environment.