

AN UPDATE ON GEOTHERMAL ENERGY IN NEW ZEALAND

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ABSTRACT

The New Zealand geothermal scene is currently very active. There has been recent installation of new generation, with more generation being planned and prepared for. While direct heat use has been relatively static, some market leaders are now installing geothermal heat pumps, and this looks like an area for considerable growth. Various regional and district councils have been, or are in the process of clarifying the rules and policies related to takes of water. Central Government remains philosophically dedicated to the greater use of renewable low-emission energy forms (including geothermal energy), but is now trying to clarify its wider energy strategies and means of encouraging further uptake of renewables.

Key Words: policy, geothermal energy, New Zealand, electricity generation, direct heat use, geothermal heat pumps, consents.

1. INTRODUCTION

Geothermal energy can be found in high temperature fields in the Taupo Volcanic Zone and Northland (suitable for both power generation and direct use); medium/low temperature fields mainly located in the upper North Island or throughout the Southern Alps (potential heating applications); or low temperature resources at shallow depths anywhere in the country (suitable for ground-source heat pump applications).

Among the various renewable resources available to New Zealand, geothermal energy is the only resource that can directly supply both heat and electricity, and has become increasingly competitive, especially as thermal fuels have increased in price and exchange rate improved. It is independent of climate and is the only renewable energy source that can provide long term reliable base load electricity generation.

The installed capacity of geothermal electricity generation in New Zealand is currently 450 MWe, or about 5% of the total capacity, plus about 7 PJ per year in direct heat largely at Kawerau. Geothermal generation can meet 7% of peak demand, and typically produces 6% to 8% of total generation.

New Zealand companies have recently been gearing up for increased investment in the domestic market. Initial focus is on further development of existing operations, but some preparations are in hand for "greenfield" developments. Figure 1 shows the increase in drilling as a precursor to these developments. Industry participants consider between 400 and 600 MWe of new generation could be constructed over the next 10 years, allowing for a wide range of restrictions and conservative behavior.

There are several companies with experience in geothermal power development in New Zealand (for details refer to the 2005 SKM report). Two companies that are frequently mentioned in this paper are Contact Energy and Mighty River Power. Contact Energy is an electricity generator, and electricity and gas retailer with a mix of generation assets that include hydro, gas, cogeneration and geothermal. Contact Energy was split from the national electricity corporation in 1996 and given the major geothermal generation stations and their staff, and was subsequently fully privatised. The majority shareholder in Contact Energy is Origin Energy of Australia, with the rest of the company freely traded on the New Zealand stock market. It operates the Wairakei, Poihipi and Ohaaki geothermal power stations, has resource consents over Tauhara and a landholding at Mokai. Its recent geothermal focus has been on renewing consents for its existing operations, managing relationships with other operators on the Wairakei field, drilling makeup steam supplies, developing a binary cycle plant at Wairakei and participating in the development of the Environment Waikato geothermal plan and policy statement.

Mighty River Power is one of three state-owned enterprises (SOEs) created from the final breakup of the national electricity corporation in 1999 following the Electricity Reform Act 1998. By that time the corporation had developed new geothermal projects and these were largely vested in Mighty River Power. The company has a range of generation assets, of which the principal assets are the string of hydro stations on the Waikato River.

However it is the only SOE to develop a geothermal business case and to subsequently establish a significant team to progress these projects. Given that the Government has a policy of non-sale of Crown assets, and wants to see its legacy geothermal wells developed, and can transfer assets to an SOE without effecting a sale, this makes Mighty River Power the developer of Crown geothermal assets (subject to fulfillment of Treaty of Waitangi obligations, as explained later). Mighty River Power has a 25% share in the Tuaropaki Power Company, and Operations and Maintenance contract for Mokai development. Mighty River Power also owns the Rotokawa geothermal power station (having purchased it from another developer in 2000), has a half share in the steamfield company and has the Operations and Maintenance contract for that facility. It has further interests at Kawerau including Operations and Maintenance contracts and a planned development.

Mighty River Power's geothermal business case was based around the exploration and development of a number of geothermal fields. In practice, the company has had difficulty in securing land access for developments, after some initial successes. This has meant that the company has had to interrupt an active drilling programme and release rigs back overseas.

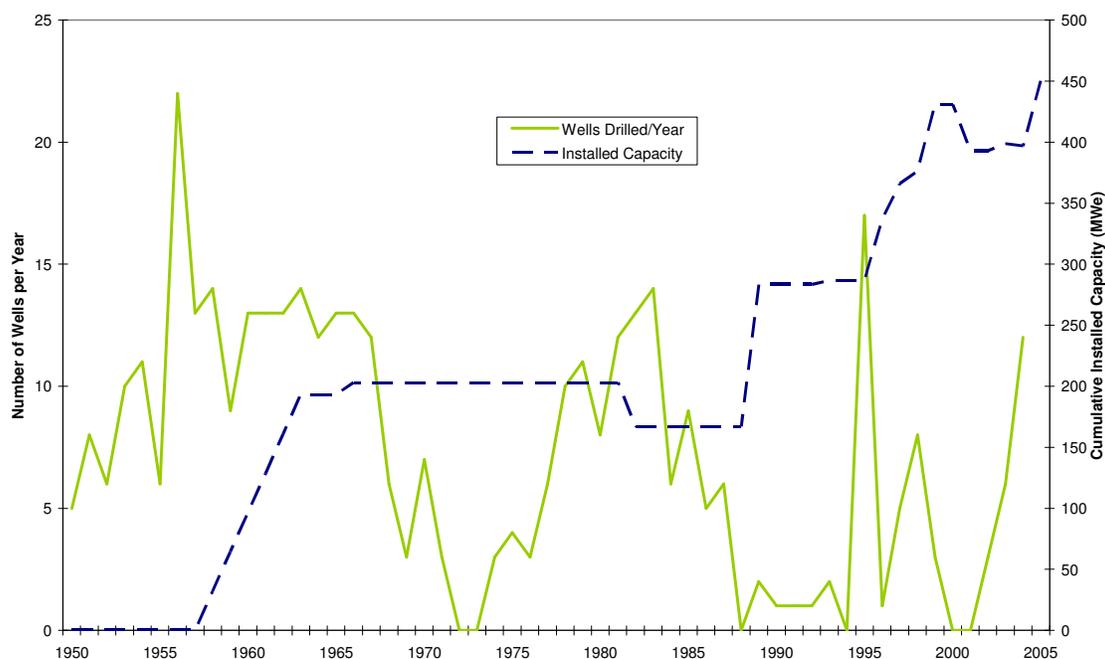


Figure 1: Historical Drilling of Geothermal Wells in New Zealand

2. CENTRAL GOVERNMENT ISSUES

In February 2002 the Government issued a report entitled “Growing an Innovative New Zealand”. This report contains an umbrella policy for government action. Broadly, what the Government wants “Economic Transformation” to a knowledge-based economy to lift New Zealand’s standing relative to other OECD countries. The two key aspects for building an economy capable of sustaining the higher growth rates needed are a) a strengthening of foundations (including critical infrastructure such as our electricity generation and transmission system) and b) building more effective innovation.

This Economic Transformation policy requires wide cross-government consultation. While each initiative has a lead Ministry, officials from a wide range of Ministries will be active members of each project. There is an emphasis on Whole-of-Government positions that can help eliminate confusion at policy implementation level.

There is an emphasis on sustainable growth and development. This flows through to sustainable programmes of action for such issues as energy and water, both of which have an impact on geothermal development. Energy has been identified as one of the target areas for sustainable development because of its strong correlation to economic growth, potential environmental impact, and because both consumers and industry are heavily reliant on its supply. The major objective of the programme of action for energy is to ensure continued delivery of energy services to all classes of consumer in an efficient, fair, reliable and sustainable manner. Three desired

outcomes are that energy use in New Zealand becomes progressively more efficient and less wasteful, renewable sources of energy are developed and maximised, and New Zealand consumers have a secure energy supply.

Over the last two decades, New Zealand's energy policy has been marked by a commitment to light handed regulation and to ongoing government monitoring and review. However, new and ongoing security of supply and environmental issues (there have been three wholesale electricity market price crises brought about by low hydro inflows and thermal fuel issues since 2001) have necessitated ongoing policy development and government action. This was summarised in a Government Policy Statement on Electricity Governance issued in October 2004. The establishment of the NZ Electricity Commission, the 155 MWe reserve power plant and the Gas Industry Company to provide regulatory oversight to industries that had previously been left to self regulation are recent results of this.

There has been a long term emphasis on promoting energy efficiency and further increasing the amount of energy produced from renewable resources reflected in the establishment of the Energy Efficiency and Conservation Authority (EECA) as a Crown entity in 2002 to assist with the implementation of the National Energy Efficiency and Conservation Strategy (NEECS) announced in 2001. This strategy had a 5 year term so has been actively reviewed over this last year. The strategy included the specific goals of improving energy efficiency by 20% and increasing consumer energy from renewable sources by 30 PJ by 2012 over levels recorded for the year 2000. Progress has been limited so it is likely that the specific goals will be revised. Perhaps more significantly, it has been recognised that incentives for action by industry have been inadequate. Consultation will soon identify a range of incentives and controls that might assist achievement of the new goals.

In addition, on 8 November 2005 the Prime Minister announced plans to develop a formal, comprehensive New Zealand Energy Strategy (NZES) which is expected to be released in its final form during the first quarter of 2007. This comprehensive strategy will closely link with the revised NEECS and so is likely to force a delay in implementation of the revised NEECS until after the NZES is finalised. The NZES will be addressing wider policy issues and industry frameworks than the NEECS.

Climate change initiatives are subject to major review. New Zealand ratified the Kyoto Protocol in December 2002 following the enactment of the Climate Change Response Bill. Key elements of the climate change response included a carbon emission charge, negotiated greenhouse agreements (NGAs) for at-risk industries and a bid-in Projects mechanism. Through to the end of 2005, several large industries had negotiated NGAs and a number of renewable energy projects (including geothermal projects) had benefited from the Projects carbon credits. In June 2005, following a revised projection of New Zealand's greenhouse gas emissions during the Kyoto first commitment period, a full review of climate change initiatives was commissioned (MfE 2005). The results of the cross-departmental review were announced in December 2005: the review questioned the true benefits of the overall climate change policy package.

Climate change initiatives were impacted by the election of a new Government in September 2005. This was a Labour-led minority government, as it had been for the previous term. Political power and direction are maintained through a series of agreements between the Labour party and coalition partners and other parties. One of the implications of the new balance of power was that it was no longer expected to be possible to pass legislation related to implementation of a carbon charge, so this portion of the climate change package has been dropped. It is still possible that a limited form of carbon charge may be suggested for the electricity industry, in which case it may negatively impact on geothermal generation.

Many parts of this paper refer to consents which are necessary for development under the Resource Management Act 1991 (RMA). The RMA is an all-encompassing environmental act that attempts to apply reasonable constraints on development, with delegation of decision making and plan/policy statement development down to regional and district level. Support and concerns about the RMA and its implementation have been expressed by a wide range of interests since 1991. As a result, the RMA has been reviewed and amendments (of a fine-tuning nature) have been made. One amendment passed in 2003 specifically encourages positive consideration of renewable energy projects (including geothermal projects). Following a review in 2004 -2005, amendments were made to address concerns about the balance between national and local interests and the allocation of natural resources. Work was also initiated on providing national guidance on infrastructure issues. The Ministry of Economic Development is currently scoping a National Policy Statement and National Environmental Standards on transmission lines and will shortly consult on generation. The results of these consultations should flow through to the implementation of regional and district plans and policy statements developed under the RMA. Eventually these plans and policy statements will be revised to reflect direction given at the national level.

Taxation provisions can sometimes create unnecessary hurdles to development and the Government has attempted to avoid these. Inland Revenue has clarified its policy on geothermal well depreciation following consultation earlier this year. This allows depreciation of all wells and the ability to write wells off if they are deemed unsuccessful.

The Government recognises that a range of incentives are needed to encourage generation. Several of New Zealand's previous geothermal (and other renewable) power developments were either developed with generation fed directly into local electricity distribution networks or directly funded by these networks. The Electricity Industry Reform Act 1998 implemented a wide range of reforms including an enforced separation between line and energy functions (with some minor exceptions) in the interests of encouraging competition in generation and retail. Line companies were forced to sell their retail customer base and their generation to pure energy companies. In the process some of the small scale (up to 50 MWe) generation opportunities that may have happened with distributor funding have not proceeded. Some of the rules have been relaxed over the last two years. The Ministry of Economic Development is currently consulting on behalf of Government on more liberal rules related to line companies and their ability to both own generation and to retail electricity. The Ministry has also been consulting on new regulations designed to encourage distributed generation into line company networks and is now proceeding to draft these regulations. The regulations have the objectives of providing a greater measure of certainty for investors, assurances to line companies and arbitration procedures for dispute resolution.

New Zealand has a good race relations reputation, but there are historical grievances held by the indigenous Maori population. The Treaty of Waitangi was signed between the Crown and Maori representatives in 1840 establishing certain rights and obligations between these parties. Efforts are now being directed to full and final settlements of all claims. The Treaty is of particular interest to the geothermal community as there are several claims with the Waitangi Tribunal related to geothermal resources. Claimants have the option of either proceeding with a Tribunal hearing (a long and resource-intensive process), or omitting this step and proceeding straight to negotiation with the Crown. In June 2003 a Deed of Settlement was signed between the Crown and Ngati Tuwharetoa (Bay of Plenty) which, amongst other things, provided the iwi a right to purchase the Crown's Kawerau geothermal assets if they were to be sold. In practice, this option was taken up and assets were sold in July 2005.

By 2003, the Crown owned around 100 geothermal wells drilled in the 1960's, 70's and 80's under previous government exploration policies. The Crown has signalled its interest in the development of its geothermal assets and has identified the State Owned Enterprise (SOE) Mighty River Power as the developer. Any transfer of the Crown's assets to an SOE would need to ensure that the Crown's Treaty obligations are fully met. The majority of the Crown wells are located on private land, but are still maintained by the Crown.

The Government regards geothermal energy as being a resource that can play a vital role in New Zealand's future energy mix. Cost of development is very similar to the cost of a range of other technologies and resources and the current wholesale cost of electricity at around 5 USc/kWh. Consequently commercial drivers will see a significant uptake of geothermal energy, provided access and regulatory barriers are not overly constraining.

3. ENVIRONMENT WAIKATO ISSUES

Geothermal resources are scattered in many regions of New Zealand, but it is thought that 80% of New Zealand's high temperature geothermal resources are located in the Waikato region administered by the Waikato Regional Council (also known as Environment Waikato).

Environment Waikato recently suggested changes to both its Regional Policy Statement and its Regional Plan on geothermal issues. These potential changes have been appealed to the Environment Court with a wide range of appellants seeking amendments. While details will not be covered here, all parties recognise the significance of the geothermal resources under Environment Waikato's influence and the importance of clear policy and plan direction.

The appeal process has been interesting in that there has been considerable effort by all parties to reach a negotiated settlement prior to formal hearings, after what started as an adversarial situation. This has seen co-operation between government departments with possibly conflicting responsibilities for development, conservation and renewable energy, and has seen similar co-operation between developers, other interested parties and Environment Waikato staff.

Two issues related to injection policy and a policy of having a single operator on a field were placed on an accelerated path for Environment Court consideration, because of the direct effect on specific resource consent applications which are under appeal and have been in process since 2001. The judge's decision released on 13 April 2006 gave great weight to community concerns over subsidence and hydrothermal eruptions and considered that injection of waste water could be used to manage these effects, while also providing other possible reservoir benefits if flexibly managed. He thought that specifying a single operator on a field was an overly restrictive means of managing potential competition on a resource and achieving sustainable management. Consequently, Environment Waikato was directed to rewrite those parts of their plan and policy statement related to these key issues.

Meanwhile Environment Waikato was in arbitration over a wide range of other issues arising from changes to their policy and plan documents with a view to resolution prior to an Environment Court hearing of all outstanding issues scheduled to start in August 2006, while also preparing for appeals to the Environment Court related to consents for both the existing Wairakei geothermal stations and a second appeal related to a new Wairakei project. This left the limited number of Environment Waikato staff with an excessive workload to achieve a quality result. Other parties have been proactive in providing additional resources to help Environment Waikato draft changes to its Plan and Policy Statements.

The end result should be a well-considered Regional Plan and Regional Policy Statement that allows further development of a large portion of New Zealand's under-used geothermal resources and enhanced protection of significant geothermal features.

4. CURRENT AND FUTURE POWER DEVELOPMENTS

4.1 Wairakei Power Stations

The original Wairakei A and B Stations commissioned between 1958 and 1963 continue to operate reliably. In 2005 a 14.4 MWe Ormat binary cycle station was commissioned near the original stations to take advantage of water brought down to the area for reinjection purposes. This brought the total output of the combined facility to 171 MWe. The station and steamfield are owned and operated by Contact Energy who has recently been offering only 157 MWe into the market. This is because there has been a developing shortfall in steam supply over the last 2 or 3 years, but Contact has been drilling in the Te Mihi sector of the field, including a number of successful wells that will shortly be connected to fully load the station. The station and steamfield continue to discharge some brine and all condensate to the Waikato River, though about 1/3rd of all fluid from the steamfield is now reinjected.



Figure 2: Location of High Temperature Fields in New Zealand

A further 55 MWe station was built by independent interests (the land owner Alistair McLachlan, and Mercury Energy) in 1996 on the western side of the Wairakei field (on Poihipi Road). This Poihipi station has subsequently been purchased by Contact Energy. The station takes advantage of a shallow steam zone in that part of the field. The original consents under which the station still operates are restrictive and do not allow full output. Hence the station tends to operate in day-night mode to maximize revenue recently offering 29 MWe during the day and evening and 10 MWe in the early morning and typically averaging about 25 MWe output on any day. All of the condensate from the station is either evaporated through the cooling tower or reinjected.

Recently, Alistair McLachlan (through the Geotherm Group) has proposed a further 55 MWe power station on the Wairakei field. Geotherm has obtained consents (which have been appealed), has purchased its own drilling rig and has commenced drilling on land owned by McLachlan.

Development and operational consents have been an issue for both Contact Energy and Geotherm. Contact Energy has been in the process of renewing consents for the operation of its existing facilities for several years, with formal consent applications lodged in 2001 after consultation and studies. Consents were granted in 2005 that allow the existing A and B stations and a fully-loaded Poihipi station to continue operation until 2026. These consents were appealed and have been referred to the Environment Court. The current Court schedule will see evidence and rebuttals being provided by various parties from the end of June and through August and formal hearings beginning in September 2006.

Aspects of the Geotherm consents have also been appealed. Evidence and rebuttals will happen in parallel with Contact Energy, but the Geotherm hearing is not scheduled to begin until November 2006. While Geotherm is proceeding with some site work and drilling, it is expected that EPC contracts for station and steamfield will await the end of the appeal process.

It should be noted that there are a number of direct heat applications cascaded from the Contact Energy operation at Wairakei. One company (NETCOR) receives brine for a tourist centre that includes a Maori village and a replication of natural silica terraces. A nearby hotel receives steam for heating. A prawn farm beside the A station receives brine for heating pond water. The prawn farm supply had to be modified following the installation of the binary plant which cooled the brine supply to the farm. The brine from the prawn farm is subsequently discharged to the Waikato River.

The Geotherm interests use a separate steam supply for heating greenhouses growing orchids.

4.2 Tauhara Developments

The Tauhara geothermal field is connected with the Wairakei field and is affected by the exploitation of Wairakei. The Wairakei development and operation is contributing to the observed subsidence at Tauhara. In the process of Wairakei consent renewals, and in the discussions and appeals around Environment Waikato geothermal plan and policy statements the local Taupo community has developed a greater sensitivity to the subsidence issue. This has led to strong community reaction to proposed or continued operations, and some claims of property damage due to geothermal withdrawal at Wairakei, when there is evidence that other non-geothermal causes are also involved. Nevertheless, concerns have to be taken account of in any consenting process. The recent Environment Court decision (April 2006) on injection-related aspects of the changes to the regional plan and policy statement has given further weight to these subsidence concerns.

Despite these concerns, the geothermal resource under Taupo continues to be used for direct heat applications, generally without deep reinjection, and Contact Energy has just undertaken some deeper drilling into the Tauhara field (one production well and two injection wells) with a view to using currently held consents to take fluid equivalent to a 20 MWe development. Contact is now in the final stages of commissioning a direct heat supply to a local timber drying operation.

4.3 Ohaaki Power Station

Contact Energy continues to own/operate the Ohaaki power station and steamfield originally commissioned in 1989. While the station continues to have a nominal capacity of 100 MWe following recent decommissioning of HP sets, its actual output has dropped from a recent peak of 37 MWe in July 2004 to 30 MWe or less in recent months. Contact now thinks of the station as a 45 MWe (net) station and will be maintaining a drilling programme to keep the station at that capacity. Contact is aware that it is difficult to bring in drilling rigs into New Zealand and maintain experienced crews so has a programme of drilling covering Wairakei, Tauhara and Ohaaki that will retain rigs and crews in the short term. Three production wells have been drilled at Ohaaki in recent months. Contact successfully renewed consents for the station and steamfield in 1998 allowing continued operation for the next 15 years.

All geothermal fluid produced by the field (Broadlands) is lost in cooling tower emissions, discharged onto land (where there were previously natural surface discharges) or is reinjected. A small quantity of brine is used by the Ohaaki Timber Kilns in a direct heat application.

General operations at Ohaaki have been restricted by management of reinjection returns and cool fluids encroaching from the field margins or above, and by concern over the possibility that subsidence could lead to flooding of important Maori cultural sites by the Waikato River.

4.4 Rotokawa Power Station

The Rotokawa power station is an Ormat geothermal combined cycle power station initially developed in 1997 at 29 MWe, but subsequently expanded by 6 MWe in 2003. The expansion included further brine units to take advantage of the changing fluid conditions within the field. The Rotokawa project is divided into two companies; Rotokawa Joint Venture (a 50:50 joint venture between Tauhara North No.2 Trust and Mighty River Power) which owns the steamfield, and Rotokawa Generation (100% Mighty River Power) which owns the generation plant. Mighty River Power operates both the station and the steamfield.

Between October 2004 and February 2005 Mighty River Power drilled three deep reinjection wells to test the western side of the Rotokawa reservoir, and to help relieve the current shallow injection target. At least one of these wells is now used as an injector. In the process, other structures were observed in the area that may form production targets at some future date.

The Rotokawa field could potentially support more than 250 MWe of generation, and Mighty River Power has expressed interest in developing an initial 100 MWe, including the existing development. An application has

been filed by Tauhara North No 2 Trust for a further 35 MWe. Adjacent land owners over the resource have indicated clear interest in development of the geothermal potential.

4.5 Mokai Power Station

The Mokai power station was commissioned in 2000. It is the first in New Zealand to be fully owned by a Maori trust (the Tuaropaki Trust which subsequently placed assets in the Tuaropaki Power Company), with Mighty River Power contracted to operate and maintain the Ormat geothermal combined cycle station which has installed capacity of 55 MWe. Mighty River Power has recently bought a 25% share in Tuaropaki Power Company. All condensate and cooled brine is reinjected. A 39 MWe expansion of similar design was commissioned in 2005 and operates in parallel with the initial station, and a large geothermally heated glasshouse complex has been developed nearby.

There is a steamfield management committee that meets regularly, and includes a Contact Energy representative. Contact Energy has land interests over part of the Mokai field with a view to a possible further development of their own, but no firm proposals are known.

4.6 Mangakino Exploration

Mighty River Power made progress in the Mangakino area through land negotiations with a large commercial forester, and so undertook further geoscientific work (including new MT-TDEM data) backed up by three deep wells (and a redrill), all with a view to a possible power station. The wells have confirmed temperatures exceeding 250°C, but have failed to identify permeability targets. Currently the project is not being pursued.

4.7 Kawerau Developments

The previous list of fields are all located in Environment Waikato's region while the Kawerau field is located in Environment Bay of Plenty's region and is covered by a different regional policy and plan. The Kawerau field was initially developed in parallel with Wairakei through the 1950's for a direct heat supply to the Tasman pulp and paper mill, and this use continues. The Tasman mill installed its own 10 MWe geothermal back pressure turbogenerator in 1966. The new owners of the mill (Norske Skog) invested in a replacement turbogenerator which was commissioned in 2004.

There have been no known changes to the existing Bay of Plenty Electricity Ormat generators located on either side of the Tarawera River. These were installed in 1989 and 1993 and generate a total of 6 MWe into the local network using a portion of the otherwise unused brine associated with the mill steam supply. Bay of Plenty Electricity has expressed interest in further development of generation on the Kawerau field. Currently about half of the brine is not used and much of it is discharged to the river.

Ownership of various aspects of the Kawerau developments has changed over the years. Some of the wells and steamfield system had been developed by the original owners of the mill, but were sold to the Crown in the late-1970's. As of 2005 the Crown owned 102 wells on many fields along with the Kawerau steamfield development and the steam supply contract with Norske Skog Tasman. The Crown signalled its interest in the development of its geothermal assets and identified Mighty River Power (a state owned enterprise) as the developer, partly because of a Government policy on non-sale of assets. As a first step to active development, in July 2005 the Crown transferred all Kawerau geothermal assets including wells to Mighty River Power. In a back-to-back deal, these assets were onsold to Ngati Tuwharetoa Geothermal Assets as the holding company for some local Maori interests. Mighty River Power now operates and maintains the assets on behalf of NTGA. Several very productive wells were transferred to NGTA in the process, so NGTA is now considering further development options.

To the east of the mill is another large Maori land block under the management of the Putauaki Trust. The Trust was aware that there was a possibility of part of the Kawerau geothermal field underlying their property, so sought expressions of interest for geothermal development from several parties. A contract was signed with Mighty River Power to explore and possibly develop a power station using the resource and this has been progressed since 2003. Mighty River Power undertook further MT-TDEM and gravity surveys in the eastern part of the field to help delineate the productive reservoir and followed this with 6 deep exploration wells into the greywacke basement. In August 2005, Mighty River followed this with a resource consent application for what is expected to be a 70 MWe power station (and possible downstream uses) and steamfield to be located on Putauaki Trust and Norske Skog Tasman land. While consents (with conditions) were granted in March 2006 for 35 years, these were subsequently appealed by other industries located over the field so development is currently stalled.

A steamfield management agreement has been entered into by Mighty River Power, Norske Skog Tasman and Ngati Tuwharetoa Geothermal Assets with a view to ongoing sustainable management and integrated development of the Kawerau resource.

4.8 Ngawha Power Station

The Ngawha field is located in Northland. The Ngawha power station was commissioned in 1998 and is also an Ormat binary cycle station nominally 10 MWe and intended as a first stage to a much larger development. A resource consent application was made for a 15 MWe extension in 2005 but was turned down because of concerns over possible effects on the local springs used for bathing. The owner of the Ngawha station (Ngawha Geothermal Resource Co, a subsidiary of Top Energy) subsequently gained consents to operate a temporary supplementary injection trial (with up to 10% extra surface water being injected) to show effects on the springs could be avoided and this trial has been successfully completed. Top Energy is now preparing to advance its appeal of the 15 MWe proposal through the Environment Court.

Top Energy is a lines company, and so there are limitations on its ability to generate electricity under current legislation (an arms-length company may have to be formed to own and operate this larger station). Relevant laws are currently being considered for revision by Government, and this may assist Top Energy in its goals.

4.9 Other Development Possibilities

Several parties have expressed interest in other geothermal developments. These are still at concept stage though it is known that Maori interests on the Tikitere field near Rotorua have been undertaking some more detailed studies. The developers are likely to be interested in a development of limited size as they also operate a well known geothermal tourism site (Hells Gate) and would want to limit possible effects on that operation.

Mighty River Power is known to have undertaken some scientific work at Atiamuri and Horohoro fields (Dunstall 2005).

5. COMMENT ON GEOTHERMAL DIRECT HEAT USE (INCLUDING HEAT PUMPS)

Dunstall (2005) reported that the direct heat use scene in New Zealand has been quite stagnant for the last decade, and this is correct.

A difficulty exists because there is no central database on direct heat usage. Estimates vary by a factor of two depending on the information sources. All data sources appear incomplete and one may have double-counted New Zealand's largest geothermal direct heat user (the Norske Skog Tasman pulp and paper plant at Kawerau). NST by itself was thought to use 5,500TJ/year out of a total use of between 7,400 TJ/year (Dunstall 2005) and 14,000 TJ/year (MED 2006).

The New Zealand Geothermal Association has commenced a study on direct heat use to get a better assessment. This project involves contact with various regional councils who might collect data and of some major users, starting from a list of all known thermal areas and springs in New Zealand. This initial project will be completed by July 2006. Step outs from the project could include the development of a comprehensive database, a report on practices and costs, and identification of source material for case studies.

One difficulty found is that few users have a clear assessment of their own use, with measurements being rare unless on a large scale or if required by local councils as a condition of consents.

The study has identified some of the first users of geothermal heat pumps. While one early example is known from the 1960's, NZGA has noted a growing number of enquiries driven by the recent increases in electricity price. Some early adopters have been identified in the study, and one engineer has reported that he is now very busy in designing and installing equipment in various parts of the country. Two specific examples are known of in Hamilton and Blenheim, neither of which are usually regarded as geothermal areas. Equipment for heat pump installations is typically imported from China. These are very initial steps, but the New Zealand public is barely aware of the possibility of heat pumps. Even air-source heat pumps are still relatively rare. NZGA is interested in producing reports on heat pumps including case studies to encourage their uptake in New Zealand. Some basic research is needed on soil properties in various parts of the country to assist uptake.

The direct heat use survey has also identified a case of use of a non-conventional source of geothermal energy for direct use. A swimming pool in the Taranaki area is partially heated by warm water from an abandoned oil and gas well. The Taranaki pool draws 27°C water from a 1000m deep well then boosts it to operating temperature using reticulated natural gas. One New Zealand scientist (Agnes Reyes) has reviewed abandoned

oil and gas wells and has found temperatures up to 180°C just based on the natural geothermal gradient in non-geothermal areas. Clearly these wells have an energy potential beyond their expired oil and gas potential, but more research is needed to see what use can be made of these wells.

6. TRENDS IN RESEARCH AND DEVELOPMENT

Over the last year there have been a number of sponsored meetings looking at future directions for the country and research and development strategies that will assist us to that end. These meetings have involved Government departments, the Government research funding agencies (Ministry of Research Science and Technology), industry associations, major industries and other interested parties. While new trends are not clear, what was evident from these meetings was that recent investment in research and development has been inadequate and was not consistent with the Government's broader goal of Economic Transformation. Consequently, when the Government announced its new budget in May 2006, research and development funding was significantly increased over previous years.

Increased venture capital investment by government was also announced that will help with the commercialisation of innovations from Crown Research Institutes, universities and the private sector. Co-investment with private sector venture capital providers is desired with a view to stimulating the private sector venture capital market.

Some additional research funds were identified specifically targeting the energy sector. In particular, the research will be aimed at assisting New Zealand to:

- More fully understand our indigenous energy resources and opportunities, in particular using renewable energy resources;
- Develop new energy technologies, and be better placed to adapt and adopt new overseas technologies, for use in New Zealand;
- Understand and implement opportunities to use energy more efficiently in homes and businesses.

7. AUCKLAND UNIVERSITY GEOTHERMAL INSTITUTE

Until recently Auckland University operated the Geothermal Institute partly funded by New Zealand aid money. Many students from New Zealand and internationally, including Asian and Pacific rim countries have attended the old diploma courses or undertook further post-graduate studies through the Institute. There was universal disappointment when this valuable training institute was effectively wound up, largely over funding issues.

Over the last three years, the University has retained one person to promote the interests of the Institute, and to assist with the running of various specialist short courses and the New Zealand Geothermal Workshop. This year Auckland University has announced that the Geothermal Institute has been re-established and will be offering significant geothermal courses next year.

8. THE NEW ZEALAND GEOTHERMAL ASSOCIATION AND INTERNATIONAL GEOTHERMAL ASSOCIATION CONNECTIONS

The New Zealand Geothermal Association (NZGA) was established in the 1980's. The NZGA represents a diverse range of members. It not only includes those whose main interests are large-scale geothermal energy development, such as developers, consultants and service companies, but also research institutions, universities, regulatory authorities and Maori groups.

In the last few years there have been increasing calls on time of the various Board members all acting in a voluntary capacity. With anticipation of accelerated development and a range of central and local government initiatives impacting on geothermal development, a decision was made in 2004 to appoint a paid part time Executive Officer. This has enabled more time to transform the NZGA into a more professional body, improve educational tools (including the website: www.nzgeothermal.org.nz), address issues and to take specific initiatives forward. The Board membership has also changed considerably. The NZGA is actively working in a number of areas now to raise the profile of geothermal energy and to help its development. The Association has been able to achieve initial changes through voluntary industry support funding. Its new and pro-active projects have been advanced with funding secured from Government departments with a focus on energy or industry.

At an early stage the need for strong international links was recognised, with many New Zealand scientists and engineers consulting around the world. Consequently some of the early NZGA members were instrumental in the establishment of the International Geothermal Association (IGA) which was incorporated in New Zealand in 1988 and still has its registered office in New Zealand. The NZGA was formally affiliated to the IGA in 1992.

More recently, there has been a growing call for a more regional focus. With the agreement of IGA, a Western Pacific Regional Branch of the IGA has been established this year to bring this regional focus. The Branch draws in voluntary members from a region encompassing China, Mongolia, all countries east of (but excluding) India including Thailand, Philippines, Indonesia, Korea, Japan through to Samoa, Fiji, New Zealand and Australia. Its first Annual General Meeting will be held in New Zealand in November 2006 and has been arranged to coincide with the 28th New Zealand Geothermal Workshop (with a theme of Pacific Rim Geothermal) and the NZGA Seminar (with a theme of Generation) to be held in Auckland, 15 -17 November 2006. The NZGA would encourage participation in the Regional Branch.

9. CONCLUSIONS

The New Zealand Government is generally supportive of renewable energy developments (including geothermal energy). Its policies are becoming more directive.

The New Zealand geothermal scene is very busy, although many developments are now held up in Environment Court proceedings. Resolution of these issues one way or the other is likely over the next year after which accelerated development is possible.

The New Zealand Geothermal Association has had to adapt to this rapidly changing scene through commitment to paid staff. The Association continues to emphasise ongoing education and is strongly supportive of international linkages.

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