

Waikato Regional Energy Strategy

A multi-stakeholder initiative by the

Waikato Regional Energy Forum

Acknowledgements

Many organisations and individuals have collaborated and contributed to the development of the Waikato Regional Energy Strategy.

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Introduction

Energy is essential to all our lives. It is the fuel that powers our modern society, a vital input to our household, industrial, commercial and transport activities.

To promote economic growth and maintain our standard of living, the Waikato region needs to have access to secure and reliable supplies of energy at affordable prices.

The Waikato has taken the initiative to develop a regional energy strategy with the following vision and purpose:

Vision statement

"Improving quality of life for people in the Waikato, and in New Zealand, through affordable and energy efficient lifestyles, a reliable and renewable energy supply, efficient infrastructure, informed decision making, and innovative solutions that enhance competitive advantage"

Purpose of the strategy

The overall purpose of the Waikato Regional Energy Strategy is to:

- **encourage and enable energy conservation and efficiency**
- **promote the Waikato region's role in maintaining security of energy supply**
- **facilitate the development and use of renewable energy sources and innovative energy technologies**
- **acknowledge and promote the crucial role of energy in the regional and national economy.**

Development of the Waikato Regional Energy Strategy

The development of the Waikato Regional Energy Strategy is a multi-stakeholder process, initiated by Environment Waikato in conjunction with other stakeholder groups including central and local government, electricity companies, lines companies, other energy producers, industry and domestic users and community groups.

The strategy is a non-statutory document that does not have any legislative or regulatory force. It will, however, help to inform decision makers at the regional and district level in the development of policy and planning documents, such as the second generation Regional Policy Statement (which lays out the policy framework for the sustainable management of the region's natural and physical resources). Environment Waikato is coordinating the development of the Regional Energy Strategy as part of its integrative function under the Resource Management Act, which forms part of its responsibility for the sustainable management of natural resources within the region.

The timeline for the strategy

Since the strategy working document was originally presented to stakeholders in November 2007, an advisory group (representing both the supply and demand sides of the sector, plus research and policymakers) have met regularly to revise the document. This group has been analysing and critiquing the recommendations and devising appropriate action points and methods of implementation.

This work by the advisory group has turned the working document into a strategy, with appropriate vision, implementation, and action steps. The strategy was presented back to the full forum in October 2008 for consideration. This was followed by a call for comments and feedback which lead to a final revision completed by the advisory group at their workshop on the 31 March 2009.

Of particular note has been the enthusiastic participation and collaboration of energy stakeholders in developing the strategy.

The recommendations will be presented and promoted as part of the process of encouraging policy and actions that help realise the vision and purpose of the Waikato Regional Energy Strategy.

As the Waikato Regional Energy Strategy is a living document, it will be subject to revision in order to take into account international events and changes in government policy and local conditions. And through its multi-stakeholder process, it is intended that the strategy will influence the actions of members of the Waikato Regional Energy Forum who will have, at their own discretion, the opportunity to adopt the measures proposed in the strategy. It is also intended that the Waikato Regional Energy Forum continue to act as a coordinating body and networking group on energy issues in the region.

The importance of a regional energy strategy

The development of regional energy strategies is seen as important for all regions within New Zealand. Each of New Zealand's 16 regions, as defined by catchment boundaries (12 regional councils, and four unitary councils), have distinctly different geography, wind and rainfall patterns, productive industry

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bases, transport networks, population dynamics and access to natural resources. Policies that apply to one region will not necessarily work within another region.

Each region has its specific strengths and weaknesses. For example:

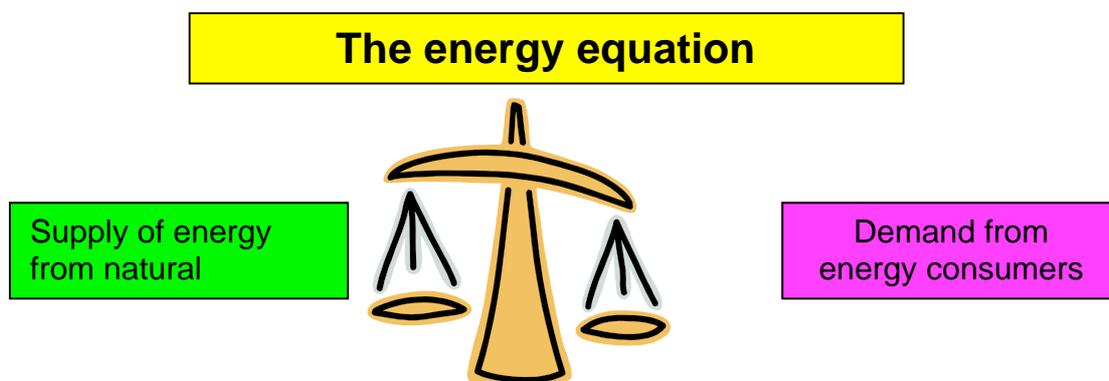
- The Waikato is rich in hydro, geothermal and thermal (Huntly Power Station), and provides up to 50 per cent of New Zealand's electricity, when required.¹
- Neighbouring regions like Taranaki are endowed with oil and gas², while Auckland leads in energy demand due to its large population.
- To the south, Wellington and Horowhenua have abundant wind resources, while parts of the South Island are particularly strong in hydro.

Hence for a national energy strategy to operate effectively it must be backed up by a regional strategy which assesses local energy supply and demand issues, and provide solutions which are specific to the needs and capacity of each region.

Local government has an important role to play in meeting the region's energy needs, as district and regional councils are involved in working with generators, lines companies, industry and communities in the development of new projects relating to energy infrastructure. Local government also has a direct impact on the community's energy needs and emissions, as it is responsible for much of the planning and delivery of local and regional transport infrastructure. This involves the provision of public transport, designing communities with adequate walking and cycling facilities, building infrastructure to reduce congestion and emissions, and providing the overall planning framework for the integration of transport modes such as road, rail, air and shipping.

Two sides to the energy equation

The fundamental principle underlying the Regional Energy Strategy is the importance of working on both the supply and demand sides of the energy equation. The strategy therefore aims to facilitate the access, development and use of energy including renewable energy sources within the region (*supply side*), and also to promote energy conservation and efficiency with the community (*demand side*).



Another aim of the Regional Energy Strategy is to foster partnerships within the community for innovation and development of pilot projects to provide workable models of energy generation and energy efficiency that can be upscaled into larger operations.

¹ See Part 3 "Snapshot of Waikato's energy profile"

² Note that the Maui gas resource is beginning to decline. Reference MED's Energy Outlook to 2030 (page 80)

On the supply side, the Regional Energy Strategy seeks to identify unintended barriers to the development of renewable sources of energy, and to find appropriate ways of minimising or removing these barriers to improve community access to these resources. For example, the regional council's work in classifying geothermal systems (into development, limited development, research and protected status categories) has clarified access provisions.

On the demand side of the energy equation (which is essentially dealing with consumers of energy) there are significant energy savings that can be made. However the level of energy gain will depend on the extent to which consumer behaviour can be changed. At a national level, agencies such as the Energy Efficiency and Conservation Authority (EECA) and the Electricity Commission have an overarching role to play, particularly in promoting energy saving lifestyles and behaviours. Initiatives and regulation to improve home energy efficiency can reduce household energy spend while improving the health and wellbeing of families.

Within the Waikato region, local authorities can play an important leadership role for the community by addressing their own internal energy efficiency at the corporate level, and by providing energy-effective technologies to their operations (such as sewerage, street lighting and water reticulation). Community groups such as those involved in energy efficiency programmes (for example, retrofitting insulation to older houses, or enabling energy efficient installations such as solar water heating) can also play an important role in energy efficiency, benefiting the consumer.

Outline of the Waikato Regional Energy Strategy

The Waikato is a major export engine for New Zealand, generating more than \$4.7 billion annually from dairying alone. Forestry, manufacturing, agricultural research, tertiary education and tourism also provide significant income streams.³

The Waikato region is also rich in energy resources. The region is New Zealand's premier electricity province, with almost 40 per cent of installed generation capacity, and the potential to generate up to 50 per cent of New Zealand's total electricity when required.⁴ In addition, the Waikato region has major energy resource potentials in coal, biomass, geothermal, wind and wave.

Energy is a master resource – a fundamental driver of economic prosperity, both within the Waikato region and around the world. This is because energy is an integral part of the production and distribution of goods and services.

As an exporting nation distant from most major markets, New Zealand is reliant on its ability to produce and transport goods to consumers at a competitive price. However New Zealand is heavily dependent on imported oil, which at present makes up more than 50 per cent of our energy needs.⁵ Yet global oil prices have risen significantly in recent years (particularly since 2003). Demand from emerging economies like China and India, political instability in some oil producing nations, fears over potential shortages in supply and the risk of global terrorism cause risks and uncertainty.

The knock-on effect that changes in the global energy market can create has been highlighted recently by the international boom in biofuels. By substituting land that would otherwise have grown food crops, the demand for biofuels has been credited as a key factor (along with climate impacts in countries like Australia) in pushing up the world prices for dairy products. With New Zealand agriculture based primarily on grass-fed (rather than grain-fed) cattle, the Waikato economy is well-positioned to take advantage of the current dairying boom. Thus global energy-related issues can have significant impacts (both positive and negative) on both the New Zealand and Waikato economy.

As an export-driven economy, the Waikato needs to be aware of these global energy trends in its long term planning. It also needs to be cognisant of changes in national policy around energy, as well as understanding the strengths and potential weaknesses in the region's utilisation of energy resources.

The Regional Energy Strategy considers these factors in parts 1 to 8 with all recommendations listed in Part 9.

³ See Waikato Regional Energy Strategy Part 3 "Waikato's economic drivers".

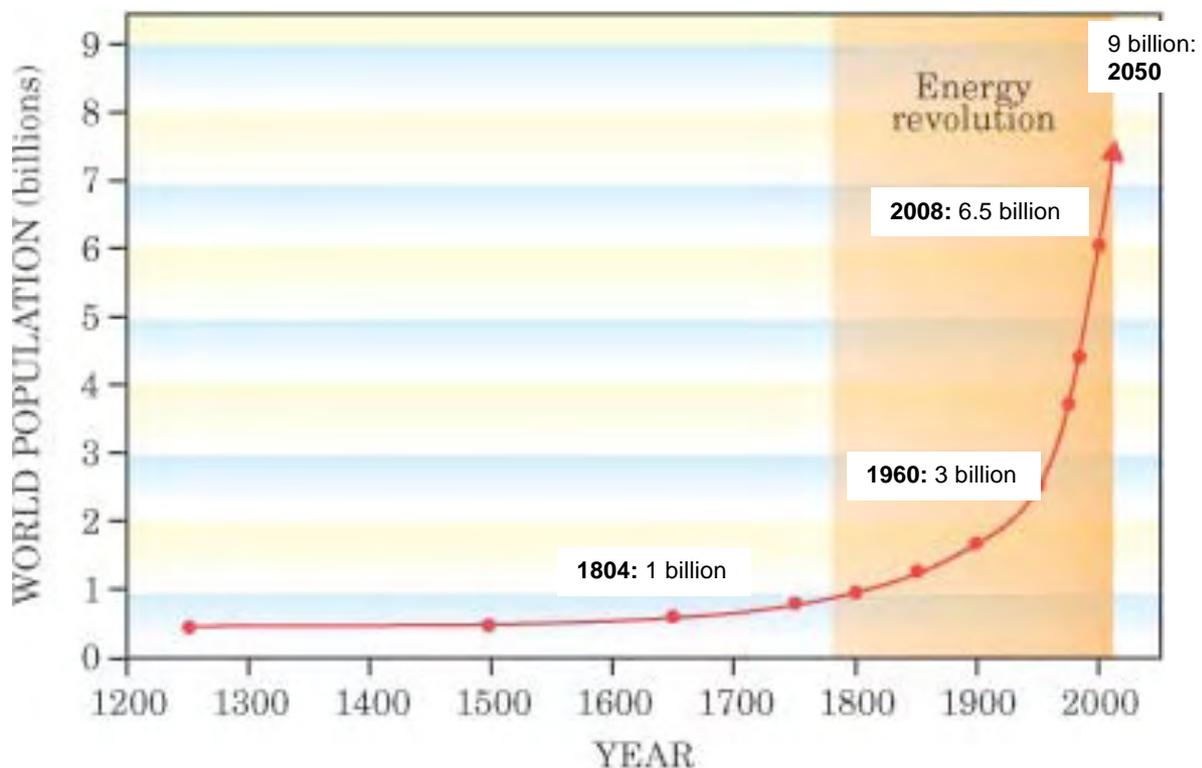
⁴ See Waikato Regional Energy Strategy Part 3 "A snapshot of Waikato's energy profile".

⁵ See NZ Energy Outlook pie chart reproduced in the Regional Strategy Part 2

Part 1 - The global context

Throughout the world, economic growth is strongly linked to the availability of cost-effective energy supply. In the 21st century, two of the major global challenges facing New Zealand are the security of energy supply at an affordable price, and the intertwined threat of climate change. These twin issues are also inextricably linked to global population growth and rising standards of living, which are driving an increasing demand for energy around the world.

Since 1900, world population has soared from 1.6 billion to 6.5 billion today. This global population growth has been driven, in part, by the availability of fossil fuel energy sources. The discovery and use firstly of coal in the 19th century, and then oil, has provided the basis for the rapid development of the industrialised world. Comparatively cheap energy sources such as oil have provided the basis for transportation, the development of complex machinery, and the growth of cities, along with a vast range of products such as plastics, pesticides, fertilisers and new technologies.



⁶ The discovery and use of fossil fuel energy sources such as coal and oil have been an important factor in the exponential growth of world population since 1800. The world's population reached the 1 billion milestone in 1804, 2 billion in 1927, 3 billion in 1960, 4 billion in 1974, 5 billion in 1987, and 6 billion in 1999. World population is predicted to hit 7 billion in 2013 – and 9 billion by 2050.⁷

⁶ Graphic representation concept by Professor Paul Weisz of the University of Pennsylvania

⁷ United Nations Population Division "The World at 6 Billion"

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Oil has also powered the mechanisation of agriculture since World War II, which has driven the 'green revolution'. This has allowed the world to feed many more people, and has been an underlying factor in the quadrupling of world population in the past century.

As population continues towards the projected 9 billion by 2050⁸, this is almost certain to be accompanied by an increasing demand for energy. Many developing countries are just beginning to reach the point where individual wealth and energy consumption start to accelerate. For example, while the number of cars in China more than doubled between 2000 and 2006, this still equates to only one car for every 40 people, compared with America which has one car for every two people.⁹ In coming years, the growing demand for vehicles in countries like China and India is likely to significantly increase the overall demand for oil and energy supplies, placing pressure on these finite resources.

Oil supplies

The Regional Energy Strategy acknowledges the potential threats to energy supply, and highlights the need to future proof against possible changes in global energy markets. At present there are four key factors which threaten access to cheap energy.

The first key threat to oil supplies comes from sudden unexpected events, such as the risk of global terrorism disrupting oil supplies from the Middle East, or climate-related events such as hurricanes Katrina and Rita which can reduce supply with no warning, causing price spikes and severely damaging US oil production.

Oil rig damage from Hurricane Katrina



Source: World Oil Damage Summary

This oil rig was one of 47 platforms destroyed by Hurricane Katrina in 2005, with 20 more suffering extensive damage. The damage to oil facilities caused a temporary spike in petrol prices due to shortages.

⁸ United Nations Population Fund "State of World Population 2007" Executive Summary

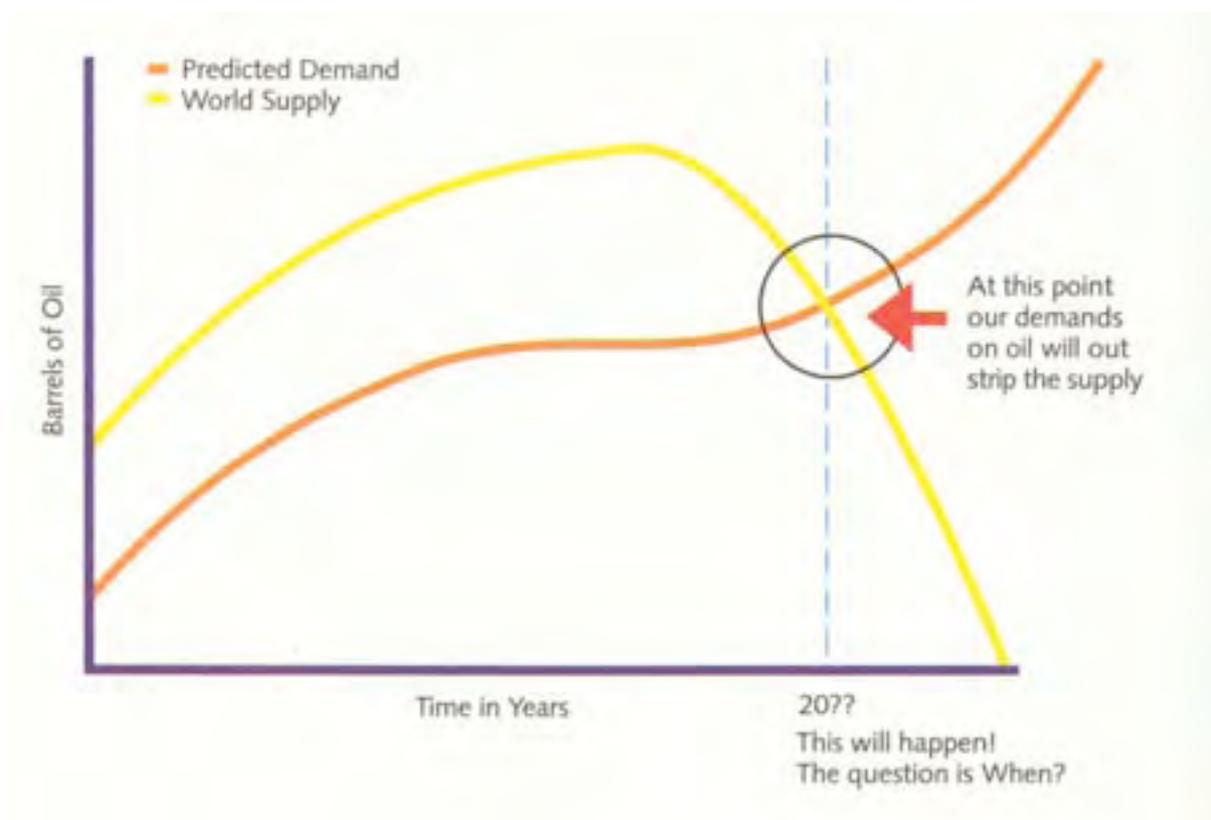
⁹ National Petroleum Council 2007 report on "Facing the Hard Truths about Energy" (page 5)

A second threat comes from geopolitical tensions in the Middle East and other oil producing nations such as Nigeria and Venezuela, which could impact on the cost and reliability of petroleum supplies, and potentially lead to conflict over scarce resources.

A third is demand driven by factors such as the growing world population, and the rapid industrialisation of China, India, Brazil and Indonesia, as well as the increasing thirst for oil within western countries. For example, while America has 4 per cent of the world's population, it currently consumes 25 per cent of the world's oil due to its high energy lifestyle¹⁰. New Zealand is also highly dependent on imported oil, which is used to meet almost 50 per cent of our energy needs.¹¹

Peak 'cheap' oil

The fourth issue relates to the long term security of supply, and concerns the debate over the forthcoming 'peak' in global oil production. Energy analysts are predicting the world will reach a point where half of the world's oil resources have been consumed, and a decline in annual production must set in. This is known as 'peak oil', and there is considerable debate about when the timing of peak oil will occur – with predictions ranging from 2005 to 2040.¹²



Source: Hamilton City Council sustainable living booklet on energy

Peak oil describes the point when worldwide production of conventional crude oil peaks in volume. After it peaks, the production of crude oil will inevitably decline. Predictions about the timing of this event currently range from 2005 to 2040. In this graph, the orange line shows a 'business as usual scenario' with growing demand. The yellow line shows a post peak decline in production.

¹⁰ "Preparing for the 21st century" by Paul Kennedy (page 32)

¹¹ NZ Energy Outlook to 2030 (page 12)

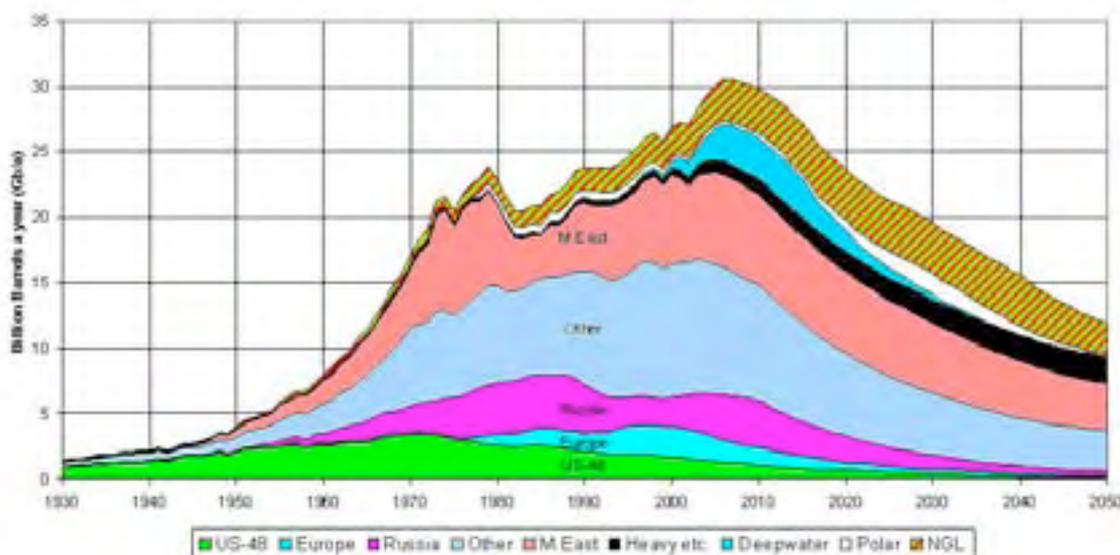
¹² "Addicted to Oil" by Ian Rutledge (page 139)

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In a recent report, the NZ Parliamentary Commissioner for the Environment states that: “globally the consensus in the petroleum industry is not if worldwide oil and gas will peak, but when it will peak.

“Estimates for when ‘peak oil’ will occur range from between 2005 and 2040, with the greatest consensus around 2012 to 2020. After it peaks, oil production is expected to decline at a rate of around 3 per cent per annum. Oil prices will rise significantly,” the Commissioner concludes¹³.

OIL AND GAS LIQUIDS 2004 Scenario



Source: ASPO

This graph shows projected estimates of the depletion of oil and gas reserves over time, and suggests that the world's production of conventional oil from cheap-to-extract oilfields is nearing its peak. If correct, then ‘peak cheap oil’ could begin a steady decline within as little as five years. This graph, which was prepared by the Association for the Study of Peak Oil and Gas (an international collection of scientists, economists and geologists), highlights the debate over peak oil, as it differs markedly from some industry estimates.

The New Zealand Energy Strategy (NZES) states that it is “uncertain” whether conventional oil production will peak in the next decade, or a decade or two later. The strategy suggests that rising prices will spur exploration, and that new technologies will prompt the extraction of liquid fossil fuels from sources such as gas, oil-rich shales and lignite. It notes that: “There are immense quantities of these non-conventional sources of oil, although extracting and using them will produce significant greenhouse gas emissions – unless carbon capture and storage is available.”¹⁴

The NZES concludes that while we will, at some point, see peak ‘cheap’ oil from conventional sources, “the world has plentiful sources of fossil-based oil.”

The former chairman of Shell Oil, Lord Ron Oxburgh puts the peak oil debate in perspective with his comment that: “Although the price of oil and gas will continue to fluctuate, the long term trend will be upwards as the resources become scarcer and more expensive to produce.”¹⁵

¹³ Parliamentary Commissioner for the Environment – “Future Currents: Electricity Scenarios for New Zealand 2005 - 2050 (page 25).

¹⁴ New Zealand Energy Strategy (page 47)

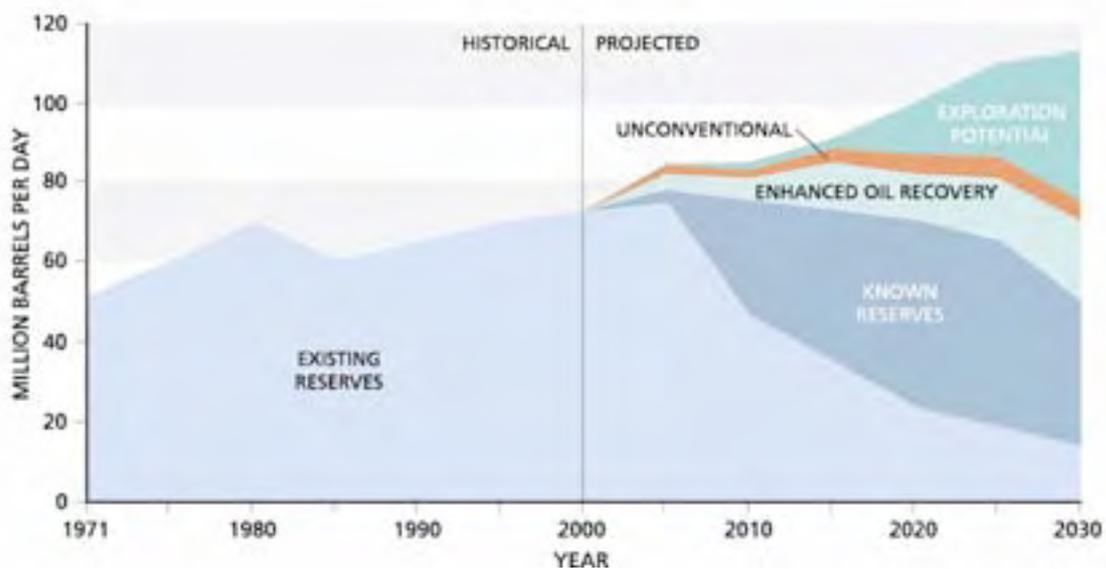
¹⁵ On the issue of peak cheap oil, the director of the Centre for Energy Research at Massey University, Professor Ralph Sims, agrees that non-conventional oil production is feasible, stating that production from oil shales, heavy oil and tar sands is already occurring in some places around the world. However, he says that these methods can have other

He concludes that: “We shall never run out of oil and gas but, in the long term, they will simply become too expensive to use – at least in the way we use them today.”¹⁶

Lord Oxburgh’s comments have been brought into sharp focus recently with warnings by two international agencies about oil shortages within a much shorter timeframe than official agencies had previously predicted.

The National Petroleum Council has recently issued a report called ‘Facing the Hard Truths about Energy’. It raises concerns about a tipping point where demand outstrips supply, stating that: “the global supply of oil and natural gas from the conventional sources... it is unlikely to meet... growth in demand over the next 25 years”.¹⁷

Historical oil production v projected future supply



Source: National Petroleum Council

The National Petroleum Council’s report gives a range of oil projections, based on differing assumptions. The report suggests that known reserves will fill the gap once existing reserves begin to decline sharply by 2010. However unconventional oil and exploration potential will be required to fill the growing gap between demand and supply.

The report from the National Petroleum Council carries weight, as it represents 175 authorities that report to the US government, and includes the heads of the world’s big oil companies such as Exxon Mobil, Chevron, Shell, BP and Conoco-Phillips.

“Although vast amounts of oil and gas remain underground, complex challenges and global uncertainties are likely to put an end to the ‘sufficient, reliable and economic energy supplies upon which people depend’. The report also warns that the crunch could come sooner, with oil production becoming “a significant challenge as early as 2015”.

adverse effects, particularly regarding the utilisation of resources like water and natural gas, as well as doubling greenhouse gas emissions. “15 per cent of Canada’s oil supply comes from tar sands, and competes with oil at around US \$50 per barrel - but at what overall cost,” Professor Sims asks. “Tar sands, for example, need four litres of water for every litre of tar extracted, plus large volumes of natural gas for heat. Large areas of land are damaged in the extraction process, and the total carbon emissions per kilometre travelled are close to double those from petroleum products..... However, unconventional oils will help to cap the price of transport fuels once the peak oil point is reached, as will the uptake of more biofuels.”

¹⁶ Lord Oxburgh - “Confronting Climate Change - critical issues for New Zealand” (page 201)

¹⁷ National Petroleum Council – “Facing the Hard Truths about Energy” 2007, and NZ Herald 23 July, 2007

“It is another hard truth that the rapidly growing world economy will require large increases in energy supplies over the next quarter century. Expansion of all economic energy sources will be required to meet demand reliably, including coal, nuclear, renewables, and unconventional oil and natural gas. All energy sources have their own challenges that must be overcome to be produced, delivered and used on an ever-increasing scale,” the report notes.¹⁸



Source: National Petroleum Council

Key oil transportation routes act as strategic 'choke points' which if subject to a terrorist attack could severely reduce the supply of oil, which would immediately cause significant international price rises.

Another authoritative report by the International Energy Agency has also recently warned that demand could soon begin outstripping supply, placing much greater power into the hands of OPEC countries. This report is considered significant, because the International Energy Agency (IEA) – which advises western governments on energy issues – has until now been projecting the crisis point some 30 years away.

The NZES makes reference to the IEA report, noting that: “oil markets may come under increased pressure due to potential supply constraints within the next five years. In any event, these consumption patterns mean that within a decade, the capacity to increase oil production will be concentrated to just a few predominantly OPEC countries.”

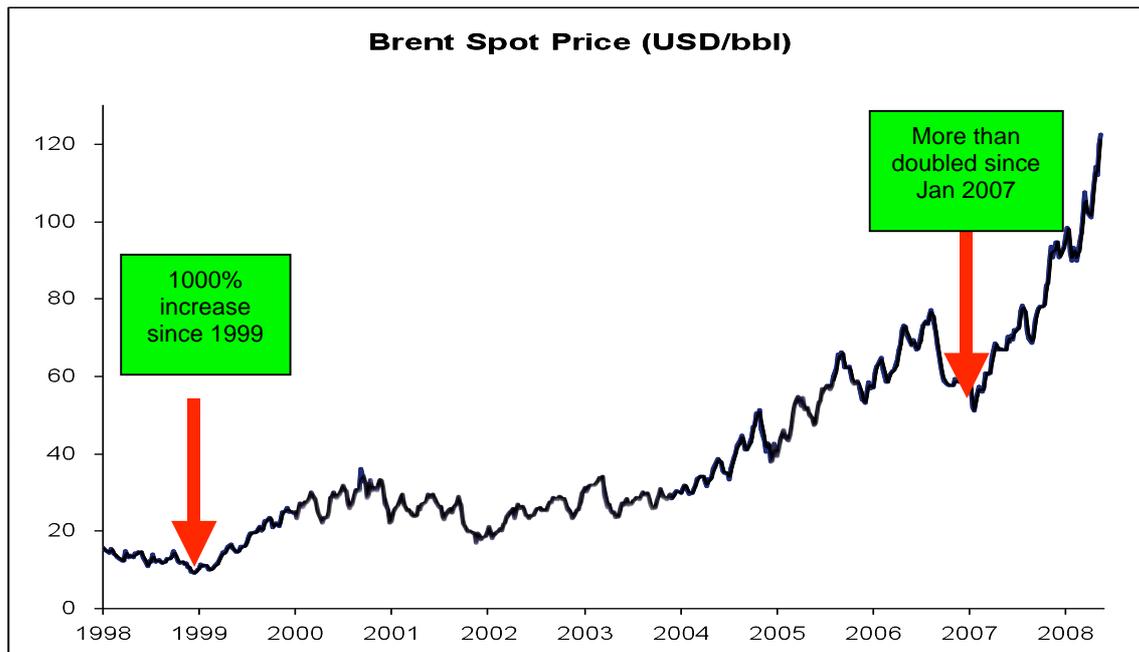
The NZES notes the IEA report as “a wake-up call for the increasing supply investment in producing countries, and energy efficiency improvements by users. New Zealand's import bill increases when oil prices rise, which is all the more reason to lessen our dependence on imported oil.”¹⁹

¹⁸ National Petroleum Council – “Facing the Hard Truths about Energy” 2007 (Executive Summary)

¹⁹ NZES (page 13)

Global instability and security issues are also highlighted by the National Petroleum Council, which warns that: “the world is entering a period in which international energy development and trade are likely to be influenced more by geopolitical considerations, and less by the free play of open markets”.²⁰

The cumulative effect of geopolitical tensions, severe weather events, the war in Iraq, and soaring demand from China and India have already caused the price of basic imported petrol to rise sharply since 2003. These factors helped push oil to record levels of \$US147 a barrel in July 2008, before dropping back to around \$US100 a barrel by mid-September in the same year. The price of oil remains volatile – and has increased more than 1000 per cent since 1999.



Source: NZ Oil and Gas

Oil prices soared to record levels in the 2008 year – more than doubling since the beginning of 2007, and showing a 10-fold increase since 1999. This price rise, unprecedented since the second oil shock in 1979, is one of the factors creating a recessionary impact on the global economy.

In the NZES, the government acknowledges the risk of oil price rises as an important factor to be taken into consideration in strategic planning.

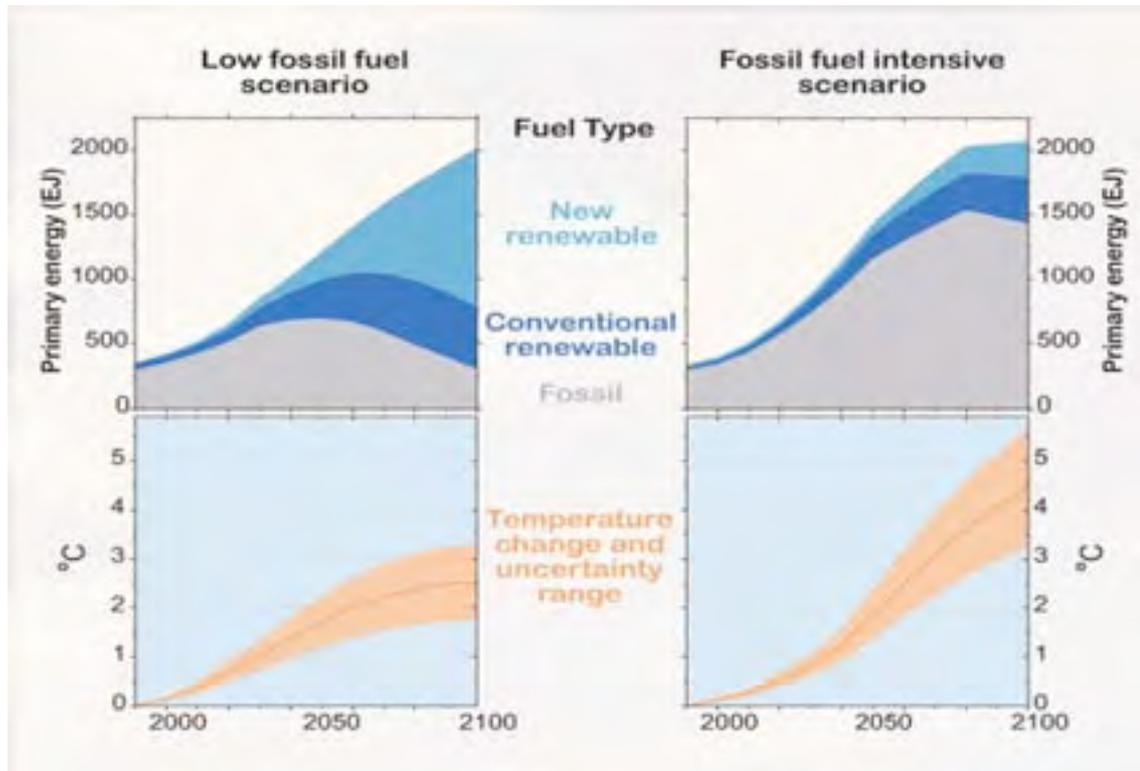
“We rely on imported oil for around 50 per cent of our energy needs, and we need to be prepared to respond to supply disruptions caused by international events beyond our control. The government has increased our oil reserves to act as a buffer and to meet our treaty obligations as a member of the International Energy Agency, as well as updating emergency response planning,” the NZES notes.²¹

²⁰ National Petroleum Council – “Facing the Hard Truths about Energy” 2007 (page 25 of Executive Summary)

²¹ New Zealand Energy Strategy (page 12)

Climate change and energy

The NZES states: “around the world, there is a growing sense of urgency about the need to address the serious challenges of climate change”.²²



Source: NIWA diagram of IPCC3 data

The increased use of renewable sources of energy globally can have a marked impact on reducing the effects of climate change.

“Some sectors in New Zealand will find it comparatively harder to reduce emissions, which makes it even more important that we reduce greenhouse gas emissions in areas where we can, such as electricity production and use, and transport,” the NZES states. The NZES notes that many climate change measures achieve other commonsense objectives, such as improving energy efficiency which can reduce the amount we pay for electricity and petrol.

As this is a global problem, finding the best ways of adapting to a changing climate, and seeking to future proof decision making with regard to the management of natural and physical resources is an issue that needs to be addressed internationally, as well as on a national and regional basis.

The NZES points out that reducing New Zealand's greenhouse gas emissions is important both because of the global environmental damage caused by emissions and the likelihood that emissions will carry an economic cost to the country in the future. Lack of action could result in a loss of New Zealand access to certain markets overseas. On the positive side, New Zealand has the potential to be at the forefront of the development of low emission technologies, especially in agriculture – and therefore well placed to take advantage of emerging opportunities.

²² New Zealand Energy Strategy

Part 2 - The national energy context



Source: NZ Energy Data File 2006

Key points

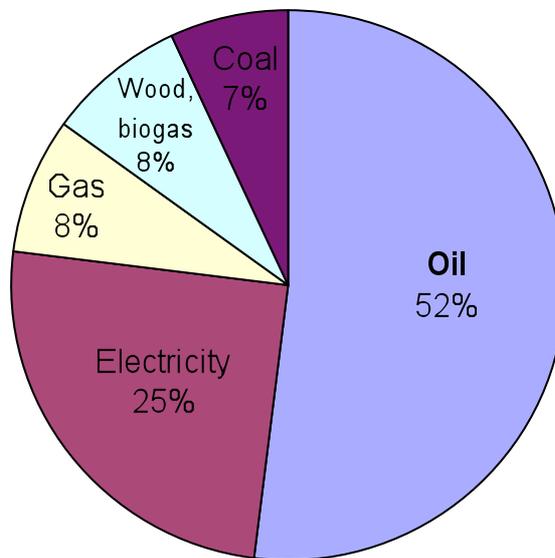
- New Zealand's energy profile
- Summary of the New Zealand Energy Strategy
- Summary of the New Zealand Energy Efficiency and Conservation Strategy

A snapshot of New Zealand's energy profile

New Zealand is comparatively rich in renewable energy such as hydro and geothermal compared with the rest of the world – with approximately 70 per cent of electricity generated from renewable sources. Electricity is also generated from non-renewable resources such as gas and coal (for example at Huntly), which is very important in terms of ensuring security of supply – particularly in dry years for hydro.

Electricity only represents approximately 25 per cent of the actual energy resources available to the NZ consumer. Oil, most of which is imported, represents more than 50 per cent of the net consumer energy which drives the economy.²³

Energy available for consumption
New Zealand's consumer energy by fuel type



Source: NZ Energy Outlook

As a nation, New Zealand is heavily reliant upon oil imports, which fuel 52 per cent of consumer energy demand. However, compared with other nations, New Zealand has a much greater percentage of renewable electricity generation.

Other renewables such as biogas, wood, solar and direct use of geothermal account for a further 8 per cent, while coal for direct use in industry (such as New Zealand Steel) amounts to a further 7 per cent of consumer energy, with gas for use in industry, commercial premises and residences amounting to 8 per cent.

Since the 1980s, imported oil has continued to grow in size and importance, due to growth in the economy and the decline in indigenous oil from the Taranaki region. Gas supplies as a percentage of total primary energy have also reduced in recent years, as Maui has reached its production peak.²⁴ Renewable resources continue to play a significant role in the generation mix, with hydro and geothermal energy supply being dominant, with other renewables such as wind and biomass growing rapidly.

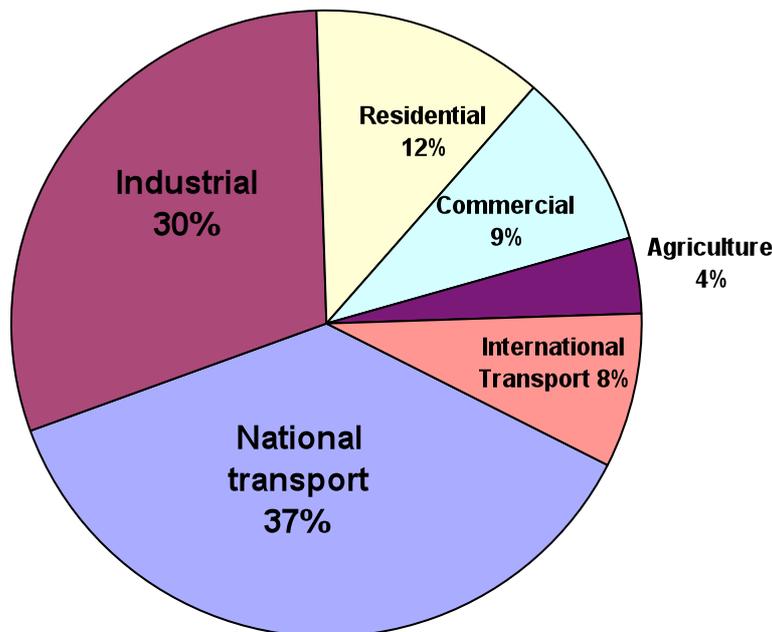
²³ NZ's Energy Outlook to 2030 (page 16)

²⁴ NZ Energy Data File summary 2006

Energy consumption by sector

As highlighted in the Ministry of Economic Development's 'NZ Energy Outlook to 2030', national and international transport accounts for almost half of New Zealand's consumer energy demand. This means that transport significantly outweighs industrial uses (30 per cent), residential (12 per cent), commercial (9 per cent), and agriculture (4 per cent).

Where energy is used in the economy
Consumer energy consumption by sector



Source: NZ Energy Outlook to 2030 (p 17)

Furthermore freight and transport have been among the fastest growing sectors for energy use, increasing by 38 per cent, and 25 per cent respectively over the past 10 years. By comparison, agriculture and fishing have shown the lowest percentage increase in energy use over the past decade.²⁵

Key issues

There are many issues in the energy sector which are providing challenges for policymakers. Among these issues are the increased usage of non-renewables, the increased energy demand, and increasing energy prices.

Increased usage of non-renewables

One of the issues facing New Zealand is the fact that over the past three decades the growth in New Zealand's energy demand has often been met by non-renewable sources. This point has been highlighted by the Parliamentary Commissioner for the Environment, who stated in the 2006 report on 'Electricity, Energy and the Environment' that there has been a "steady reduction in the proportion of electricity generation from renewable sources – approximately 10 per cent over the last 30 years."

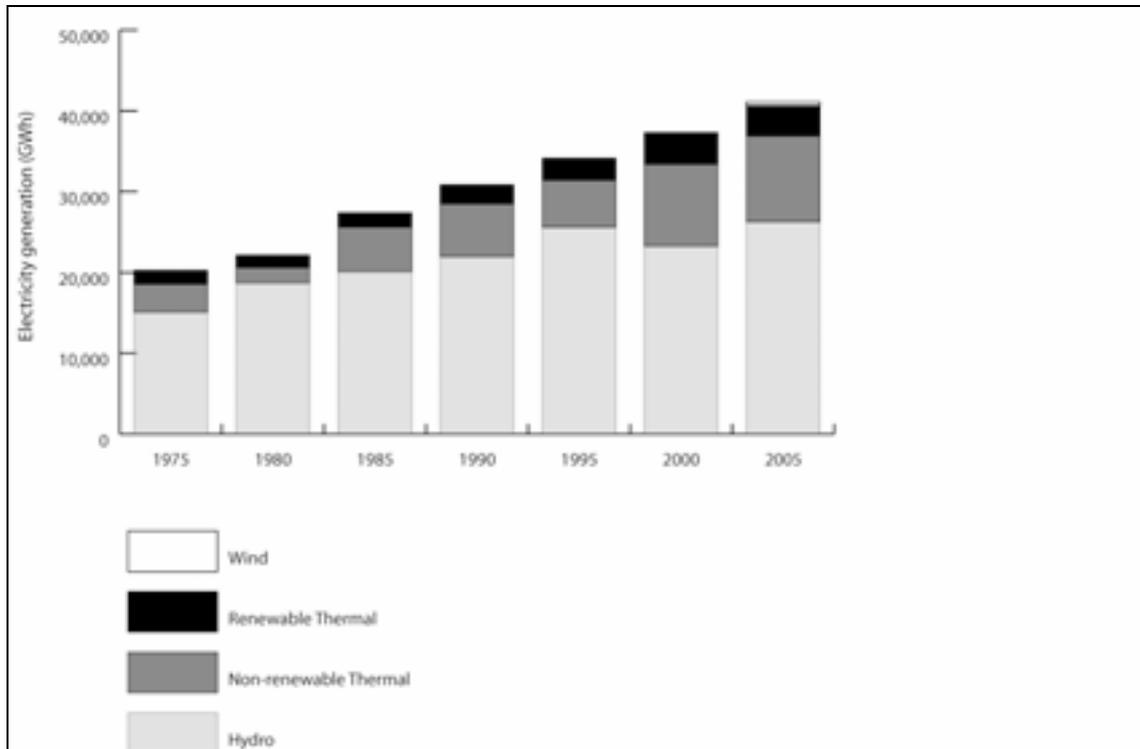
"Although many forms of renewable electricity generation have increased (i.e. hydro, wind and renewable thermal), the increase has not kept pace with the increase in total electricity generation. The majority of the increased demand

²⁵ Data from 2006 NZ Energy Efficiency and Conservation Strategy (page 9)

Waikato Regional Energy Strategy

over this period has been met by non-renewable thermal generation. This leads to the adverse environmental effect of increased carbon dioxide emissions both in absolute and relative terms. In addition, the growing reliance on fossil fuels means greater exposure to world fossil fuel prices.”²⁶

Electricity generation mix (GWh) 1975-2005



Source: PCE – "Electricity, Energy and the Environment:

There has been a steady reduction in the proportion of electricity generation from renewable sources over the past 30 years. While renewable energy generation has increased, this is not kept pace with the increase in total electricity generation – which is driven by growing consumer demand.

The NZES sought to address this issue with a target of generating 90 per cent of New Zealand’s electricity from renewable energy sources by 2025.

While renewable sources have begun to increase in the past few years, particularly with the development of wind and the emerging renaissance of geothermal, an ECCA-Sinclair Knight Merz report points out that renewable energy resources face barriers to development, including high capital costs, difficulty securing access to the use of natural resources, and the practicalities of delivering the energy to where it is to be used.²⁷ The proposed National Policy Statement on Renewable Energy (see following pages for details) is an attempt to redress this balance.

Increasing energy demand

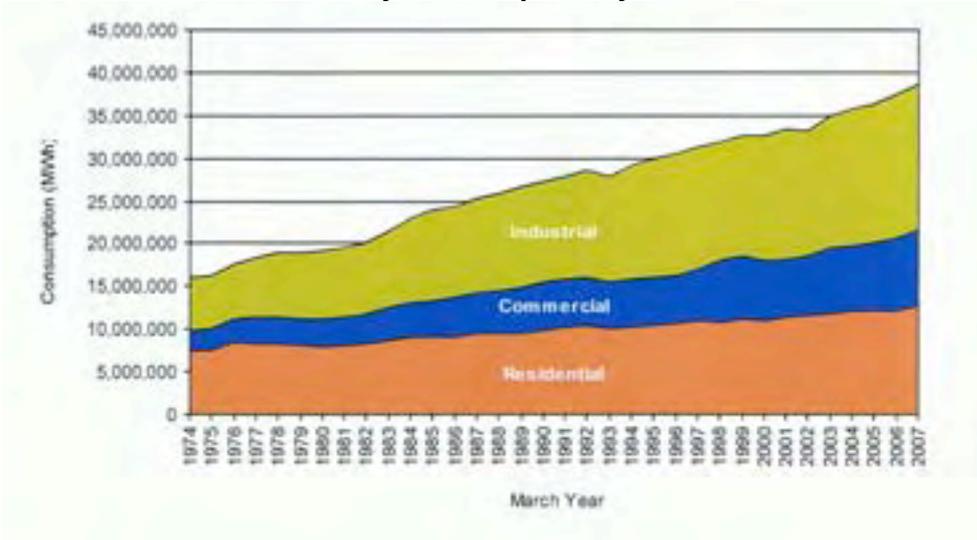
Another key issue affecting the energy sector in New Zealand is the increasing demand for energy. Throughout the world, particularly with the exponential growth of emerging economies like China and India, the demand for natural resources and the energy to convert these into products is growing rapidly.

²⁶ Parliamentary Commissioner for the Environment - "Electricity, Energy and the Environment: Environmental Performance Assessment 2004-05" (May 2006)

²⁷ EECA-SKM Waikato Regional Renewable Energy Assessment (page 1)

A similar pattern, if less pronounced, is observable in New Zealand. The Ministry of Economic Development (MED) Energy Data File statistics 2008 show that demand for energy resources such as electricity has been growing steadily over the past three decades.²⁸

Electricity consumption by sector 1974–2007



Source: Energy Data File 2008

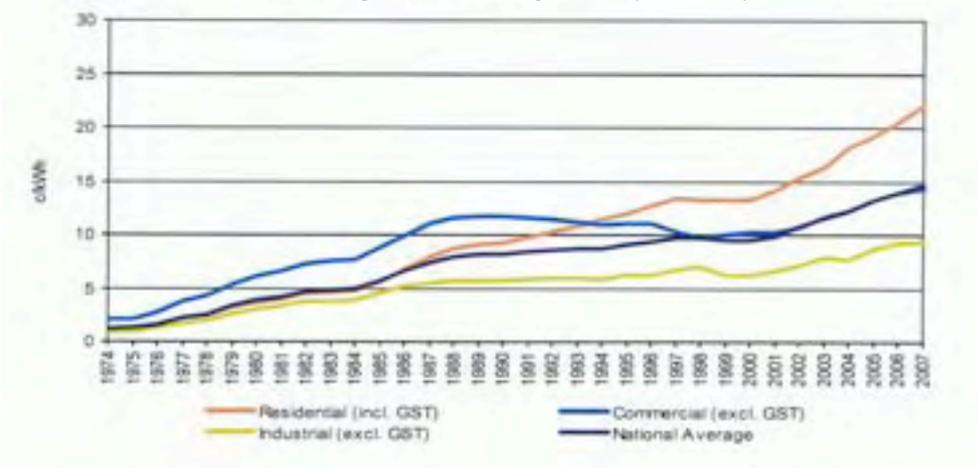
New Zealand is following worldwide trends, with the demand for energy resources such as electricity growing strongly over the past three decades.

In the 2007 year alone, electricity consumption increased by 3 per cent over the previous year to stand at 38,545 GWh. Consumption in the commercial sector was the fastest growing at 7 per cent, followed by 4 per cent in the residential sector.²⁹

Increasing energy prices

As demand for energy has increased, the price trends have also been upwards – as exhibited in the overall cost of both electricity and transport fuels.

Electricity consumer prices (nominal) 1974–2007



Source: Energy Data File 2008

The price trend is also upwards for electricity users, especially residential consumers who faced price rises of 8 per cent in the 2007 year.³⁰

²⁸ Energy Data File 2008 (page 113)
²⁹ Energy Data File 2008 (page 97)
³⁰ Energy Data File 2008 p97

Dominance of transport as energy end user

When it comes to analysing which sectors are the major end users of the available consumer energy, transport continues to dominate. National transport utilises 38 per cent of available consumer energy, with international transport taking a further 8 per cent – comprising almost half of the total consumer energy use.

The problem with transport is that it almost exclusively powered by liquid fuels (petrol and diesel), almost all of which are imported. This means that the transport sector is heavily influenced by international surges in the cost of oil – which have been very significant in the 2007-2008 year.

International energy analyst Dr Robert Hirsch has pointed out that the era of plentiful, low-cost petroleum is coming to an end, warning that this “represents a liquid fuels problem, because motor vehicles, aircraft, trucks, and ships have no ready alternative to liquid fuels – certainly not for the existing capital stock, which has lifetimes measured on a decade-long scale”.³¹

New Zealand’s Reserve Bank governor, Dr Alan Bollard has also warned that the oil price spikes of the 2007–2008 period are likely to have serious ramifications for the NZ and global economy.

“Traditionally, oil price spikes of this magnitude have tended to augur economic downturns, if not recessions,” Dr Bollard comments. “Oil is a key input into the production process, while households spend a significant fraction of their disposable income on petrol. Uncertainty about the future price of oil prompts households to consider delaying consumption on a range of other goods and services and firms to delay investment in major projects. An oil price spike therefore can have significant implications for both prices and economic activity.”

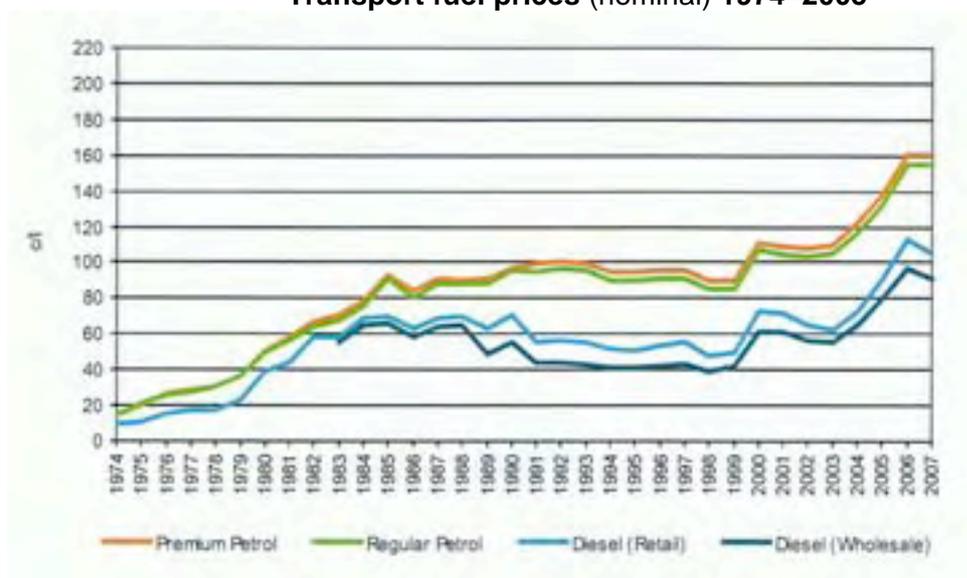
“...While robust global economic conditions and the rapid industrialisation of China and other emerging markets, together with a weak supply response, might largely explain the run up in oil prices, for oil importing countries like New Zealand, the current oil spike still represents a cost shock to the economy.”³²

Energy analysts predict that upward pressure on energy prices – both oil and electricity – will continue in the foreseeable future. This is likely to be driven both by international demand for oil, as well as any moves within New Zealand and many other western countries towards an emissions trading regime, which would impose some kind of emissions cost on the producers of carbon dioxide emitting energy sources.

³¹ Robert Hirsch “The Peaking of World Oil Production” – a report for the US Department of Energy 2005

³² Dr Alan Bollard “Coping with Shocks – a New Zealand perspective” 25 January 2008 (p7)

Transport fuel prices (nominal) 1974–2005



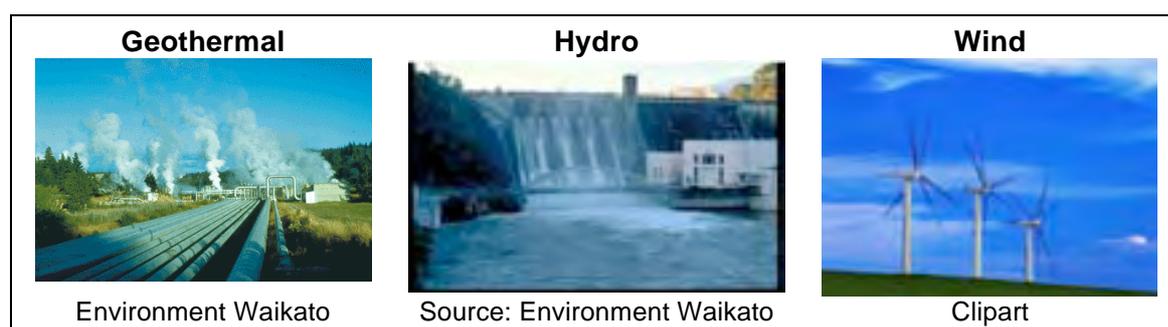
Source: Energy Data File 2008

This graph from the Energy Data File for the 2007 year does not yet show the spike in oil prices experienced during mid-2008. However it does show that the price trend for transport fuels has increased markedly since 2003. Note that the oil price has now climbed significantly higher than \$1.60 to sit above \$2 a litre. And falls in the value of the NZ dollar are likely to see prices remain high, even if the international price of oil fluctuates downwards.

New Zealand Energy Strategy

The New Zealand Energy Strategy (NZES), along with its companion document, the New Zealand Energy Efficiency and Conservation Strategy, published in October 2007 set out the government's vision for New Zealand's energy sector, and provided a proposed plan of action and implementation.

The NZES states its vision of "a reliable and resilient system delivering New Zealand sustainable, low emissions energy services" and goes on to detail the government's priorities for investment in renewable generation, efficient transmission, efficiency in energy use, and new technologies.



The government's preference is for new electricity generation to come from renewables, such as geothermal, hydro or wind – all of which are comparatively abundant in the Waikato.

Key actions in the New Zealand Energy Strategy

The following is a summary of the key actions the government could implement or is already implementing to give effect to the objectives set out in the NZES.

Security of electricity supply³³

Maintaining security of energy supply at competitive prices is essential for a modern economy. Energy efficiency, demand-side management and an increased diversity of electricity supply all contribute to high levels of security. Long term, security of supply depends on competitive markets, cost-effective demand-side response, greater use of renewables, and a stronger national grid.

Low emissions power and heat³⁴

The government has set a target for 90 per cent of our electricity to come from renewable sources by 2025. Coupled with energy efficiency measures, this would see New Zealand cut its greenhouse gas emissions from electricity generation back to 1990 levels.

Emissions pricing and other measures, such as introduction of tools available under the Resource Management Act could also be used to support achievement of the target.

Using energy more efficiently³⁵

Historically New Zealand hasn't been particularly efficient in the way it uses energy, and the government believes everyone should make energy savings in areas where the savings are cheaper in the long run than the financial and environmental costs of supplying more energy. Energy efficiency measures can reduce energy costs and greenhouse gases, as well as provide other benefits to people, communities and the economy.

The New Zealand Energy Efficiency and Conservation Strategy (NZECS) is the dedicated and detailed action plan for whole-of-system energy efficiency (see next chapter). Energy efficiency initiatives are focused on reducing demand for stationary energy, which includes all forms and uses of energy services other than transport and mobility. The government's role is in ensuring pricing and other incentives encourage energy efficient choices, and in addressing barriers to energy efficiency.

Affordability and wellbeing³⁶

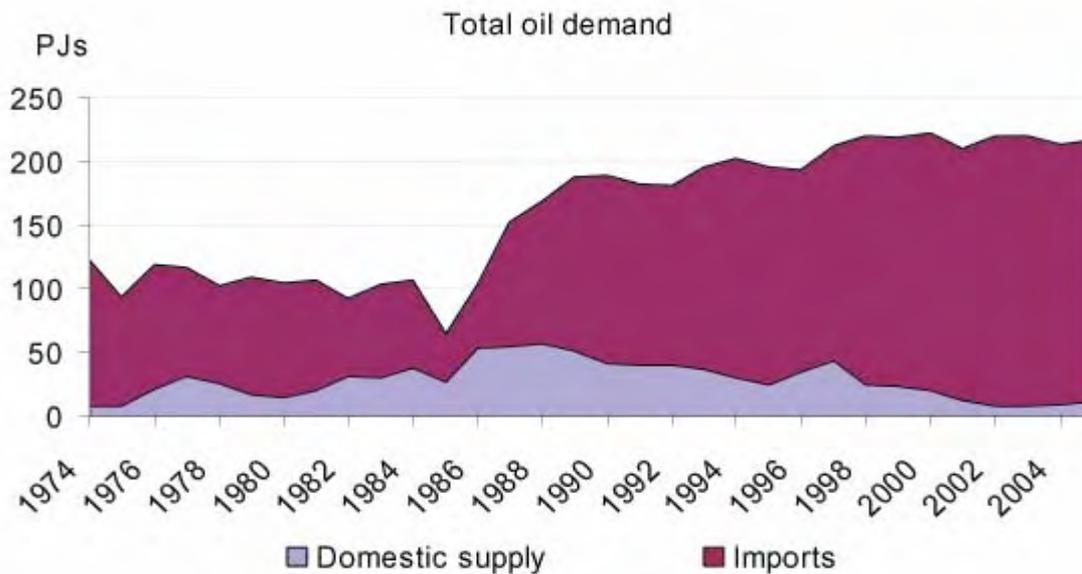
Historically New Zealand has enjoyed cheap and abundant energy. In recent years electricity prices have risen in response to growing demand, and the depletion of the Maui gas field. Oil prices have also risen sharply, impacting on the transport sector in particular.

³³ New Zealand Energy Strategy (Chapter 8, page 59)

³⁴ New Zealand Energy Strategy (Chapter 9, page 71)

³⁵ NZES (Chapter 10, page 82)

³⁶ NZES (Chapter 12, page 98)



Source: MED

New Zealand's dependency on imported oil has increased significantly since the late 1980s, and at the same time New Zealand's domestic supply has declined. Oil accounts for around half of the nation's energy needs.

The government says that while it doesn't set international prices for energy, it aims to ensure that the market remains competitive to protect all customers.³⁷

Sustainable energy technologies and innovation³⁸

Affordable, energy efficient, low emissions technologies will be crucial to improving New Zealand's security of supply and reduction of greenhouse gas emissions. The government's could support initiatives and development that build capacity and link participants from the research community, industry, central and local government, to bring forward adoption of low carbon sustainable energy technologies.



Source: Clip art

Wave power offers abundant, renewable energy, if it can be effectively harnessed.

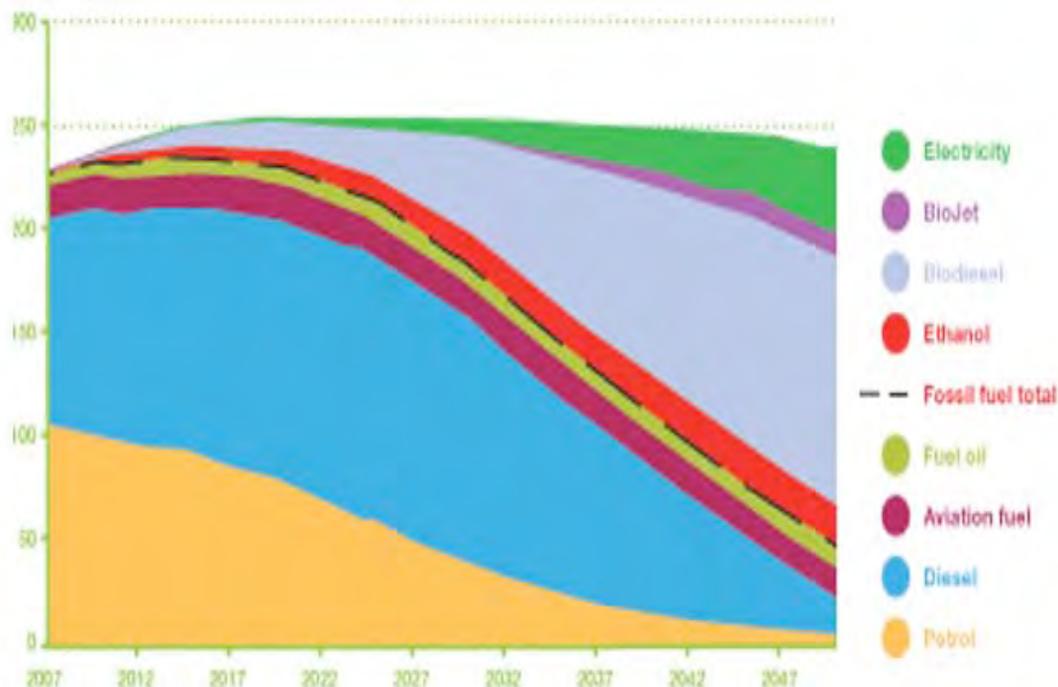
³⁷ Referenced from speech by Minister of Energy (11 October, 2007)

³⁸ NZES (Chapter 11, page 90)

Resilient, low carbon transport³⁹

To reduce greenhouse gas emissions, New Zealand must substantially cut emissions from transport. The previous government set a target of halving domestic transport emissions per capita by 2040. As part of achieving this target, it saw New Zealand being one of the first countries to widely deploy electric vehicles, in addition to using more efficient and lower-impact transport modes, alternative renewable fuels, increasing vehicle fleet efficiency, and reducing kilometres travelled through smarter urban planning.

New Zealand Energy Strategy predictions of shifts in transport fuel use 2007–2050



Source: NZES

The government's NZES projects that reliance on imported oil will be largely phased out over the next 45 years, and that will be replaced by electricity and biofuels as the predominant transport fuels.

The New Zealand Energy Efficiency and Conservation Strategy

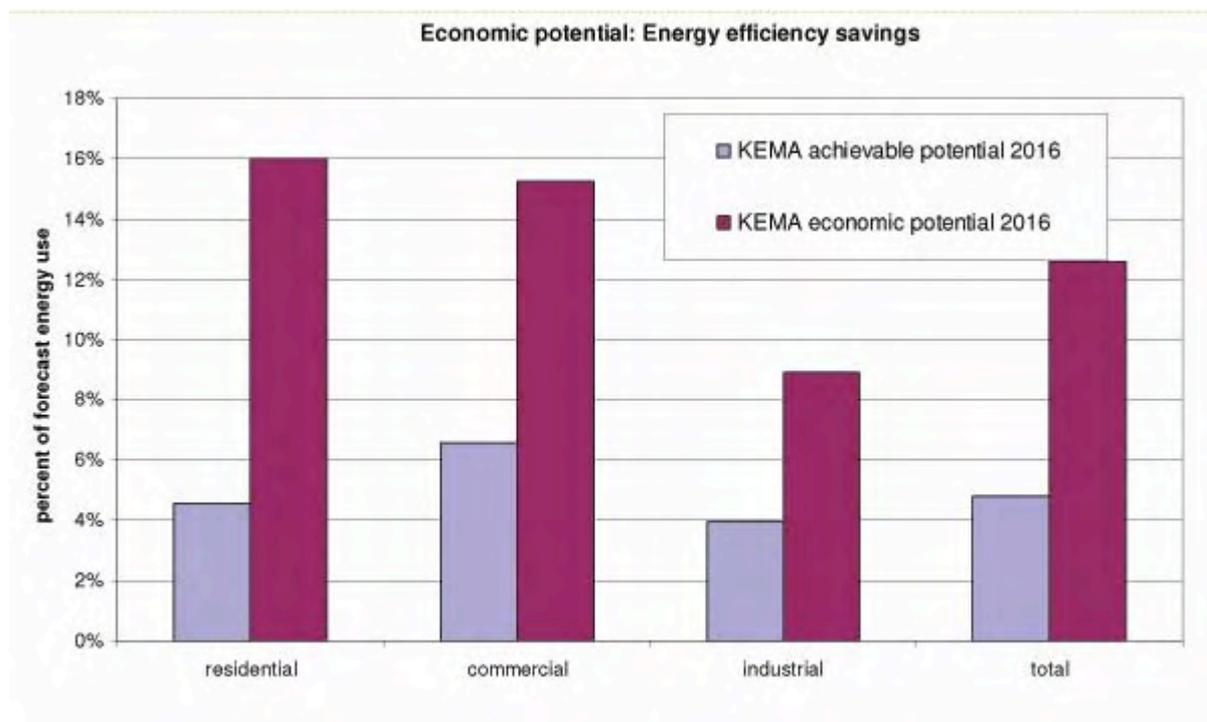
The government believes that energy efficiency and conservation programmes represent good value for money. Commercial programmes in energy efficiency delivered \$88 million in energy savings between 2001 and 2005. The benefits also extended to health and air quality improvements and emissions savings, with a recent study finding a combined health and energy savings return of \$2.20 for every dollar spent on home energy efficiency retrofits.⁴⁰

Overall, the New Zealand Energy Efficiency and Conservation Strategy (NZEECS) is projected to deliver annual non-transport energy savings of 30 PJ per year by 2025. This is equivalent to the electricity used by 30 cities the size of Nelson in 2006, or 18 months of coal-fired production from Huntly (at 2006 levels). In transport, cumulative savings by 2025 are projected to be around 4.8 billion litres of fuel

³⁹ NZES (Chapter 7, page 44)

⁴⁰ Speech by Government spokesperson on energy efficiency (11 October, 2007)

The underlying philosophy is that investment should occur in energy efficiency measures where this is cheaper than the long term costs of building extra generation capacity, including environmental costs.



Source: NZEECS backgrounder

This graph shows how much electricity could be saved at a cost lower than providing new generation. The blue bars show how much savings in electricity is realistically achievable. The maroon bars indicate the level of electricity savings that are cost-effective (although beyond what it is reasonable to expect can be achieved). The gap between the two bars, which is most marked in the residential and commercial sectors, highlights the great potential for energy efficiency across the economy by showing untapped opportunities for cost-effective savings.

Five key actions:

The New Zealand Energy Efficiency and Conservation Strategy 2007 targets actions in five areas:

1. Energywise homes

This is a programme which aims to promote warmer, drier and healthier homes with reduced energy costs.

2. Energywise business

This programme targets the business sector, with the goal of making businesses more energy efficient and competitive through using more renewable energy and emitting less carbon dioxide.

3. Energywise transport

Transport is a major user of energy, as New Zealanders have a strong desire for travel and mobility. Transport is also seen as a significant contributor to greenhouse gas emissions.

Waikato Regional Energy Strategy

The government has a number of strategies in place relating to transport issues. These include the New Zealand Transport Strategy, the NZES (which sets out a vision for a low carbon transport future) and the NZEECS, which provides specific goals and targets.

4. New Zealand's efficient and renewable electricity system

An efficient electricity system can help reduce peak demand. By relieving congestion on transmission and distribution networks, line losses can be reduced, system reliability improved, and overall costs to consumers reduced. The government believes that over time investment in new peaking generation, transmission and distribution assets (and their associated costs) may be delayed or avoided.

Reducing peak demand can also reduce emissions from fossil-fuelled generators that are currently required to provide power at peak times.

5. Local and national government actions

The NZEECS states that both central and local government have key roles to play in building a more reliable, resilient and renewable energy system. The government acknowledges that it has a responsibility to improve its own performance with regard to energy efficiency, conservation and the uptake of renewable energy.

How local government manages energy issues is also seen as having a major impact on the future use and development of energy resources. Central to this is both the regional planning for resource use, and local planning regarding the quality of urban form and design – especially in the way this influences the need for energy and transport services.

National Policy Statements

National Policy Statement on Electricity Transmission

This National Policy Statement (NPS) was gazetted in March 2008. It sets out the national significance of the national electricity grid, and provides guidance for RMA decision makers, through establishing one objective and 14 policies. Local authorities are required to notify changes to their respective RMA plans to give effect to this statement within 4 years of date that the statement took effect (10 April 2008).

Overall objective

The stated objective of the NPS is:

“To recognise the national significance of the electricity transmission network by facilitating the operation, maintenance and upgrade of the existing transmission network and the establishment of new transmission resources to meet the needs of present and future generations, while:

- managing the adverse environmental effects of the network; and
- managing the adverse effects of other activities on the network.”

Proposed National Policy Statement on Renewable Electricity Generation

The proposed National Policy Statement (NPS) on Renewable Electricity Generation aims to “recognise the national significance of renewable electricity generation by promoting the development, upgrading, maintenance and operation of new and existing renewable electricity generation activities, such that 90 per cent of New Zealand’s electricity will be generated from renewable sources by 2025”.



Source: MED

The government has developed a proposed National Policy Statement for Renewable Energy, which will provide guidance for councils and other decision-making agencies about the comparative importance of renewable electricity generation

The NPS has been developed partly to counter concerns that the NZES is not recognised under the RMA as a matter to which councils and courts must have regard to. An NPS is considered to be one way to assist decision makers by setting out clear objectives on renewable energy.

Announced in August 2008, the proposed NPS will be considered by an independent Board of Inquiry, which will receive public submissions and report back to the Environment Minister on the proposed NPS before it is gazetted.

Policies contained in the NPS are:

- recognising the national significance of the benefits of renewable electricity generation activities
- acknowledging the practical constraints associated with the development, upgrading, maintenance and operation of new and existing renewable electricity generation activities
- having regard to the relative reversibility of adverse effects associated with particular generation types
- enabling identification of renewable electricity generation possibilities
- supporting small and community-scale renewable electricity generation.

Part 3 - The regional context

Waikato's economic and energy profile

A snapshot of Waikato's energy profile

The Waikato is New Zealand's premier electricity province, generating more electricity than any other single region in the country.⁴¹ The Waikato provides the backbone of the nation's electricity system, with almost 40 per cent of the nation's electricity generation capacity – and it is capable of generating up to 50 per cent of New Zealand's electricity when required.



Source: Environment Waikato

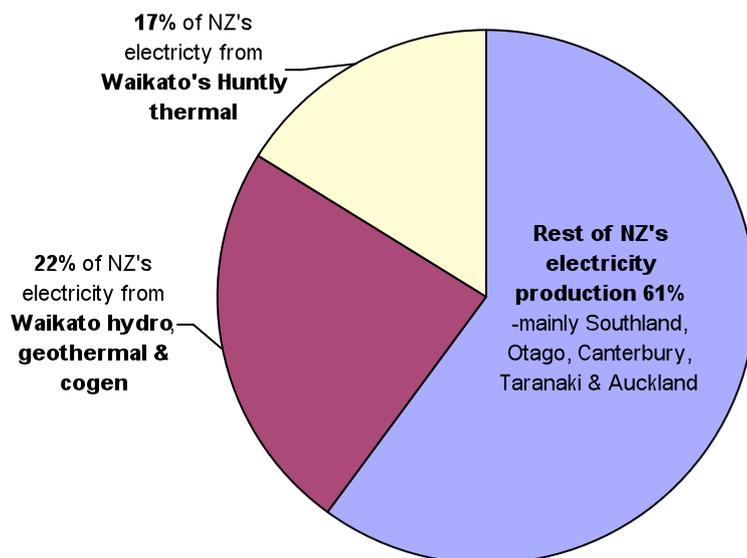
Abundant energy resources help to power primary industry, manufacturing and timber processing, which drives Waikato's economic growth.

⁴¹ The Waikato region has about 38.78 per cent of the nation's operating capacity (based on the MW capacity of grid-connected generating stations of approximately 8,397 MW listed in Transpower's 2008 Annual Planning Report (Table 6-1). No other region has as large a percentage of grid-connected operating capacity as the Waikato.

In addition to major hydro-power generation (on the Waikato River and Tongariro systems) and the Huntly coal and gas-fired electricity power station, the Waikato is well positioned with energy resources including:

- significant coal reserves, particularly around the Huntly area
- 80 per cent of New Zealand's geothermal fields
- cogeneration plants at major forestry and dairy industries
- significant potentials for wind power, wave power and biofuels.

The Waikato region has almost 40 per cent of New Zealand's electricity generation capacity – more than any other single region



The Waikato region has the largest percentage of electricity generation capacity in the country. Huntly thermal generation (including e3p) provides approximately 17 per cent of New Zealand's operating capacity, with the Waikato and Tongariro hydro systems, plus geothermal and cogeneration providing approximately 22 per cent of operating capacity (as per Transpower's 2008 data). While the bulk of the remaining operating capacity exists in the South Island, no other single region provides as large a percentage as the Waikato, because hydro is split between Otago, Southland and Canterbury.

Electricity from other regions

While the South Island hydro has anecdotally been seen as the powerhouse of New Zealand's electricity system, this generation capacity is split between Southland's Manapouri and White Hill (approx 9 per cent), Otago's Clutha River system (approx 10 per cent) and Canterbury's Waitaki system (approx 21 per cent). In addition, Auckland's Otahuhu B, Glenbrook and Southdown provide approx 7.5 per cent of installed capacity, while Taranaki's Kapuni and Taranaki combined-cycle stations provide approx 6 per cent, with the Hawkes Bay providing approx 3.5 per cent of generation capacity (including the reserve generation station of Whirinaki). Other smaller generation is provided by Bay of Plenty (approx 1.2 per cent), Horowhenua (2.5 per cent), and Nelson/Marlborough (0.5 per cent).⁴²

⁴² These percentages of generation capacity are based on Transpower's 2008 Annual Planning Report (Table 6.1), which gives an overall MW capacity of 8,397 MW. In some cases, the estimates of MW *operating* capacity in the Transpower report are lower than the figures provided by the generating companies for *installed* capacity. For example, Manapouri is rated by Meridian at 850 MW, while the Transpower figures list its operating capacity at 710 MW. The same applies to Taranaki oil-fired plant, which is listed at 300 MW installed capacity, but zero MW in operating capacity. This is because the Transpower figures are based on "operating" capacities, which is the capacity to which the stations can realistically generate up to, rather than "installed" capacity. However in order to gain an assessment of the Waikato's contribution to the nation's electricity generation, the figures for each region is based on Transpower's figures in order to provide accurate comparisons. Effectively this is a way of standardising the percentages.

Waikato Regional Energy Strategy

Thus, when looked at from an inter-regional perspective, the Waikato region with approximately 38.8 per cent can be seen as the premier electricity generating region in the country.⁴³

Table of the electricity production within the region

	Capacity (MW)	Output (GWh)
▪ Hydro		
Waikato	1040	
Tongariro	360	6000
▪ Thermal		
Huntly	1048	
e3p	400	10,000
▪ Geothermal		
Wairakei/Poihipi/Ohaaki (Contact)	300	
Mokai/Rotokawa (Mighty River Power)	135	3300
▪ Cogeneration	150	1125
	3433⁴⁴	20,425

Source: Mighty River Power presentation to Waikato Energy Forum, March 2007

The Waikato region has an installed generating capacity of 3433 MW, with a maximum potential output of up to 20,425 GWh. Generating capacity is measured in megawatts (1 million watts), which is a measurement of electricity generation capacity related to the *production* of electricity. The amount of electricity capable of being generated over a year is measured in gigawatt-hours (1 million units of energy), which is a measurement of the supply of electricity and is related to the amount of power available for *consumption*.

In the adjacent table, Waikato's hydro output can be up to 6000 GWh (when the load factors are taken into account), geothermal output 3300 GWh and cogeneration 1500 GWh, giving a total of up to 10,425 GWh. Similarly the potential combined output of the Huntly operations can be up to 10,000 GWh – giving an overall total of 20,425 GWh.

In terms of installed capacity, Waikato hydro and geothermal provide a generating capacity of approximately 1835 MW based on renewable energy sources. In addition, the combined installed capacity of the Huntly thermal and e3p stations totals 1448 MW. There is also approximately 150 MW from cogeneration at Te Rapa dairy factory, along with Kinleith. Cogeneration plants may use either renewable or non-renewable sources, for example Kinleith generates electricity using biomass, while Te Rapa uses gas or coal to generate electricity. (The Te Awamutu dairy factory also used to provide cogeneration of 54 MW, but this plant – operated by Genesis Energy – closed during the 2007/08 year).

National generation capacity

The amount of electricity generated nationally in the 2007 calendar year is approximately 42,374 GWh per annum (source: MED Energy Data files 2008). Therefore, at 20,425 GWh, the Waikato region has the potential to almost

⁴³ The Transpower figures take into account new wind projects like White Hill, and also deletes Te Awamutu's 52 MW cogeneration, which ceased in 2008. Kawerau geothermal (which commenced in 2008) is not yet listed in the figures

⁴⁴ This figure of 3,433 MW is calculated from data provided by Mighty River Power and Genesis Energy. This installed capacity figure for the Waikato is higher than the 3,257 MW used in calculations from the Transpower report. However, as MW capacity for other stations such as Manapouri is lower in the Transpower report than provided by Meridian, this suggests that the relative percentages across the country would be comparable at a similar level. Note that the Transpower report does not include non-grid-connected electricity generation.

generate up to 50 per cent of New Zealand’s electricity (particularly in dry years) – which emphasises the importance of Waikato’s electricity generation to the national economy.

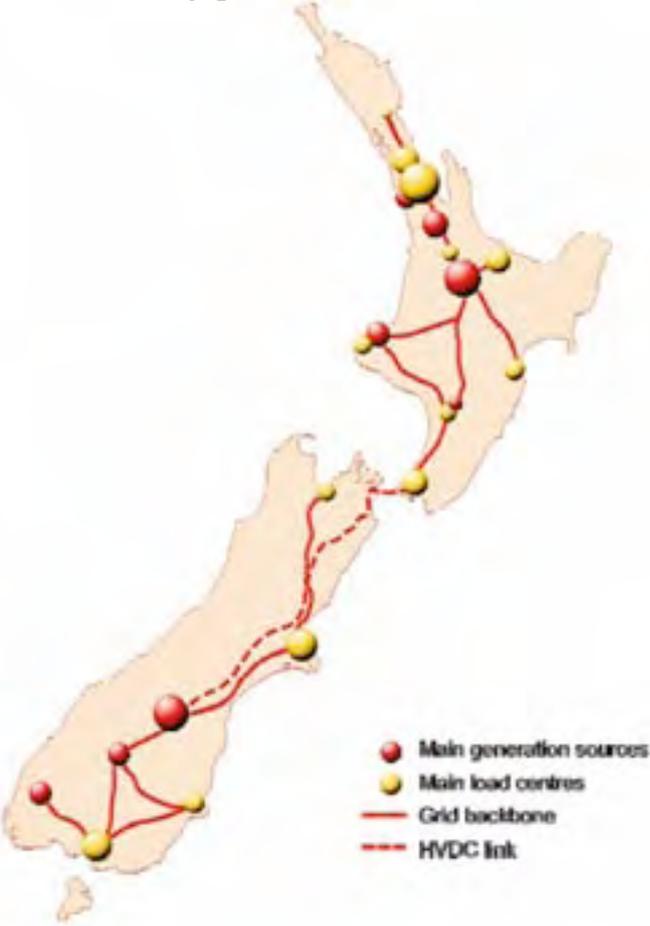
However, while the Waikato region has the capacity to generate up to 20,425 GWh over a year, the amount actually generated in the Waikato is determined by the wholesale electricity market and will depend of a number of factors (for example, hydrological conditions). In wet years, South Island hydro will tend to make up a greater percentage of generation, but in dry years thermal stations like Huntly will substitute for the decline in availability of hydro. Huntly also continues to provide an important baseload generation in both wet and dry years to meet fluctuations in market demand and supply availability. So while the Waikato has a maximum theoretical output capacity of 20,425 GWh, the region’s historical maximum of electricity production has been 19,000 GWh, with the average annual production over 1999–2005 standing at 17,761 GWh (prior to the commissioning of e3p).⁴⁵

Transmission of electricity

In addition to having the capacity to generate up to 20,425 GWh, the Waikato is also a major corridor for electricity transmission. As many of the nation's key electricity generation facilities are in the Waikato or to the south, much of New Zealand's electricity is transported through the Waikato. A significant portion of this electricity is actually generated in the Waikato itself – and exported to other regions.⁴⁶

Major sources of electricity generation and main load centres

Transpower's diagram shows that the Waikato region (including hydro, geothermal and Huntly thermal) is one of the major generators of electricity, along with the South Island hydro. However as Auckland is the largest load centre in the country, South Island electricity must pass through the Waikato region to service Auckland's demand, along with exported Waikato generation. Note that the Waikato contains two major generation sources (the Waikato/Tongariro hydro plus Taupo geothermal, and the Huntly thermal generation) within one region, whereas the South Island generation is spread across three regions – Otago, Canterbury and Southland.



Source: Transpower’s Annual Planning Report 2007

⁴⁵ Source: Transpower – information on GWh production from personal communication with strategy analyst.
⁴⁶ Source: Mighty River Power presentation to inaugural meeting of the Waikato Energy Forum, March 2007, and conversation with Transpower.

Other energy resources

The Waikato's position as the premier electricity province is likely to be further enhanced with the renaissance in geothermal (which involves an additional 400 MW of proposed projects), and the development of wind generation (with Contact's proposed 650 MW wind farm in north-west Huntly area, and WEL Energy's proposed 84 MW wind farm at Te Uku).

One of the key advantages of the Waikato is its close proximity to the major demand centre of Auckland, which means that transmission losses are lower compared with building generation to the south of the Waikato. This means there are advantages in harnessing Waikato's wind resources (although analysts see these as second-tier in wind strength and reliability, compared with the Wellington and Horowhenua areas), as well as developing additional geothermal capacity from the Taupo area.⁴⁷

In addition to acting as both a producer of electricity and a transmission corridor to Auckland and Northland, the Waikato also provides a transmission corridor for gas from Taranaki, as well as acting as the centre of a transport hub linking the ports of Auckland and Tauranga.

Gas



Source: ClipArt

Biomass and biofuels



Source: Wikipedia

Wave



Source: Clipart

The Waikato has a range of energy resources, which act to further supplement its crucial role in national electricity generation.

Apart from its strengths in electricity generation, the Waikato region is also a major producer and exporter of coal. Another major potential energy source is biomass (particularly in the form of forestry and agricultural by-products), as well as offering biofuel potentials from woody biomass, waste and agricultural sources. The NZES points out that the development of these second generation biofuels (which are considered less likely to compete with food supplies or promote unsustainable land use), will help reduce New Zealand's dependence on oil-based fuels.⁴⁸ As oil prices rise, these types of non-fossil fuel products will become more financially viable, and show strong promise for meeting future growth in energy demand, particularly in the transport sector. Another exciting new technology (although still in the developmental stage) is the harnessing of wave energy off the west coast, which offers significant potential as a future electricity source.

The Waikato's abundance of energy resources (which are addressed in detail in subsequent chapters) provides an important driver of economic growth within the region. Electricity generation and supply, of itself, creates sales of \$800 million a year for the region, and employs more than 10,000 people.⁴⁹

⁴⁷ However more development of geothermal will require investment in parts of the main grid to handle the additional injection of electricity (see Transpower's Wairaki ring project - in 2007 APR-2.6.2)

⁴⁸ New Zealand Energy Strategy (page 47)

⁴⁹ Data from Katolyst briefing paper on the Waikato region - December 2006

Waikato's economic drivers

Apart from the region's role as a leading player in energy production and electricity generation, the Waikato has been characterised as the nation's food bowl and the agri-biotech capital of New Zealand.

According to the economic development agency Katolyst, this status is founded on our agricultural base and our potential for innovation, which make the Waikato so successful as 'an export engine'.

Key economic drivers include:

Dairying

The region is the major dairy production area in New Zealand, with dairy farming and processing generating \$4.7 billion dollars in sales (2004 figures)⁵⁰, and employing more than 42,000 full-time equivalents. The processing of dairy products is energy intensive – an important factor to the Waikato economy as the Te Rapa dairy factory to the north of Hamilton accounts for 25 per cent of Waikato milk production.



Source: Environment Waikato

Dairying generates annual sales of more than \$4.7 billion for the Waikato.

Pastoral farming

Sheep, beef, deer and processing bring in sales of \$2.1 billion, and employ more than 30,000 full-time equivalents.

Forestry

Forestry and logging, which is primarily located in the Taupo, South Waikato and Rotorua sub regions, generate sales of around \$500 million, and employ more than 6000 full-time equivalents.

As Waikato forestry is not located adjacent to a port, forest products must be transported via a combination of road and rail to the Port of Tauranga – which requires energy in the form of transport fuel.

⁵⁰ Sales and employment figures from Katolyst briefing paper on the Waikato region - December 2006

Education and scientific research

The Waikato has a strong tertiary base (Waikato University, Wintec, Ruakura, Dexcel, NIWA, Scion, Livestock Improvement etc) with the region's scientists undertaking 25 per cent of New Zealand's research. The education and scientific research sector generates sales of more than \$800 million, and employs more than 18,500 people.

Manufacturing centre

The Waikato is a national centre for specialised engineering including the design and manufacture of food processing and packaging equipment, plastics, light aircraft and small boat manufacturing. This manufacturing base, which produces over \$2 billion worth of components and equipment for the agriculture, food, aviation and marine industries, employs more than 15,000 people.



Source: www.gallagher.co.nz

Gallagher's electric fencing systems provide a synergistic combination of the Waikato region's key strengths – electricity generation and dairying production, combined with specialist engineering and manufacturing – and have enabled the company to become a successful international exporter.

Tourism

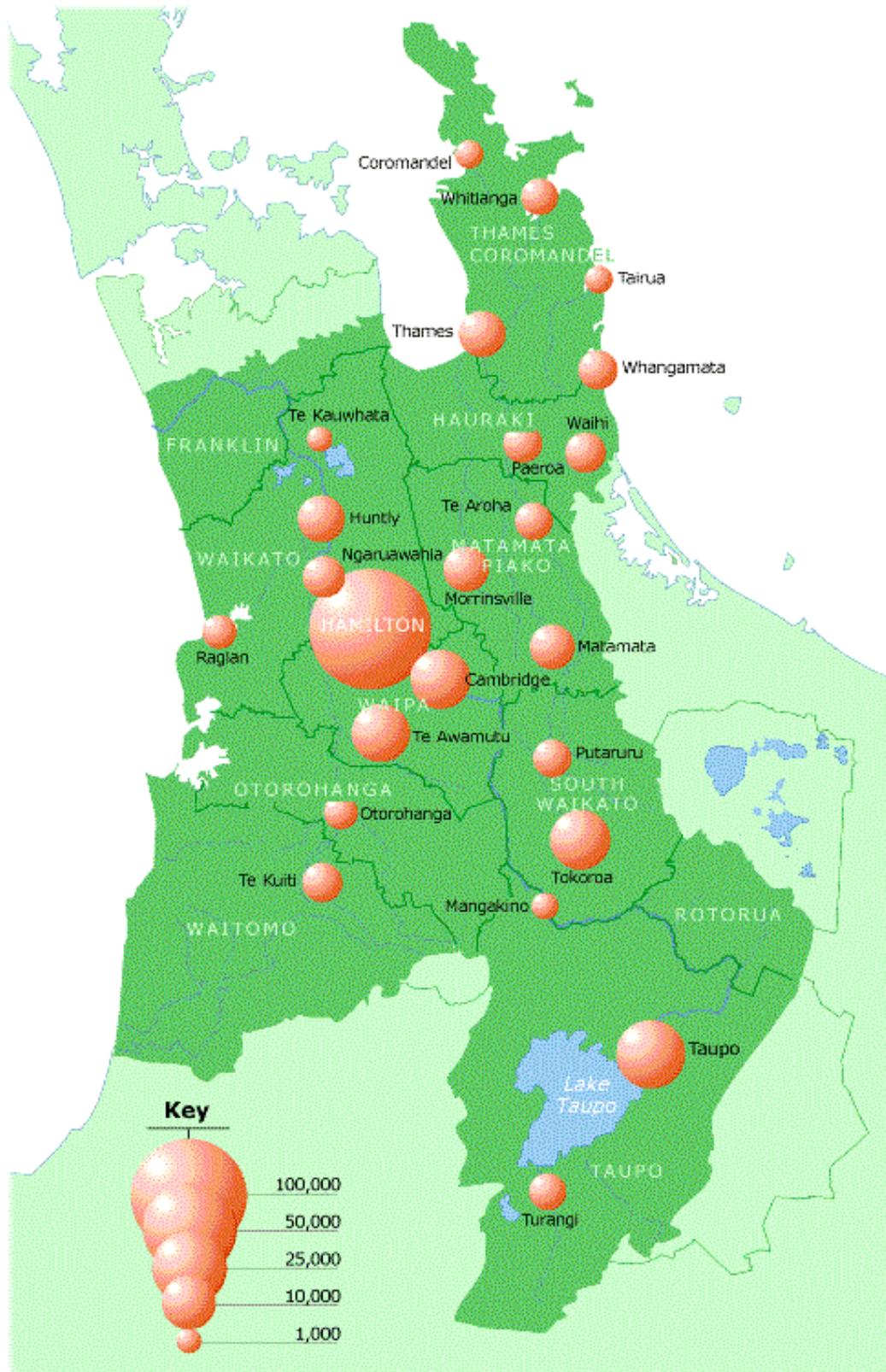
This is another major growth sector for the Waikato economy, with Waitomo Caves as the third most visited tourist destination in New Zealand.⁵¹ Coastal-based tourism activities in the Coromandel and west coast, and the strong promotion of lake and thermal activities at Taupo also attract increasing numbers. In addition, the city of Hamilton is now positioned as a major events centre with Hamilton Gardens, Mystery Creek and the V8s.

Each of these sectors has differing energy demands, which place different burdens on the energy sector.

Demographics

Another key element in energy demand is population growth. The Waikato region contains 9.5 per cent of New Zealand's population – and has grown 7 per cent (24,990 people) since the 2001 census to reach 382,716 by the 2006 Census. The Waikato region's population ranks fourth in size out of the 16 regions in New Zealand. See map on next page.

⁵¹ Source: Waikato Regional Land Transport Strategy



Source: Environment Waikato analysis of Statistics Department census data
Population projections suggest that the region's population will continue to increase over the next 20 years – with significant growth projected in Hamilton city.

Projected population growth

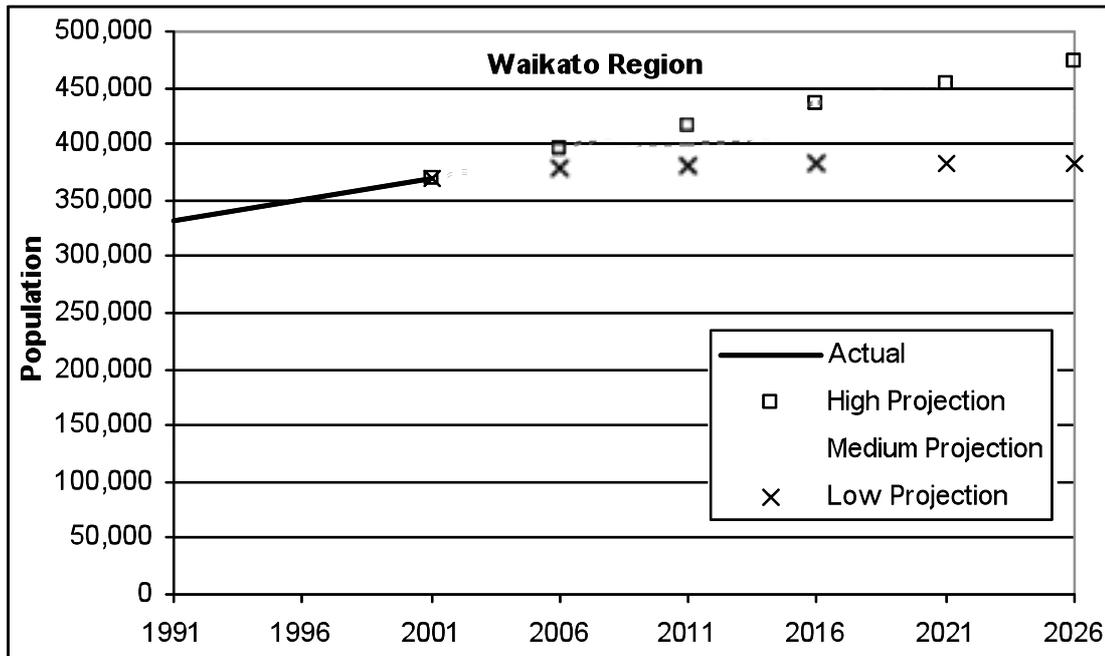
In the University of Waikato report 'Demographic Change and Transport Needs in the Waikato Region', the population demographers (using a medium growth

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scenario) predict that the Waikato regional population is expected to grow 15.4 per cent between 2001 and 2026, compared with 21.9 per cent nationwide.⁵²

Comparing low with high growth scenarios, the demographers estimate that Waikato population growth between 2001 and 2026 could be as low as 3 per cent, or as high as 28 per cent.

Population projections suggest that 94 per cent of this total growth will occur in the Hamilton, Waikato and Waipa sub-regions – which is likely to drive a significant demand for energy use, particularly in Hamilton city. Other regional growth spots include Franklin, Thames-Coromandel and Taupo districts.



This graph shows the projected population for each of the three scenarios (high, medium and low). These projections result in markedly different population estimates for 2026, ranging for the total Waikato region from a low of 381,700 (approximately 3 per cent more than 2001) up to a high of 473,100 (28 per cent more than 2001)⁵³.

Ageing population and social demographics

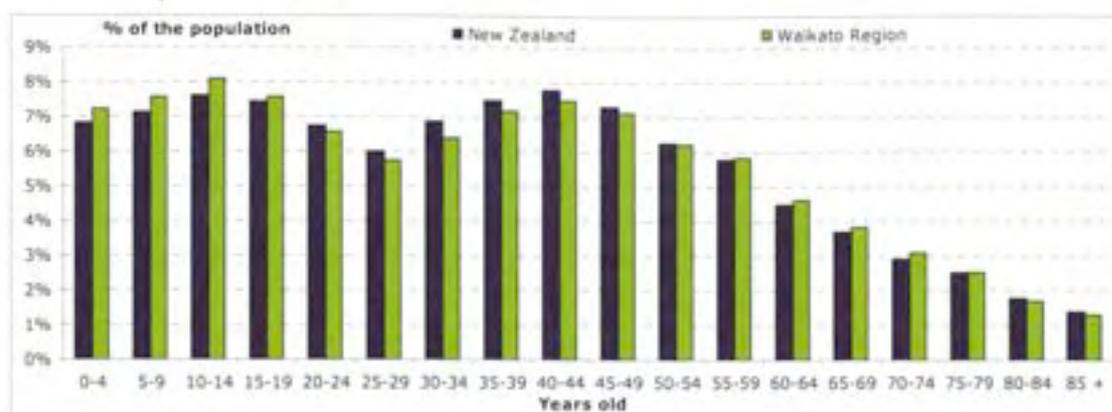
Demographers point out that the 'dependent populations' (those aged under 14, and those aged 65 and over) compared with the working age population are higher in the Waikato region than nationally. Structural ageing (the increase in the share of those aged 65 and over) will take place in all Waikato local body areas between 2001 and 2026, with the projected increase ranging from 5.9 per cent points in Hamilton city to 20.3 percentage points in the Hauraki district.

The proportion of the population aged 75 and over is growing faster in the Waikato region than in New Zealand as a whole, which has implications for health care and transportation.

⁵² Demographic change and transport needs in the Waikato region – Sandra Baxendine, Bill Cochrane and Jacques Poot from Waikato University 2005 (Executive summary)

⁵³ Graph source: Ibid (page 16)

Waikato's population v NZ demographics by age



Source: Department of Labour regional statistics

The under 14 and over 65 age groups (which often rely upon the working age population for support) is higher in the Waikato region than nationally.

In addition, the Waikato region has a higher proportion of Māori (and lower proportions of Pacific and Asian populations) than the nation. However, ethnic diversity is expected to increase further. The percentage of Europeans is expected to remain relatively high in Thames-Coromandel, Hauraki, Matamata-Piako and Waipa. The percentage of Māori is projected to be about, or more than, double the national average in Waikato, Otorohanga, South Waikato, Waitomo and Taupo districts.

Overall, the growth of population, combined with ageing demographics (which impact on things like public transport) are likely to put additional demand on existing energy supplies and infrastructure over the coming decades.

Regional climate change predictions

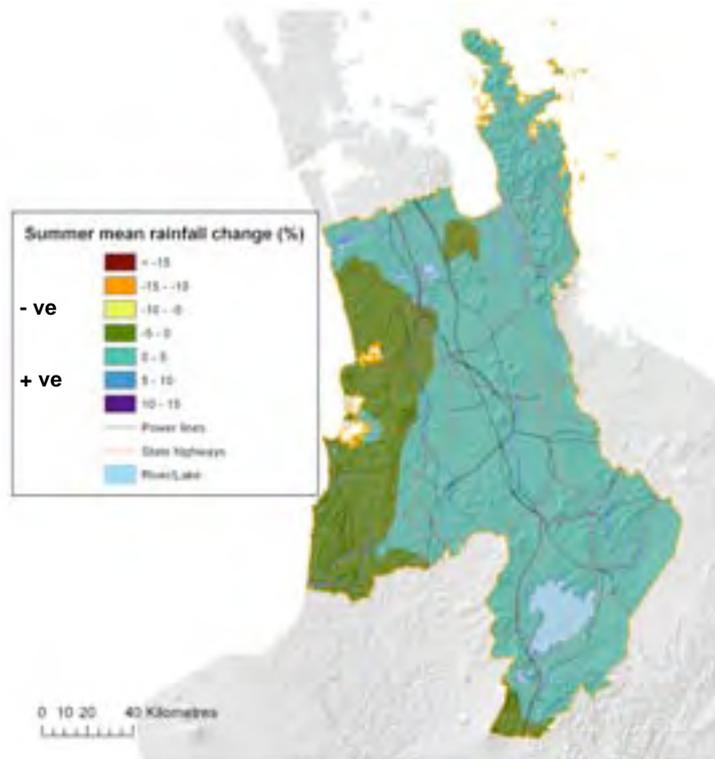
NIWA predicts that temperatures within the Waikato region are likely to be hotter and drier on the east coast, and wetter and windier on the west coast in coming decades. In the Waikato, latest figures suggest that annual rainfall is expected to increase by up to 19 per cent by 2080. Meanwhile in the southwest, the Taranaki region is predicted to see annual rainfall increase by 22 per cent. Over on the southeast coast, Hawke's Bay is likely to see droughts occurring much more frequently – with today's one in 20 year droughts occurring closer to once every five years.⁵⁴

However the 19 per cent increase in rainfall predicted for the Waikato represents an annual average figure across the whole region – and patterns of rainfall are likely to vary significantly between different districts, as well as showing changing patterns compared with traditional summer and winter rainfall.

⁵⁴ Information from the Minister of Climate Change's office – July 2007

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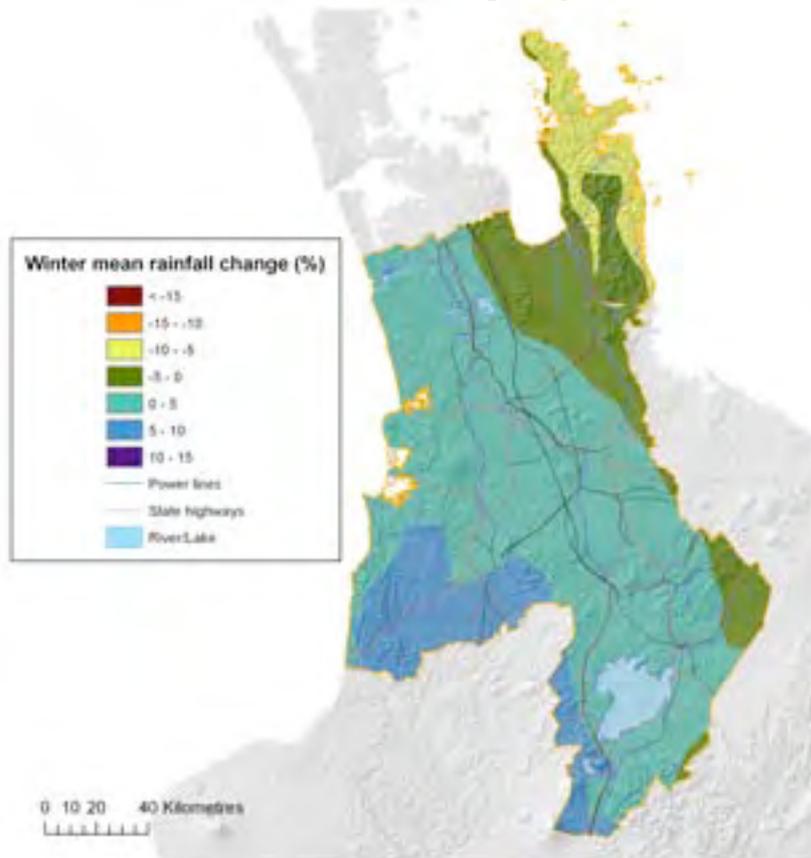
Predicted rainfall changes by 2040 - Summer



Source: NIWA

NIWA's predictions indicate that the Waikato's west coast and the Tokaanu district are likely to get 5 per cent less rain in summer by 2040, while the rest of the region gets approximately the same summer rainfall as now.

Predicted rainfall changes by 2040 - Winter

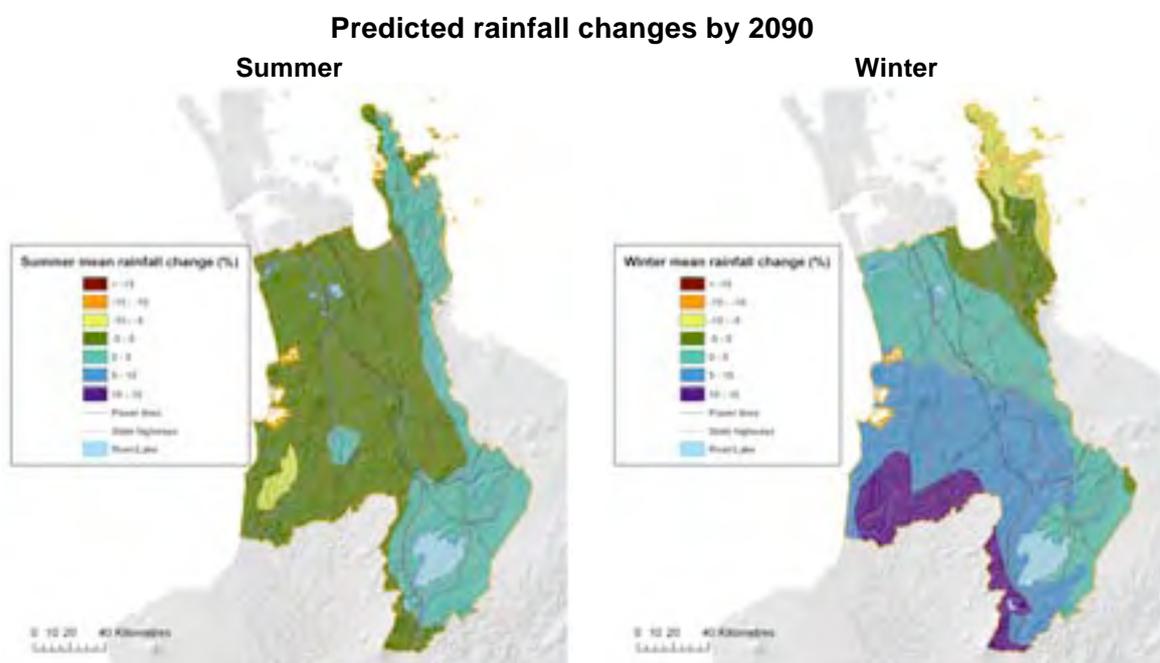


Source: NIWA

NIWA's predictions indicate that the Waikato's south-western area is likely to get up to 10 per cent additional rainfall in winter by 2040. While the central part of the region is likely to see its rainfall pattern relatively unchanged, the Coromandel is liable to face up to 10 per cent less rainfall in winter, while the Matamata-Mamaku area faces a 5 per cent decline.

Across New Zealand, climate change is also likely to bring an increased frequency of severe weather events, such as droughts, floods and storms. Tropical cyclones are also predicted to increase in frequency and intensity, particularly on the east coast. The impact of climate change will alter growing seasons within the region, and increase the risk of biosecurity threats, such as mosquitoes carrying tropical diseases. Government agencies say that New Zealand needs to look at changing our cultivars, storing more water in drought-prone regions, and readying our towns and cities so they are less flood-prone.⁵⁵

Climate change is also likely to have an impact on the demand for energy, with warmer winters likely to reduce peak demand for winter heating, while hotter summers may increase demand for air-conditioning – until building design and construction address this change in climate. Climate change is a factor that needs to be taken into account in energy planning – although the indications to 2040 suggest that the Waikato River system will be largely unaffected by reduced rainfall. However by 2090, NIWA predictions suggest the Waikato region will see less summer rainfall.⁵⁶



Source: NIWA

Summer – NIWA’s predictions indicate that by 2090 there will be up to 5 per cent less summer rainfall across most of the region. However this will be offset by up to 5 per cent increased summer rainfall around the Mamaku and Coromandel Ranges. A pocket of land in the Te Kuiti-Taumaranui-Mokai area is projected to see up to 10 per cent less summer rainfall.

Winter – NIWA predicts much heavier rainfall (up to 15 per cent more) in the southwest of the region and around Tokaanu. The western and lower-central region is likely to see up to 10 per cent more rainfall, while the central region including Hamilton is likely to be comparatively unchanged from current winter rainfall patterns. However the Hauraki Plains are projected to be 5 per cent drier, with the northern-Coromandel 10 per cent drier.

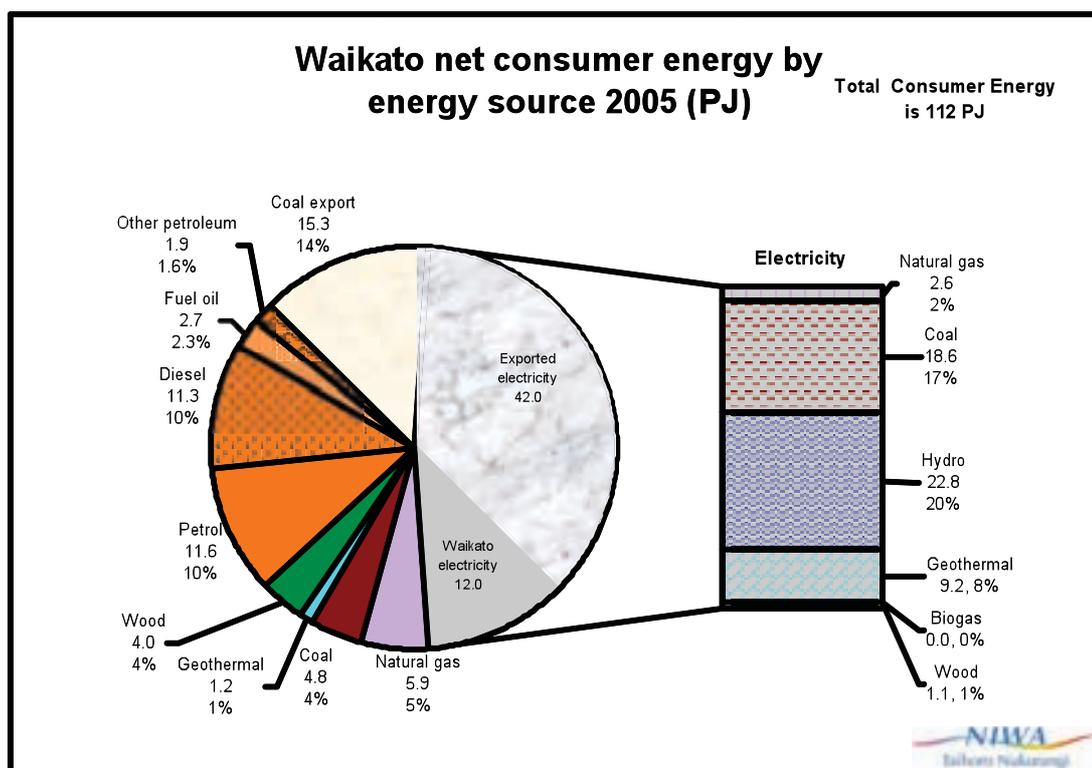
⁵⁵ Ministry for the Environment “Preparing for and Adapting to Climate Change”

⁵⁶ Overseas, climate change is already throwing up issues regarding security of energy supply. The severe flooding in Britain in July 2007 has seen power stations shut down due to rising floodwaters, leaving thousands without power. In Europe, soaring temperatures in both 2003 and 2007 caused deaths, and increased power demand for services like air-conditioning.

Part 4 - Waikato's energy profile

The data for analysing the supply and demand of energy within the Waikato region is not readily available, as the Ministry of Economic Development collects energy statistics primarily on a national basis, rather than breaking these figures down to a regional level. To overcome this problem, Environment Waikato commissioned the National Institute of Water and Atmospheric Research (NIWA) to map out the specific energy equation in the Waikato.

The NIWA analysis⁵⁷ shows that the Waikato is particularly strong in geothermal, coal and hydro as energy sources. It also highlights just how important electricity generation is within the Waikato region. (see right-hand box in the graph below).



This pie chart highlights the importance of electricity generation to the Waikato region. Electricity generation, which comes primarily from hydro, geothermal, coal and gas, accounts for almost 50 per cent of the net consumer energy within the region (54 PJ). However a significant percentage of the Waikato's electricity (42 PJ) is exported to other parts of the country. The other point to note is that the Waikato, like New Zealand in general, is still heavily reliant upon petroleum imports, which account for almost 25 per cent of net consumer energy (petrol 10 per cent, diesel 10 per cent, and other oil 3.9 per cent).

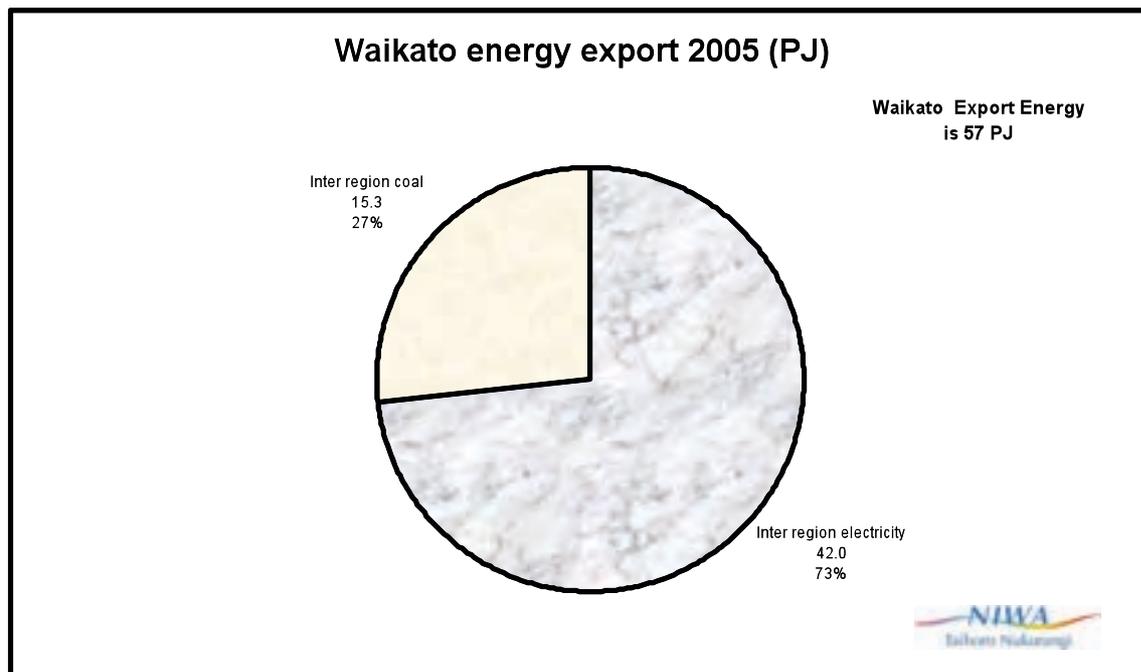
The NIWA figures show that a total of 112 petajoules (PJ) of energy are available for consumption in the region – and almost 50 per cent of this net consumer energy (54 PJ) is in the form of electricity. As can be seen from the pie chart on the previous page, this electricity is derived from a number of sources including:

- hydro 20 per cent
- coal 17 per cent
- geothermal 8 per cent
- natural gas 2 per cent
- wood (in cogeneration plants) and biogas 1 per cent.

⁵⁷ NIWA-CRL Energy "Waikato Energy Balance" 2007 (page 2)

Energy exported

Another interesting point to note is that almost 75 per cent of the electricity generated within the Waikato region is exported to other regions within New Zealand. Of the estimated total of 54 PJ electricity generation within the region, Waikato users consume just 25 per cent (12 PJ), which means that after transformation and transmission losses, 42 PJ is available for export to other parts of New Zealand. This 42 PJ of exported electricity, along with 15.3 PJ of exported coal, mean that the Waikato region is a major supplier of energy to other parts of the country.



The Waikato region is a major exporter of energy to other parts of New Zealand. Electricity and coal.

Reliance on petroleum

However, despite being a major producer and exporter of electricity, the Waikato region, like New Zealand in general, is still heavily reliant upon petroleum imports. Adding together the Waikato's net consumer energy use of petrol, diesel, fuel oil and other petroleum products shows that petroleum products account for 24 per cent of the region's net consumer energy.

Measurement units

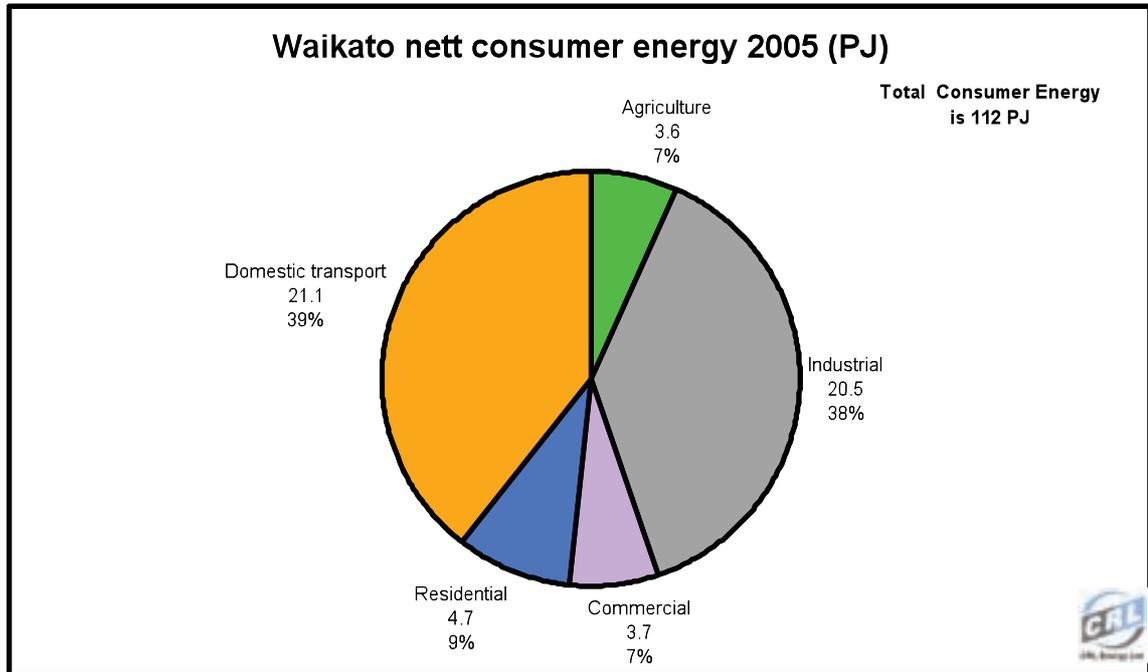
The international unit of energy measurement is a joule.⁵⁸ A petajoule = 10^{15} (one quadrillion) joules. This is the unit most often used to measure energy production and use on a national scale. One petajoule, which is estimated to cost between \$20 and \$30 million to produce in New Zealand, is roughly equivalent to:

- over 10 days output from the Huntly Power Station at full capacity
- a coastal tanker load of 25,000,000 litres of oil
- the annual electricity consumption of 35,000 households
- 140 years (1.2 million hours) of electricity generated by a 1 MW wind turbine.

⁵⁸ NZES (page 106)

Where is the Waikato's energy used?

The importance of petroleum products to the regional economy is highlighted when an examination is undertaken of which sectors use most of the available energy. The greatest demand within the Waikato (once the inter-regional export of energy is removed from the equation) comes from transport (39 per cent).



Transport is the greatest user of consumer energy within the Waikato, followed by industry (which includes agricultural processing of meat, dairy and forestry), then residential and commercial uses. Agriculture, which represents 7 per cent of energy use, is almost double the national average, as would be expected given the Waikato's strong dairying background.

As would be expected in the Waikato, agriculture is a significantly higher user of energy (7 per cent) than the national average (4 per cent). On top of this, industrial uses of electricity, which include agricultural processing such as Fonterra's dairy operations, meat industry plants, and forestry processing, represent 38 per cent of the total Waikato net consumer energy. This compares with the national average of 30 per cent.

Energy use by sector – comparison of national v Waikato

Sector	New Zealand	Waikato
Agriculture	4 per cent	7 per cent
Industrial	30 per cent	38 per cent
Commercial	9 per cent	7 per cent
Residential	12 per cent	9 per cent
Transport (national)	37 per cent	39 per cent
Transport (international)	8 per cent	–

Energy exported within New Zealand

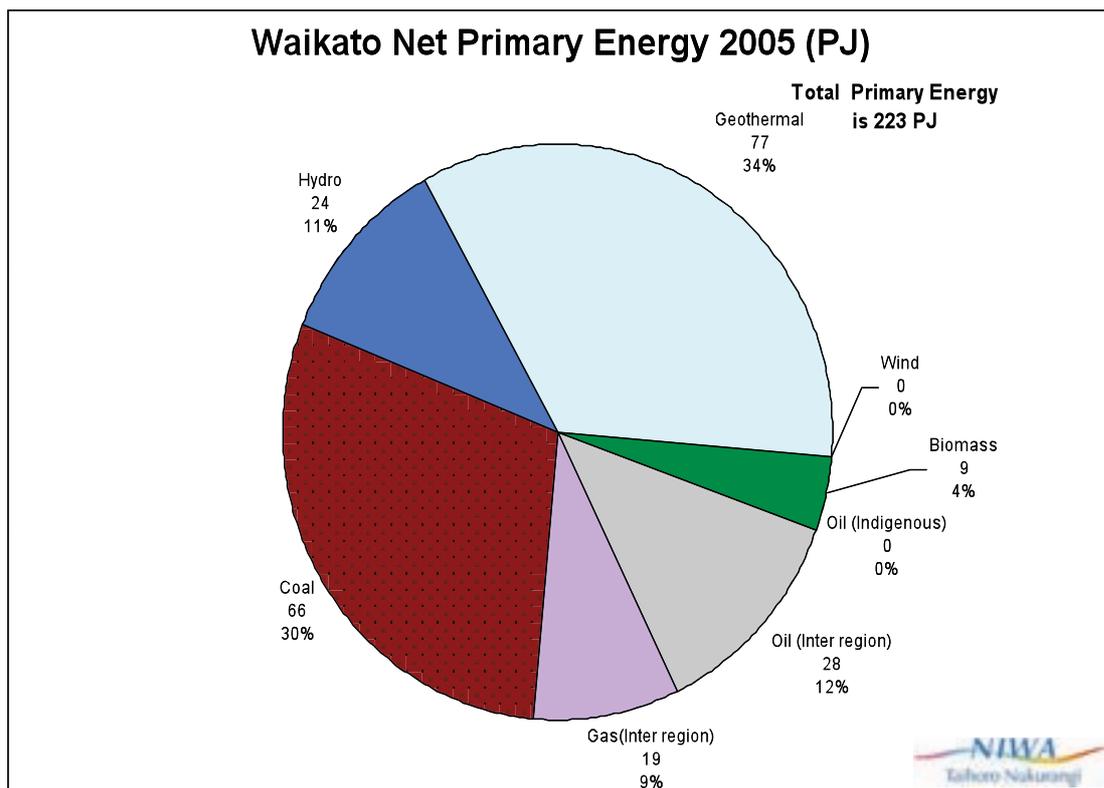
Electricity (42 PJ) and coal (15.3 PJ) = 57.3 PJ

Source: National figures from NZ Energy Outlook (p17); Waikato figures from NIWA regional analysis

When compared with the national figures, the Waikato is a much bigger user of energy in industry (38 per cent Waikato compared with a national average of 30 per cent), and agriculture (7 per cent Waikato compared with 4 per cent nationally).

Energy flows across the regional economy

In order to show energy flows across the Waikato economy, NIWA have prepared a Sankey diagram (page 48). In this chapter, the *outputs* in terms of the energy available for consumer use, and the comparative weightings of energy used by various sectors such as industry, residential or agriculture have been illustrated in the previous pie charts. However, in order to accurately assess the flow of energy across the economy, it is necessary to examine the *inputs* in terms of Waikato's net primary energy. This *primary* energy (as opposed to net *consumer* energy) calculates the energy available for transformation as it is first obtained from natural resources.



This pie chart shows the net primary energy available in the Waikato. Net Primary energy is measured at the source of energy, so the figure for geothermal appears disproportionately high, as there are considerable losses in the process of transforming geothermal energy into electricity for consumer use. This issue is addressed in the Sankey diagram, which provides a clearer overall picture.

Reliance on this type of net primary energy statistic can lead to confusion as is highlighted in the Waikato, where geothermal appears to distort the actual picture of energy capability within the region. For while geothermal is an important resource within the region, it does not out-produce hydro when it comes to providing a usable *consumer* energy product like electricity. However when measured as net primary Energy, the geothermal component is very high at 34 per cent, compared with the input of hydro (11 per cent). The problem with relying on primary energy data relates to the fact that while geothermal may be the largest primary energy source in the Waikato (at 77 PJ), this energy potential is significantly reduced when it is converted to electricity. Typically geothermal achieves only 10 per cent efficiency for pre-1999 power plants, and 15 per cent for power plants built after 2000.

The Sankey diagram

In order to overcome the potential for confusion created by relying on net primary energy to assess the energy resources available in the region, we should look at NIWA's Sankey diagram (on the next page). This diagram shows energy flows across the Waikato economy. It shows *inputs* in terms of energy sources on the left hand side, and the *outputs* in terms of consumer demand by sector on the right hand side. The thickness of the lines within the diagram illustrates the strength of energy flows.

The Sankey diagram indicates that while for example, geothermal is a large contributor to Net Primary Energy (77 PJ out of a total 223 PJ), its generation potential drops significantly as it passes across the diagram through the transformation process. This means that by the time it reaches the consumer (on the right hand side of the diagram), the amount of geothermal energy available drops down to only 9.2 PJ.

The Sankey diagram shows that hydro, geothermal, coal, gas and biomass all contribute to electricity generation in varying degrees. Over 70 per cent (42 PJ) of the Waikato regions electricity generation is exported to other regions.

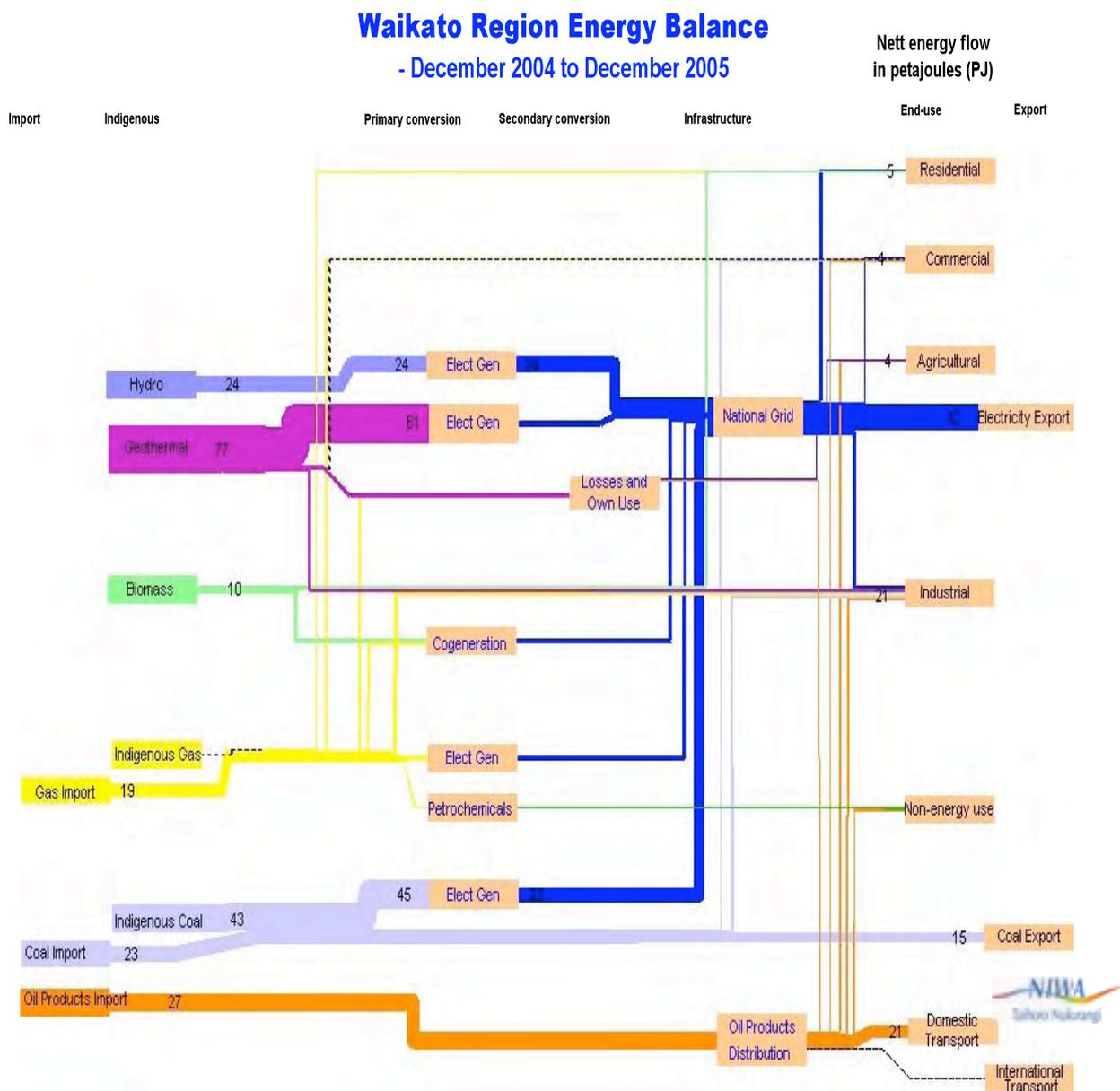
When it comes to transport within the Waikato region, the Sankey diagram shows that this is primarily fuelled by petroleum products – which need to be imported into the region, along with natural gas from Taranaki.

Sankey diagram data sources

It is worth noting that the figures in Sankey diagram for consumer energy use within the Waikato are estimates only, based on available data through information like grid exit points. In arriving at these figures, NIWA/CRL Energy have taken into account historical and projected regional population, vehicle statistics, dwelling stocks, employee numbers and GDP statistics – and then used these statistics to pro-rata energy consumption using ratios from the national energy balance. In lieu of taking direct measurement of energy usage through detailed business and household surveys, these figures provide a basic snapshot of the energy supply and demand in the region. They give a means of comparing the Waikato's unique characteristics (such as the high proportion of dairying, and the coal and gas-fired electricity generation) with the national picture.

The Sankey diagram (next Page)

The Sankey diagram



The Sankey diagram illustrates the three big contributors to electricity generation within the Waikato – hydro, geothermal and coal (indigenous and imported). Note that while geothermal is large as a primary source of energy, it experiences significant losses in the conversion to electricity so that once it enters the grid, its output falls from 77 PJ to 9.2 PJ. (For large format of Sankey diagram see Appendix 3).

For a larger version of the Sankey diagram, see the Appendix 2.

Part 5 - Waikato's electricity generation

As the Waikato region is New Zealand's premier electricity province (with the capacity to generate up to 50 per cent of the nation's electricity when required), this chapter is devoted to the wider electricity generation issues within the region. Subsequent chapters will deal specifically with the region's wider range of energy resources, such as geothermal, wind, hydro, marine, coal, gas, solar and biomass.

Aratiatia
Dam and
rapids



Source: Environment Waikato

The Waikato River has been a major source of hydro electricity for many years. The Aratiatia Dam was commissioned in 1964.

Electricity generation

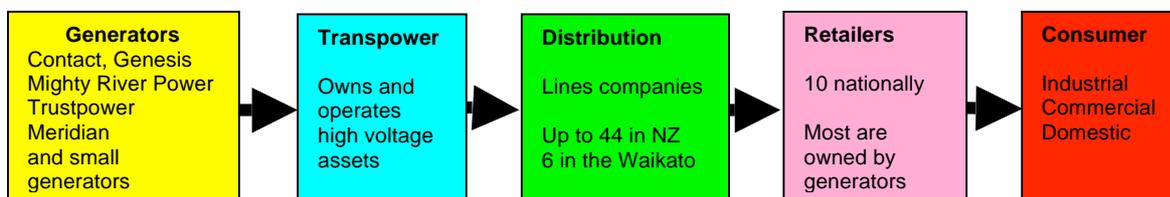
Structure of the electricity system

There are five major components of the electricity system nationally, which are also represented at the regional level. These are electricity generation, transmission on the national grid, local distribution via the lines companies, retailing of electricity and use by consumers.

Generation: Nationally, there are five major operators involved in electricity generation – with a mix of private and state-owned enterprises. They are, in alphabetical order: Contact Energy (private company with 27 per cent of national generation capacity⁵⁹), Genesis Energy (SOE with 18 per cent), Meridian (SOE with 30 per cent), Mighty River Power (SOE with 12 per cent), and Trustpower (private company with 5 per cent).

In addition there are several small generators (as well as on-site cogeneration plants) which are mainly private or locally owned, and account for 8 per cent of national generation capacity. For example, King Country Energy operates small hydro generation to the west of Lake Taupo.

In the Waikato region, generation is dominated by three main players – Contact Energy (which is strong in geothermal energy), Genesis Energy (which operates the Tongariro hydropower scheme and the Huntly thermal stations) and Mighty River Power (which is the dominant player for hydro generation on the Waikato River). Trustpower is strong in the Bay of Plenty region and elsewhere, and Meridian is a dominant player in the South Island market (but is also involved in some small scale Waikato projects relating to geothermal heating and biogas production).



Transmission: The transmission system, which consists of a network of high voltage assets, is owned and operated by Transpower New Zealand Ltd. Transpower is a state-owned enterprise (see next section for more details).

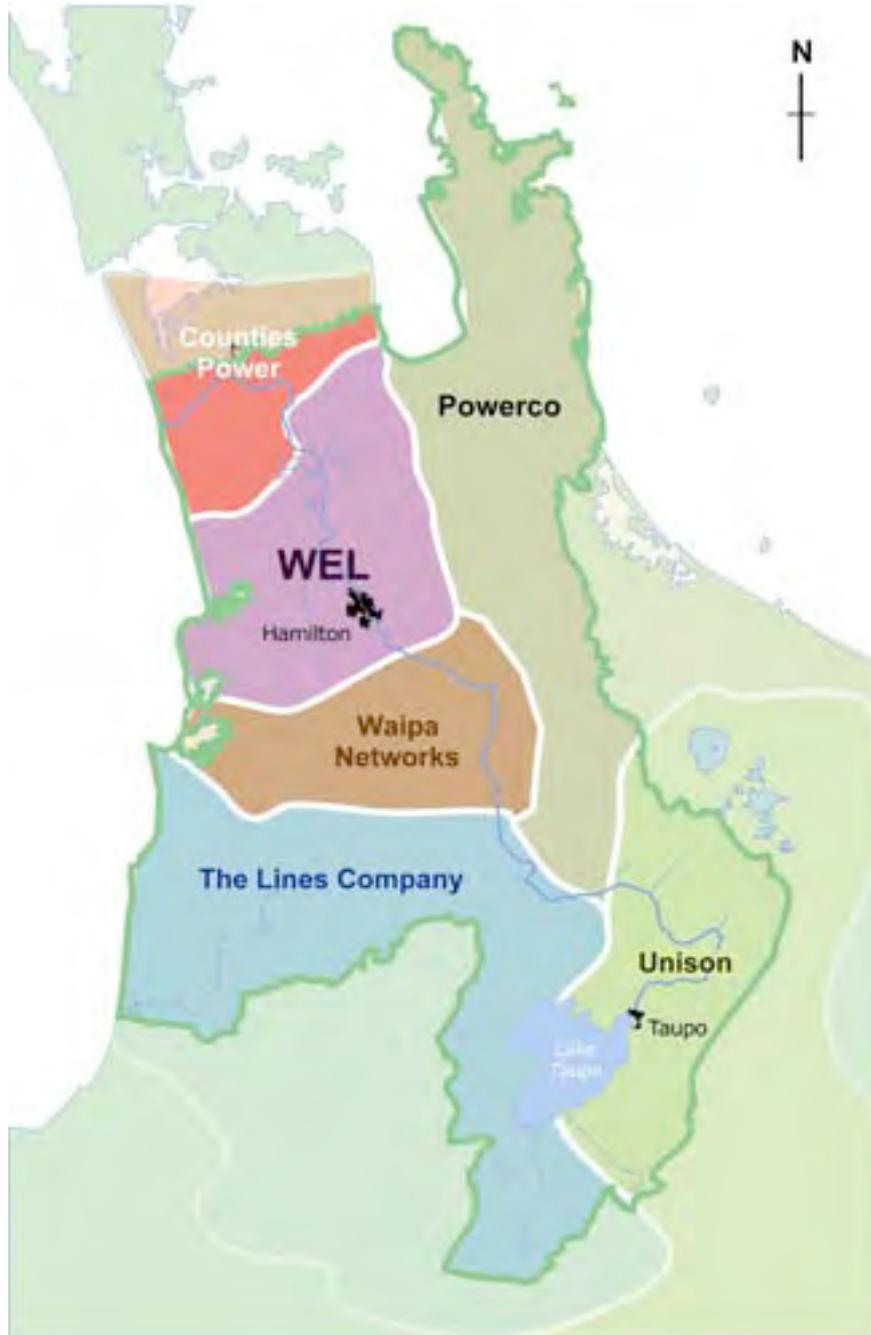
Local distribution: Nationally there are 28 significant line companies (and up to 44 in total including small private networks), which are responsible for transporting power to the user. These companies are a mix of privately-owned operations and locally-owned community trusts.

In the Waikato region, there are six lines companies which operate distribution networks. They are Counties Power, WEL Networks Ltd, Waipapa Networks Ltd, Powerco, The Lines Company and Unison. Four of these lines companies (Counties Power, Powerco, The Lines Company, and Unison) also own networks outside the region.

⁵⁹ Percentages of generation capacity from Energy Data File 2008 (page 94)

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Map showing the six lines companies operating in the Waikato region



Source: "Background report on Energy for the Waikato region – Electricity"

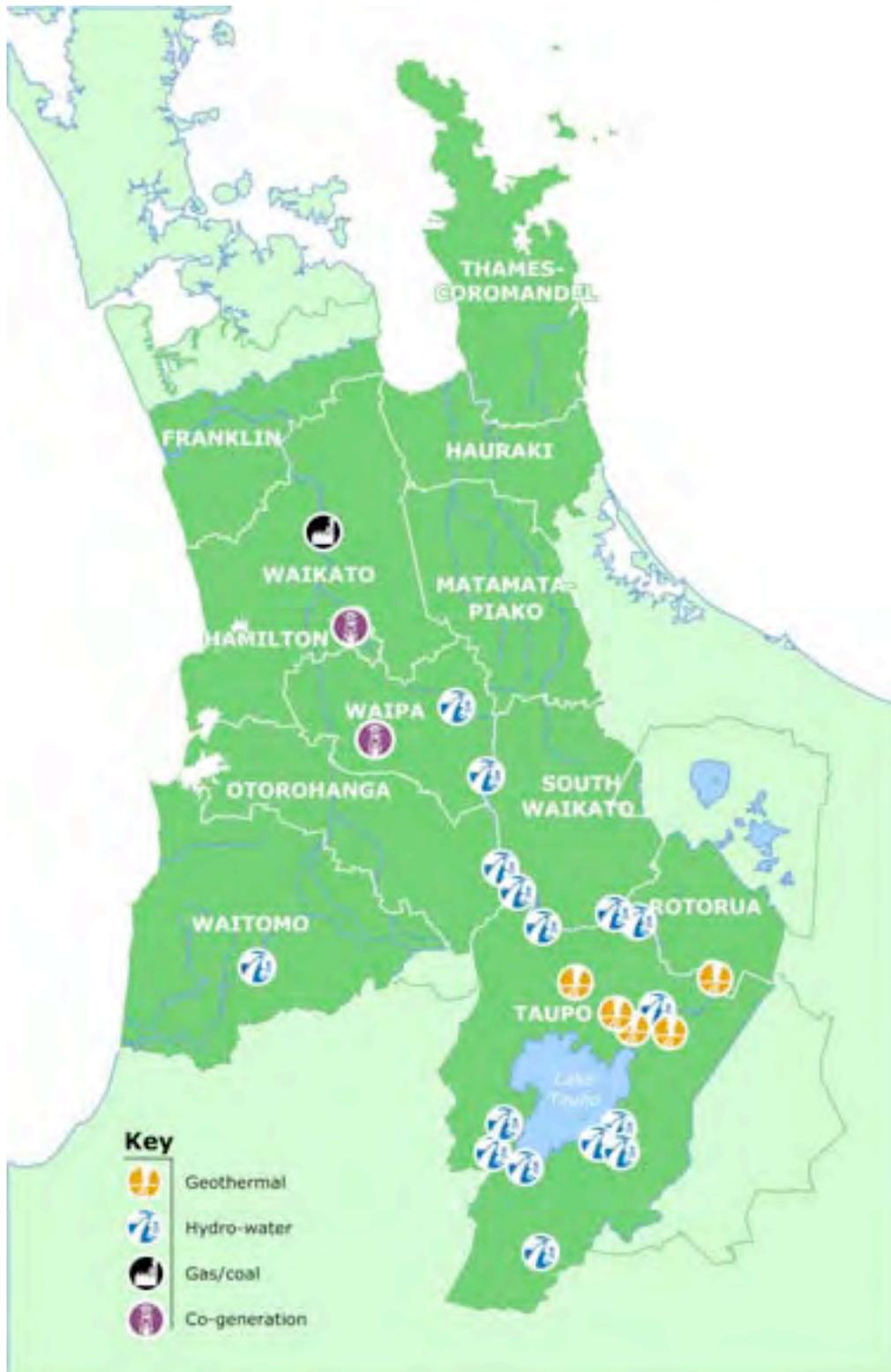
There are six line companies which operate distribution networks in the Waikato region.

WEL Networks Ltd is based in Hamilton, and therefore has a large load centre. Waipa Networks with the towns of Cambridge and Te Awamutu, and Counties Power with Pukekohe also have reasonably sized load centres. However all Waikato line companies have sizeable parts of their networks in rural and remote areas.⁶⁰

Retailers: Nationally, there are 10 electricity retailers (most of whom are also generators) who sell power to the consumer. In the Waikato region, the predominant retailers are Contact, Genesis, Meridian, Trustpower and Mercury (owned by Mighty River Power).

⁶⁰ "Background report on Energy for the Waikato region – Electricity" prepared by Environment Waikato's Community and Economy Programme, Eclectic Energy and COVEC (page 45)

Map of existing electricity generation in the region



Source: Environment Waikato: Background Report – Energy for the Waikato region – Electricity 2006.

The most common type of electricity within the Waikato region comes from hydro – mainly the Waikato River system of dams, and the Tongariro Power Development, along with several small hydro power plants. In addition, there are five geothermal power plants, three cogeneration plants (two dairy factories, and one pulp mill), two thermal power stations (Huntly and e3p), and one landfill gas generation plant.

Range of electricity generation sources

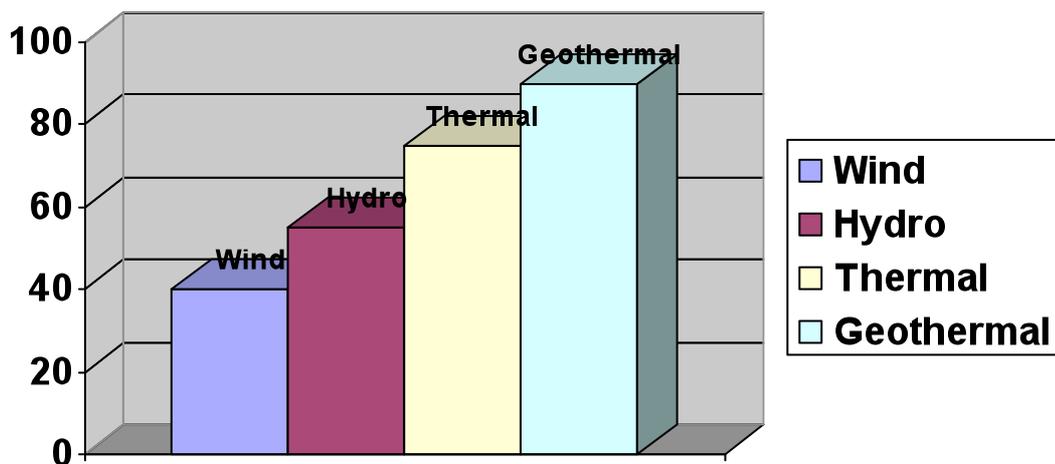
There are four main types of electricity generation within the Waikato region. These are:

- **hydro-power** – predominantly on the Waikato River (1040 MW capacity), and the Tongariro system (360 MW), along with several small hydro power plants such as King Country Energy
- **geothermal power** – including Contact Energy’s Wairakei, Poihipi and Ohaaki stations (300 MW), and Mighty River Power’s Mokai and Rotokawa stations (135 MW)
- **thermal power** at Huntly – which includes the 1048 MW Huntly coal-gas capable station, and the new e3p gas-fired generation plant (400 MW)
- **Cogeneration** – including one landfill gas generation plant, two cogeneration plants (one dairy factory, and one pulp mill), totalling approximately 150 MW of generating capacity.

Wind power is planned for the Waikato region – but while some sites have been consented, no wind farm has yet begun operation.

Effective power output

Effective Power Output of various types of electricity generation



The different types of electricity generation have varying rates of effective power output (load factors) relative to their installed capacity. In other words, wind power is considered approximately 30-40 per cent⁶¹ useable, because the wind does not blow all the time. Similarly hydro power is approximately 50-60 per cent available, because it relies upon a stored water supply which varies both over the year and during a day as water is let through the power station gates⁶². Thermal generation such as coal or gas provides greater certainty of supply (approx 70-80 per cent), as the energy supply can be stockpiled and used at a known rate of generation. Geothermal has the highest load factor of approximately 90 per cent because it is available almost continuously from a natural heat source – and has the added advantage of being a renewable resource.

⁶¹ Wind load factor reference from NZES (page 63). This load factor applies in the Waikato, which is seen as a 2nd tier resource.

⁶² See Part 6 on hydro for detailed explanation

The importance of security of supply

The issue of effective power output highlights the difficulty in finding adequate replacement for Huntly's thermal generation (when Huntly reaches the end of its productive life). Huntly's dual-fuel power station currently provides security of supply for the NZ electricity system as it offers baseload capacity in drier winters when hydro is in short supply, or wind is not blowing.

Karapiro hydro



Source: Environment Waikato

Huntly thermal



Source: www.coalnz.com

The issue of one day needing to find a suitable replacement for the power output from Huntly thermal is not an easy one, given its role in maintaining security of supply. Due to the differing effective power output capacities of hydro versus thermal, it has been calculated that it would take more than one-and-a-half river systems the size of the Lake Taupo/Waikato River hydro system to replace the output of Huntly.

The Huntly thermal system has a generating capacity of 1448 MW at an effective power output of approximately 70-80 per cent. By comparison, the Waikato River system has a generating capacity of 1040 MW at a load factor of approximately 50 per cent. In effect, this means that more than one-and-a-half hydro systems the size of the Waikato River hydro would be needed to replace Huntly thermal generation.

Geothermal, with its high effective power output of approximately 90 per cent, provides the best alternative in terms of fuel source. But geothermally-generated electricity relies upon a limited range of geothermal systems within the Waikato region – only some of which are available for power generation. Wind energy such as Contact's proposed 650 MW wind farm on the north-west coast of the region could provide significant additional capacity, but wind is limited by its lower effective power output of between 30 and 40 per cent due to the fact that wind does not blow all the time. This is why the current thermal generation at Huntly is considered important in terms of security of supply, because it provides a backup for consumers when the South Island hydro system is facing dry years.

New generation capacity

A number of new generation projects planned for New Zealand are scheduled to occur within the Waikato region. In the NZES, a total of 29 new generation projects are identified as potentially occurring between 2007 and 2012.

If all these projects should gain consent *and* end up being constructed, this could provide an additional 3639 MW of new capacity nationally. However, as previously discussed, the nameplate MW capacity is not directly comparable since load factors differ between generation types, with wind (for example)

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having a load factor of between 30 and 40 per cent⁶³. In other words, the amount of effective power output from a new 100 MW wind farm is not necessarily directly comparable with the output from a new 100 MW geothermal plant in terms of the average annual generating capacity available to the national grid.

Of the planned generation projects listed in the NZES (which do not include Contact's proposed wind farm in north-west Waikato as it was not formally launched at the time of the 2007 NZES), the breakdown into generation types is as follows:



Source: Clipart

Wind generation is the predominant source of new generation proposals

- **Wind:** (15 projects) Wind is the predominant new generation source of the planned generation projects, and makes up 51 per cent (1879 MW) of the 3639 MW total.
- **Geothermal:** (7 projects) Geothermal falls into second place with 17 per cent (633 MW) of the total proposed generation.
- **Hydro:** (4 projects) The proposed new hydro capacity is comparatively small (comprising only 149 MW in total, the largest station being 70 MW, and two of the others being only 17 MW and 16 MW respectively). This comparatively low amount of proposed new hydro may suggest that hydro capacity is already heavily utilised in New Zealand, so that only smaller sites are left. This is certainly the case in the Waikato, as evidenced in the next chapter.

- **Tidal:** (1 project) As with all marine energy projects, the tidal project proposed for Kaipara Harbour is a technology which is still at the stage of being proven within the New Zealand environment. This project has yet to receive consent.
- **Gas:** (2 projects) Two of the largest generation projects proposed for New Zealand are Contact Energy's 400 MW Otahuhu C (which is already consented, but currently deferred), and Genesis Energy's 360 MW Rodney plant (which has applied for a consent). These gas plants are likely to be affected both by the government's desire to shift new generation away from fossil fuels, and the impact of the cost of carbon emissions.

⁶³ See footnote on page 63 of the New Zealand Energy Strategy.

Planned power projects 2007-2012
As identified in New Zealand Energy Strategy

Owners/ operators	Plant name	Planned year	Fuel type	Capacity (MW)	Status
Mighty River Power	Kawerau	2008	Geothermal	90	Consented
Top Energy	Ngawha II	2008	Geothermal	15	Consented
Contact Energy	Hawea Gates		Hydro	17	Consented
New Zealand Windfarms	Te Rere Hau Wind Farm	2006 ^a	Wind	49	Consented
Ventus Energy (NZ)	Taumatototara West Road	2008	Wind	20	Consented
Hawkes Bay Wind Farm Ltd	Te Pohue Wind Farm	2008	Wind	225	Consented
Meridian Energy	West Wind	2008	Wind	140–150	Consented
Meridian Energy	Manapouri Efficiency	2008	Hydro	16	Efficiency gain
Unison/Hydro Tasmania	Titiokura Wind Farm Stage 1 (Te Pohue)	2009	Wind	48	Consented
Taharoa C	Taharoa Wind Farm		Wind	100	Consented
Contact Energy	Otahuhu C		Gas	400	Consented
Genesis Energy	Awhitu		Wind	18	Consented, on hold
Trustpower	Wairau River		Hydro	70	Under appeal
Alco Wind Energy	Motorimu		Wind	110	Under appeal ^b
Contact Energy	Te Mihi	2008	Geothermal	18	Awaiting consent
Contact Energy	Poihipi Road (Steamfield)	2009	Geothermal	25	Awaiting consent
Trustpower	Arnold River/ Dobson		Hydro	46	Awaiting consent
Crest Energy	Kaipara Harbour		Tidal	200	Awaiting consent
Meridian Energy	Project Hayes		Wind	630	Awaiting consent
Trustpower	Mahinerangi		Wind	200	Awaiting consent

Owners/ operators	Plant name	Planned year	Fuel type	Capacity (MW)	Status
Pioneer Generation	Horseshoe Bend		Wind	1.8	In process
WEL Energy	Te Uku		Wind	84	In process
Contact Energy	Te Mihi Stage II		Geothermal	225	Notified
Unison	Te Waka		Wind	102	Notified ^c
Genesis Energy	Rodney		Gas	360	Consent applied for
Contact Energy	Tauhara	2011	Geothermal	200	Planning
Contact Energy	Wairakei upgrade/ replacement	2012	Geothermal	60	Planning
Alco Wind Energy	Waverly		Wind	135	Planning
Mainpower	Mt Cass		Wind	35–63	Planning

Proposed new Waikato generation

The Waikato will be an important national player in the development of the planned new generation projects over the next 5 years. The projects which are planned to occur in the Waikato include:

- **Geothermal – 640 MW**
 - **Rotokawa (132 MW)** - under construction
 - **Tauhara Phase 1 (23 MW)** - under construction and planned for commissioning by 2010
 - **Te Mihi (220 MW)** - received consent via 'call in' process in mid September 2008. Expected to be generating by 2012.
 - **Tauhara Phase 2 - (220 MW approx)** planned for consent application by 2009
 - **Ngatamariki Geothermal Development** - Applications for first stage of development expected late 2009.
- **Wind – 744 MW**
 - **Taumatotara - (20 MW)** already consented
 - **Taharoa - (100 MW)** already consented
 - **Te Uku - (84 MW)** consent granted. Currently under appeal.
 - **Contact's Hauauru ma raki - (540 MW)** project undergoing 'call in' process August 2008.



Source: Environment Waikato

The older-generation Wairakei Power Station will eventually be phased out as the Te Mihi development comes on stream

As the market is competitive among developers for new sites (particularly for wind), there are likely to be other projects which are on the drawing boards – but which have not yet been made public, or listed in the NZES.

The importance of renewable generation

In the NZES, the government has signalled its target for 90 per cent of electricity to be generated from renewable generation by 2025.⁶⁴ This target is based on an average hydrological year, and includes electricity generated from both grid-connected and distributed generation sources.

With its availability of hydro and geothermal energy, the Waikato region is an important producer of renewable energy. Of the total amount of electricity produced in New Zealand, the Waikato region produces up to one-third of the nation's renewable (non-thermal) electricity.⁶⁵ This means that the Waikato region is likely to play an important role in the development of future renewable electricity generation, given that significant infrastructure and networks are already in place.

The NZES notes that achieving the target of generating 90 per cent of electricity by renewable sources by 2025 will require factors such as:⁶⁶

- **distributed generation:** market and regulatory structures to enable investment in a diverse range of renewable generation projects, including small scale and distributed generation
- **transmission:** a robust transmission grid to support the development of renewable energy resources remote from major load centres
- **security of supply:** prudent monitoring and management of security of supply, including minimising the potential detrimental impacts of intermittent forms of renewable generation on system security, as well as recognising the value of fossil fuel generation for supporting security and operational requirements
- **energy efficiency:** investing in and encouraging demand-side management, energy efficiency, and emerging technologies such as marine energy, and carbon capture and storage for coal.

Managing intermittent renewable generation

The NZES states: “the market share of wind power and other intermittent renewables is likely to increase under emissions pricing and the introduction of the renewable electricity target. Wind generation is not a security of supply risk at current levels, but will need to be carefully managed as its share of total generation grows to ensure security at peak times – and to ensure that system has adequate reserve capacity in place”.



Source:Clipart

Renewable energy sources such as wind are more intermittent and weather dependent, which will require careful management both for impacts on the grid, and for ensuring security of supply in terms of dry-year vulnerabilities. Flexible, fast-start gas-fired peaking plants (such as the proposed new Stratford plant) are one way of supporting the more intermittent nature of wind.

⁶⁴ NZES (page 78)

⁶⁵ Source: Mighty River Power presentation to Waikato Energy Forum March 2007, and MED Energy Data File 2006 (page 120), which points out that 65 per cent of New Zealand's hydro generation is generated in the South Island, with another 10 per cent of New Zealand's electricity total coming from renewable sources such as geothermal (which are predominantly situated in the Waikato).

⁶⁶ Quoted from NZES (page 79)

The NZES states that options for dealing with intermittency issues arising from a higher percentage of renewable generation include “improved wind forecasting, increased demand response, and more geographically-dispersed development of new wind farms. Other longer-term measures may include encouraging a greater diversity of renewable technologies. Existing fossil fuel generation will continue to be needed to provide backup in the meantime”.⁶⁷

Security of supply with a greater proportion of renewable generation

The NZES states that emissions pricing will increase the competitiveness of renewable alternatives, and encourage investment. However it notes that greater reliance on renewable generation has implications for the way security of supply is managed.

“Thermal plants such as Huntly will continue to play a critical role in New Zealand’s electricity system, providing necessary security and versatility to both the provision of energy and the stability of delivery (voltage and frequency).

“Huntly, running on coal (or gas if it is available) is well-positioned to provide dry year energy security to the electricity market, particularly in autumn and spring. It could also provide market support during major generation plant or transmission maintenance outages.”⁶⁸

Security of supply regarding water allocation

In order to meet the government’s goal of 90 per cent renewable electricity generation by 2025, it is likely that more hydro capacity will need to be built. This will require certainty regarding the supply of fuel – namely water to run the turbines. In terms of ensuring that Auckland’s lights do not go out, existing hydro stations will need to have certainty regarding their water availability.

Environment Waikato has recently undertaken an extensive consultation process regarding the proposed variation to the water allocation rules. Under this proposed variation, priority would be given to domestic users (who need water for drinking), and for hydro stations (which generate power from this renewable energy source, but do not ultimately consume the water).⁶⁹

Policy guidance on renewable energy projects

In order to ensure uptake of the 90 per cent renewables target, the government may give guidance to decision makers, particularly at local government level, on assessing renewable energy projects in terms of the Resource Management Act.

The NZES notes that the management of electricity and heat generation under the RMA seeks to avoid, remedy or mitigate adverse environmental effects from projects, while Section 7(j) requires decision makers to also have regard to the benefits to be derived from the use and development of renewable energy.

The NZES states: “All forms of energy generation have some adverse environmental effects. Proposals with unacceptable adverse effects should not proceed, but our commitment to a renewable electricity target requires a substantial increase in renewable capacity overall.”⁷⁰

⁶⁷ NZES (page 68)

⁶⁸ NZES (page 64)

⁶⁹ Environment’s Waikato’s proposed Water Allocation Variation 2007.

⁷⁰ NZES (page 80)

The government has therefore developed the proposed National Policy Statement on renewable energy to help decision makers weigh up the national benefits of renewables. Councils will have to incorporate a National Policy Statement into their regional policy statements, as well as regional and district plans, and must consider it when deciding whether to grant consent applications.

Promoting the importance of electricity generation

Waikato Regional Energy Strategy

Recommendation 1: The Regional Energy Strategy advocates for policies and actions that promote the generation of electricity from renewable sources and innovative energy technologies within the region, that recognise the importance of security of supply.

This includes:

Recommendation 1a)

Supporting the building of sufficient generation capacity to meet demand.

Who is involved/lead agency

Generators, local authorities, Environment Waikato (second generation Regional Policy Statement).

What action is required

- Develop a Regional Policy Statement that recognise the importance of building energy infrastructure, and provides for the development and use of renewable sources of energy.

Where should actions be focused

Across the region

When should the action occur

Making sure this is on the agenda of the annual planning cycle

Continued next page

Recommendation 1b)

Promote planning for appropriate allocation of natural resources for the development of renewable electricity generation to assist nationwide security of supply (to cope with peak load times and future overall demand).

Who is involved/lead agency

Generators, local authorities, Environment Waikato, EECA, New Zealand Clean Energy Centre, Waikato Regional Energy Forum, Ministry of Economic Development and related agencies.

What action is required

- Encourage appropriate agencies in particular Environment Waikato, district and city councils to make provision in their policy and planning resource assessment.

Where should actions be focused

In the identification of resources and in policy provision for development.

When should the action occur

Making sure this is on the agenda of the Regional Policy Statement and annual planning cycle.

Recommendation 1c)

Enabling investment in transmission and distribution to connect generation to load.

Who is involved/lead agency

Lines companies, Transpower, Environment Waikato and local authorities

What action is required

- Commercial/operational decision for Transpower and lines companies

Where should actions be focused

- In policy planning and development planning.

When should the action occur

- ASAP

Recommendation 1d)

Acknowledging the importance of developing of distributed generation

Who is involved/lead agency

Environment Waikato, lines companies, distribution companies, Electricity Commission, Transpower, gentailers and alternative energy companies.

What action is required

- Ensure the Regional Policy Statement assists with removal of barriers to the development and distribution of distributed generation.
- Promote greater public awareness of micro generation alternatives.
- Seek buy-in from the territorial local authorities.

Where should actions be focused

- Regional Policy Statement

When should the action occur

- ASAP

Transmission of electricity

As well as being a major source of electricity generation, the Waikato region is also an important corridor for electricity transmission. The Waikato region exports more than 75 per cent (42 PJ out of 54 PJ) of electricity produced in the region, and also transports a significant amount of New Zealand's electricity through the Waikato on the National Grid. The transmission of energy through the National Grid is the responsibility of Transpower.

The National Grid in the North Island

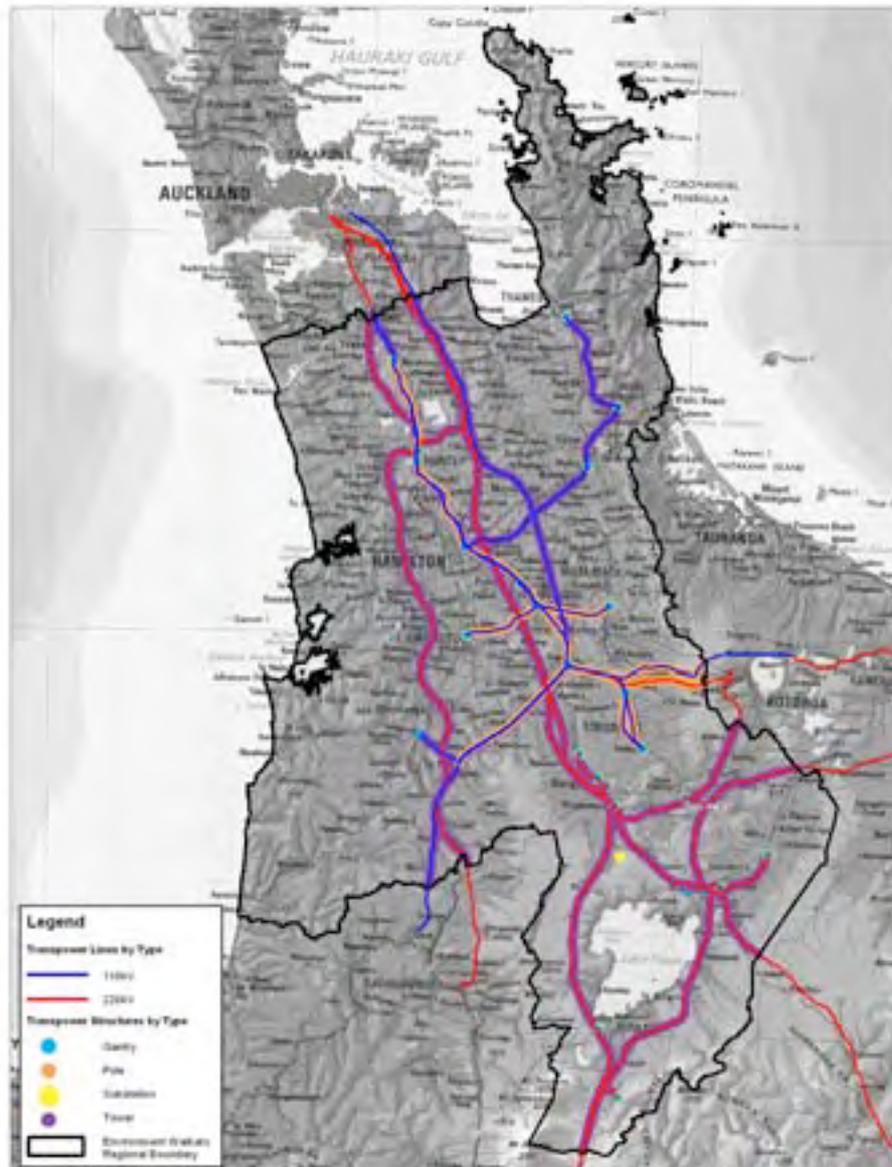


Source: Transpower

The National Grid is owned, operated and planned by Transpower, and is an electrical transmission system that stretches across all local and regional authority boundaries, connecting major generation sources to towns and cities. However some smaller generators may not use the grid, but instead utilise local networks.

Waikato Regional Energy Strategy

Transpower's electricity grid in the Waikato region



Source: Environment Waikato with data supplied by Transpower

Waikato grid upgrade

Transpower's grid upgrade proposal through the Waikato has now been 'called in' by the government because of its national significance. The call in process involves the Minister publicly notifying resource management applications for the project, seeking submissions and appointing an independent board of inquiry chaired by a former Environment Court judge. The board of inquiry released its draft decision in May 2009. The call in process has been utilized by the government as it is generally seen as speeding up the decision making process, as there is no ability to appeal the board's decision except on points of law.

As these statutory processes regarding the transmission upgrade are currently underway, this issue is deemed to fall outside the scope of the Regional Energy Strategy, as decisions will be made through the board of inquiry.

National Policy Statements on Electricity Transmission

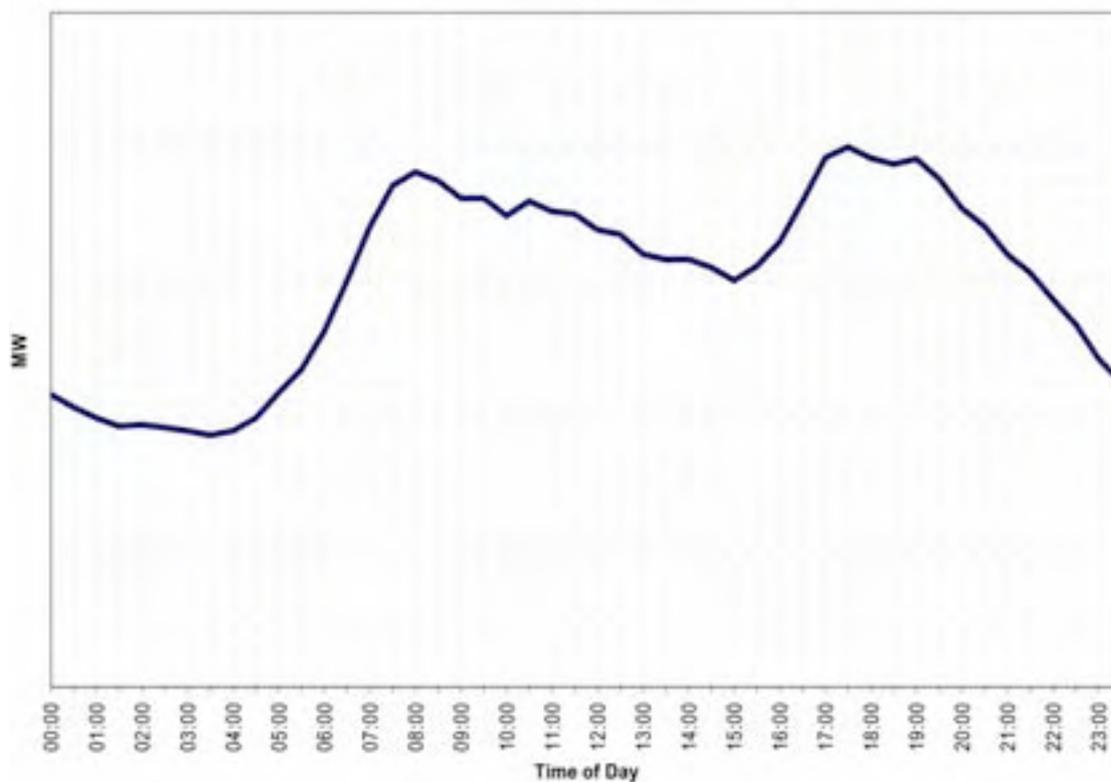
The government has already released a National Policy Statement (NPS) on Electricity Transmission (see Part 2 for details) which is designed to provide a

more coordinated set of planning rules and guidelines across all 72 local and 12 regional council boundaries.

In addition to the NPS, the government has also proposed a National Environmental Standard (NES) for Electricity Transmission, which sets out specific regulations dealing with the maintenance and protection of built electricity transmission structures to help ensure the robustness of the national grid.

Typical pattern of daily energy use

Typical Daily Load Profile



Source: Transpower's Annual Planning Report

Demand for electricity tends to peak at around 7.30 a.m. on a typical morning, and then decline slightly during the day before reaching another peak between 5 p.m. and 8 p.m. Generators aim to meet these peak demand times by providing extra electrical output, which must be capable of being carried through the transmission network. Planning for network upgrades is required to meet the forecast peak demands.

Connection of renewable generation

With the government's desire to increase renewable generation, attention will be focused on the ability of the National Grid to cope with new renewable generation (which may have more intermittent characteristics than the traditional generation mix).

While some of the new generation will undoubtedly be provided on a distributed generation basis (which will not necessarily connect the grid), major projects will still require a secure and stable national grid to allow for the connection of new generation – particularly given the long timeframes in planning for new investment (up to seven years).

Recommendation 2: The Regional Energy Strategy advocates for policies and actions that recognise transmission of electricity as an important part of maintaining security of supply.

That the Waikato is an important conduit for meeting the transmission of electricity around New Zealand to meet national demand.

Grid and network investment and maintenance is an important component in the development of renewable sources of electricity generation (due to its role in facilitating connection to the National Grid).

Who is involved

Transpower, Electricity Commission, lines companies, Environment Waikato, territorial authorities, and Waikato Regional Energy Forum.

What action is required

- Acknowledge the importance of the Waikato region's role in transmission and distribution both for local and national business and community energy needs.
- Recognise the importance of all transmission and distribution, in national, regional and local policy documents.
- Improve information and education available to local authorities and policy makers to support understanding of the importance of transmission and distribution and to recognise its critical role for wellbeing and economic growth.
- Advocate for policy to support and enable planned maintenance and upgrading of existing transmission lines.
- Support the development of new lines to meet local and national needs.

Where should these actions be focused

- Through advocacy and information work to strengthen the relationships between Transpower, regional councils, district councils, lines companies and communities.
- District plans should have criteria that support the intended generation.
- Inclusion in Regional Policy Statement.

When should the action occur

- Linked to Regional Policy Statement review for long term planning.
- Ensure connections with Electricity Commission planning.

Part 6 - Waikato's energy resources: existing and potential



Geothermal



Hydro



Coal



Gas



Wind



Wave



Solar



Biomass and biofuels

In order to assess the future potentials for energy generation and supply in the Waikato region, it is necessary to examine the range of energy sources available in the Waikato, including geothermal energy, hydro electricity, coal, natural gas, wind, marine energy, solar photovoltaics and solar hot water, as well as biomass and biofuels.

In this chapter, the current state of these resources is assessed, along with recommendations on ways in which the region can begin to promote and develop future potentials.

a) Geothermal resources

The importance of geothermal energy as a key renewable energy has been recognised in the NZES, as well as being highlighted by significant investment decisions recently announced by two major electricity companies.



Source: Environment Waikato

Environment Waikato has mapped the geothermal fields in the region – and classified them into development, limited development, research or protected fields. Electricity generation occurs in some of the larger fields (brown), while the smaller fields (white) are often used for tourism activities or bathing (Miranda, Hot Water Beach, Te Aroha, Okoroire, Waingaro etc).

Geothermal energy is renewable, requires no external fuel, and because it is not dependent on wind or rain, can play an important role in providing diversity of secure energy supply during dry or calm periods in our weather patterns. In addition, it is a low carbon-emitting source relative to fossil fuels.

The Waikato Regional Renewable Energy Assessment (undertaken in 2006 by SKM on behalf of Environment Waikato and the Energy Efficiency and Conservation Authority) estimates the additional geothermal resource available for development within the Waikato region is about 520 MW.⁷¹

As the Waikato region has more than 80 per cent of the nation's geothermal resources, the regional council has been at the forefront of developing policy for the sustainable use of this important resource. This has involved mapping the geothermal systems within the region and determining which systems may be developed, partly developed, researched, or protected for purposes of geothermal biodiversity – and then making the requisite changes to the Regional Policy Statement and Regional Plan.



Environment Waikato has developed a geothermal policy for the region, which has provided certainty for developers and the community regarding the sustainable use of the resource – and seen \$1 billion in new projects announced.

⁷¹ This estimate is based primarily on using geothermal for electricity generation. It does not take into account new technology that can produce power from resources as low as 74 degrees C, nor does it take into account geothermal systems that may only have 1-5 MWe potential. It is important to note that direct heat use can be a more efficient of the geothermal resource, given that huge amounts of heat are used in industrial processes. The use of direct heat is referred to later in this chapter, and in the subsequent "Biomass" chapter.

These geothermal policy changes have assisted with creating the conditions for a significant renaissance in the use of geothermal energy, which has seen several electricity companies recently announcing major investment intentions totalling more than \$1 billion in geothermal energy.

Balancing the competing uses

In making the policy changes, the regional council's aim has been to find the appropriate balance between the different uses of geothermal energy. This includes recognising the importance of the region's five geothermal power stations, while at the same time acknowledging that geothermal features provide an important tourism attraction with more than 2 million visits in the Waikato region annually.



Source: Environment Waikato



Source: Environment Waikato

The production of energy from geothermal sources must compete with other uses such as tourism and cultural uses. In devising the geothermal policy, Environment Waikato has sought to find the appropriate balance between economic, cultural, social and environmental wellbeings. Pictured above are tourists visiting geothermal attractions like the Lady Knox geyser (right), with Maori cultural uses such as a traditional cooking pot at Tokaanu (left).

The uses of the regional geothermal resources include:

- electricity generation at Wairakei-Tauhara, Ohaaki, Rotokawa and Mokai
- domestic and commercial space heating by hot water and steam in the Taupo and Tokaanu urban areas
- thermal bathing pools, both domestic and commercially operated (for example, Taupo, Miranda, Te Aroha, Tokaanu)
- commercial hot water operations such as prawn farming at Wairakei, commercial glasshouses at Wairakei and Mokai, and timber drying at Ohaaki
- the scientific study of geothermal features, processes, and ecosystems
- Maori traditional and contemporary use of the resource
- tourist recreational and scenic attractions
- a potential source of microorganisms for industrial processes, and the potential for extraction of useful minerals such as silica, lithium, boron, gold, silver and zeolites.

All of these uses have the potential to increase in scale, and expand into new areas. This is a factor which Environment Waikato's geothermal policy takes into account. For example, one of the key issues facing the sustainable use of

geothermal energy involves balancing the differing requirements of potential users such as electricity generation or tourism. This is because sustaining spectacular surface features like geysers⁷², while at the same time accessing fluid to generate electricity can tend to be mutually exclusive – at least with today's technology.



Source: Environment Waikato

The Wairakei Geothermal Station, which was first commissioned in 1958, is operated by Contact Energy and has a generating capacity of 140+ MW.

When a geothermal system is developed for electricity, the fluid features tend to fail over time, while the steam features increase. At Wairakei there has been the loss of the fluid features which provided the Wairakei Thermal Valley, while at the same time there has been an expansion of the steam features at Karapiti 'Craters of the Moon'. In order to find a way around this dilemma and to provide for sustainable use of the resource, Environment Waikato followed a detailed and rigorous process for developing an effective policy for geothermal resources. The first stage of this process involved surveying the full extent of the geothermal resources within the region – with particular regard for identifying which were large or small scale systems.

The resources were then prioritised into five system types, depending upon the size of the system, its existing use, and the vulnerability of significant geothermal features to extractive uses. The resulting five classes of geothermal systems are classified as development systems, limited development systems, protected systems, research systems, and small geothermal systems.

⁷² Note that not all geothermal systems have spectacular surface features.

Waikato Regional Energy Strategy

Geothermal power stations in the Waikato region					
District	Generator	Station	Type	Capacity	Year Commission
Taupo	Contact Energy	Wairakei	Geothermal	176 MW	1958
	Contact Energy	Ohaaki	Geothermal	50 MW	1989
	Contact Energy	Poihipi Road	Geothermal	30 MW	1996
	Rotokawa Joint Venture (Mighty River Power and Tauhara North Trust)	Rotokawa	Geothermal	35 MW	1997
	Tuaropaki Power Company (run by MRP)	Mokai	Geothermal	112 MW	2000+

Source: MED Energy Data File 2008, and Environment Waikato's Background Report: Energy for the Waikato

One of the key uses of development systems is the production of electricity – and since the policy became enacted, significant electricity generation projects have been announced, as geothermal is seen as a renewable energy resource, which is low-carbon emitting.

Throughout the classification approach, Environment Waikato applied the precautionary principle to the management of regional geothermal resources where there was scientific uncertainty and a threat of serious or irreversible effects on the resource.

In being proactive in setting the policy for the development of geothermal energy, Environment Waikato has helped create a more favourable investment climate for areas which may be developed, while ensuring that other geothermal areas are protected for their tourism and cultural values. This geothermal policy has been recognised at national level as providing a successful template for fostering the development of a renewable energy resource in a sustainable way.

The current renaissance in geothermal energy

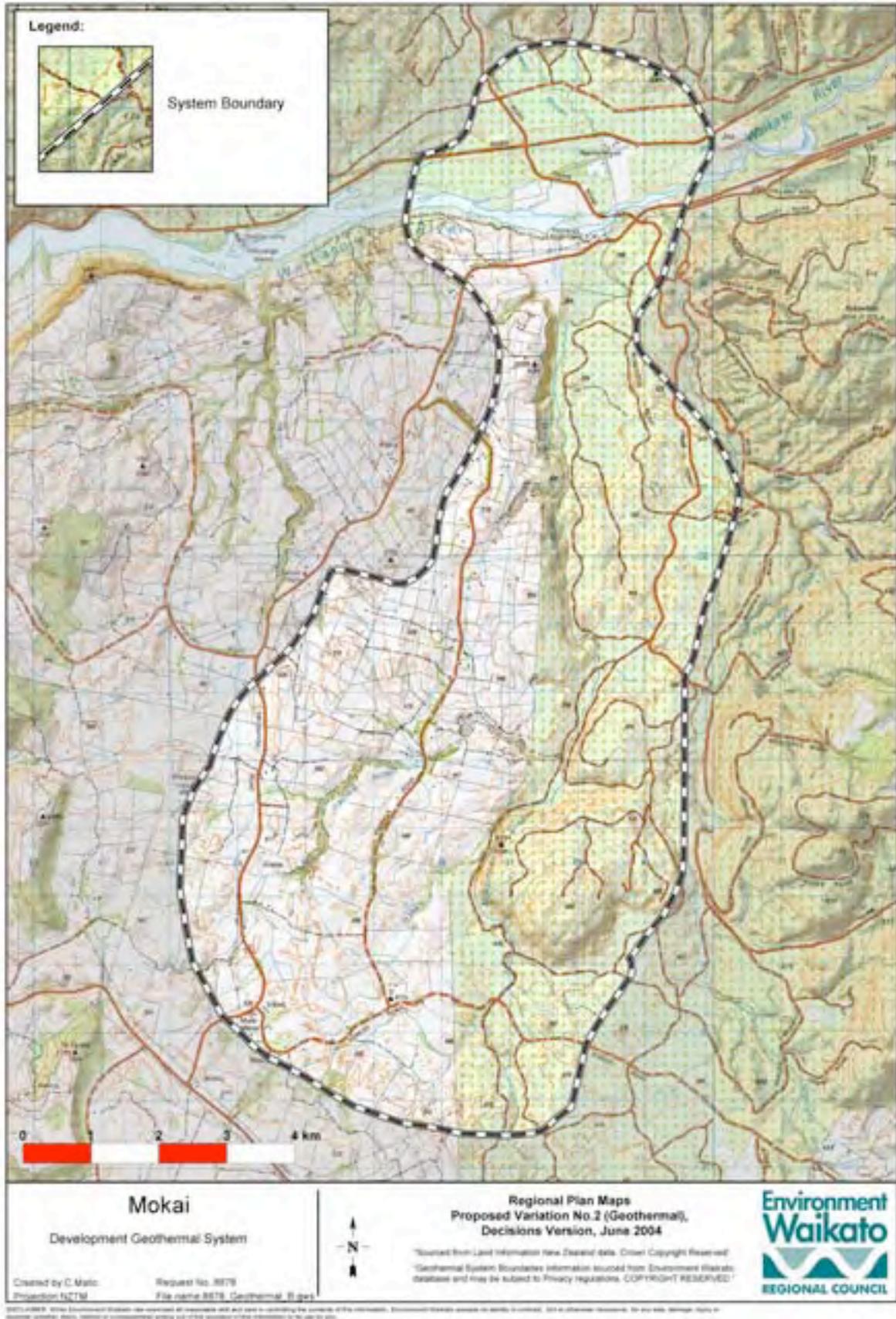
The policy framework and baseload nature of geothermal generation have laid the groundwork for a renaissance in geothermal energy in the Waikato in the coming decade.

As mentioned earlier, the following projects are planned to occur:

- **Rotokawa** (132 MW) under construction
- **Tauhara Phase 1** (23 MW) under construction and planned for commissioning by 2010
- **Te Mihi** (220 MW) received consent via 'call in' process in mid September 2008. Expected to be generating by 2012.
- **Tauhara Phase 2** (220 MW approx) planned for consent application 2009
- **Ngatamariki Geothermal Development** Applications for first stage of development expected late 2009.

Note that the existing Wairakei Power Station (generating up to 160 MW approximately) will be phased out as the new Te Mihi station comes on stream.

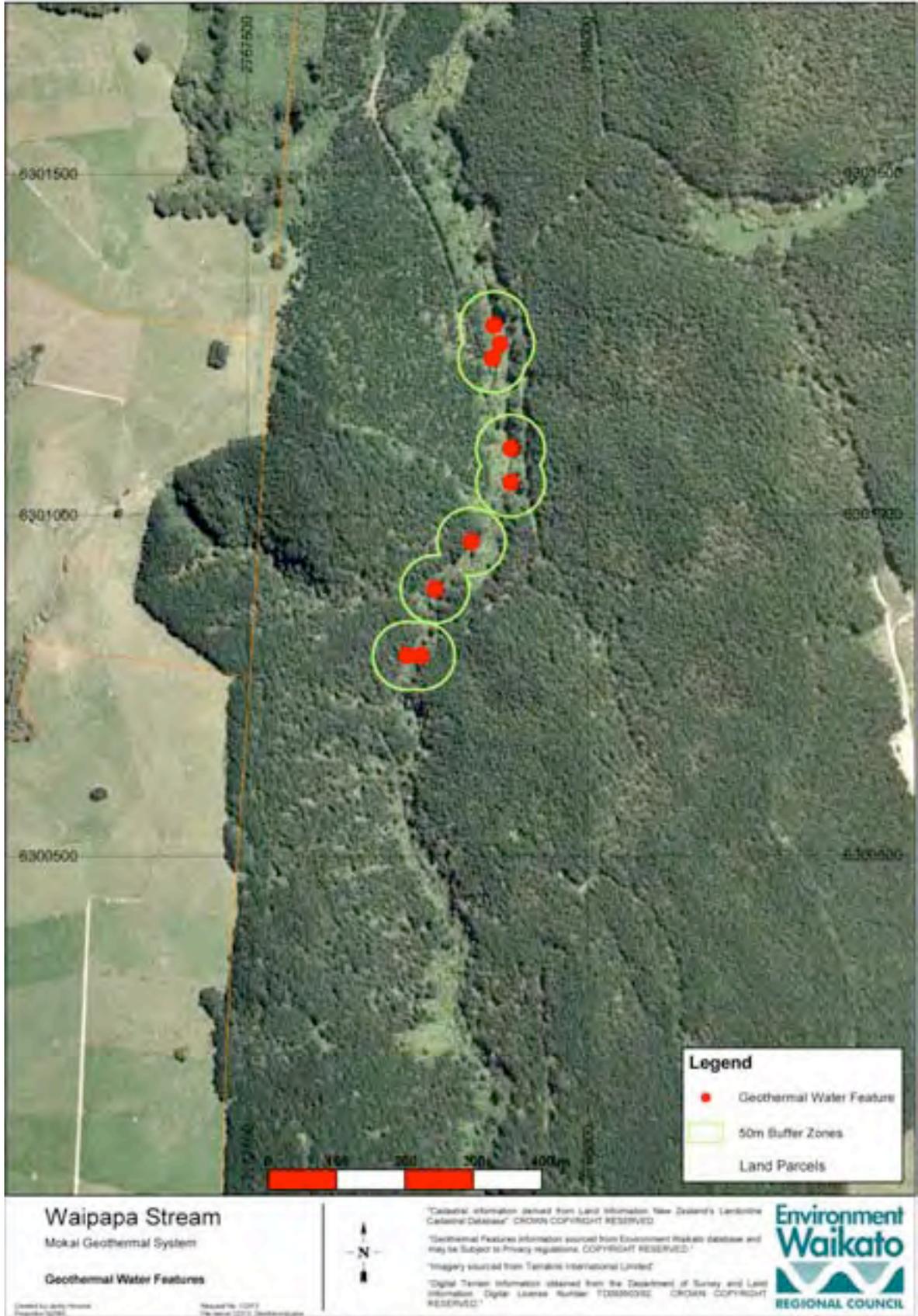
Example of Environment Waikato's detailed mapping of the geothermal system at Mokai



This map from Environment Waikato's Geothermal Policy shows the geographic extent of the Mokai field obtained through remote sensing information

Waikato Regional Energy Strategy

Example of the detailed mapping of features within the Mokai system



This map shows the actual sites of geothermal springs, and 50 m buffer zones.

The development of geothermal energy as a heat source for domestic and commercial use

Apart from electricity generation, geothermal energy is used for a number of commercial operations in the Waikato region. These include the heating of horticultural greenhouses at Mokai, the development of a geothermally-heated prawn farm at Wairakei, the drying of timber at Ohaaki, and greenhouses at Broadlands.

In addition, geothermal energy is ideal for domestic or commercial heating in suitable locations. The Regional Renewable Energy Assessment notes that geothermal space heating is common within the areas of Taupo and Tokaanu, where shallow wells or downhole heat exchangers provide heating for individual homes and businesses.

“In other parts of the world, a district like Taupo would have a district heating scheme, whereby a few larger wells would provide heating for all homes and businesses in the district.”⁷³

In an innovative development within the Waikato region, the Clean Energy Centre in Taupo is investigating the potential for industrial scale use of geothermal such as heating of schools and hospitals. The centre has received government funding to look at a mini-geothermal district heating scheme for Taupo Hospital, Taupo Intermediate School, and a private aged-care hospital. Considerable savings are anticipated from switching the heating needs of these facilities from coal to geothermal – which will also have benefits in terms of reducing carbon emissions.

The feasibility study has indicated that the project could deliver reductions in carbon dioxide emissions of approximately 1200 tonnes a year, while also delivering more certainty over the future cost of fuel for the heating project. Resource consents have now been obtained for the project, and partnerships formed to provide energy plant and technical expertise.



The New Zealand Clean Energy Centre is planning a mini-geothermal district heating scheme for hospitals and schools in the Taupo area.

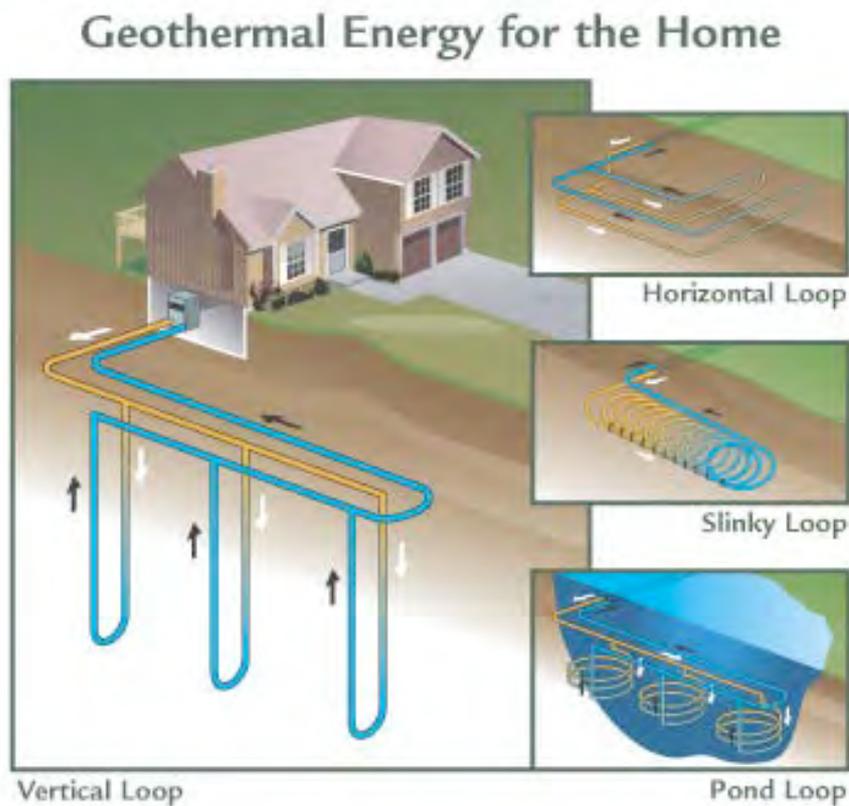
⁷³ The Waikato Regional Renewable Energy Assessment (page 55)

Ground-based heat pumps

The Waikato Regional Renewable Energy Assessment also promotes the concept of ground-source heat pumps for use in domestic and industrial applications – noting that this technology is now used in America, Sweden, Germany, Canada, Switzerland and Austria.

This heat pump technology works similar to a fridge in reverse. The coil or slinkie is laid out into the ground, and then the liquid pumped through the coil takes the heat from the soil, and releases the heat inside the building. The only energy required is that needed to pump the circulating fluid through the system.

These geothermal heat pumps can operate in a vertical or horizontal mode, depending upon the available land area, and the depth of the hole. And as they work on natural temperature gradients within the earth, they are not restricted to geothermal areas.



Source: [www.daviddarlingencyclopaedia of sustainable living](http://www.daviddarlingencyclopaediaofustainableliving)

Downhole heat exchangers, which have become widely used since the 1980s, are now installed in large numbers overseas. They operate by extracting the heat from warm ground, or from groundwater. A heat pump system is currently being trialled at Mighty River Power's Hamilton headquarters.

In one example in Britain, a dwelling is heated with a 12 kW geothermal heat pump connected to three slinkies, which are placed into 50 m long trenches. The system is connected to underfloor heating, and installed and commissioned by a plumber for around \$12,000. A similar system is utilised at a school, which heats its buildings by using renewable energy from slinkies buried in the nearby sports field.

Environment Waikato's new geothermal policy allows the use of groundwater for domestic heating as a permitted activity (not requiring resource consent) provided the heat is extracted in situ, and the water retained in the ground.

Recommendation 3: The Regional Energy Strategy acknowledges the value of the extensive geothermal resources within the region and its importance, in addition to the contribution of clean renewable energy to regional and national energy needs.

The Regional Energy Strategy advocates for policies and actions that promote research and appropriate development and use of existing and potential geothermal heat sources, for heating and generation of electricity.

Cogeneration

The Regional Energy Strategy supports the development of cogeneration projects.

Who is involved

- New Zealand Clean Energy Centre
- EECA, Ministry of Economic Development , Electricity Commission for funding demonstration projects
- Industry for development of small and large scale geothermal projects
- Industry working for re-categorisation of specific areas.
- Waikato Regional Energy Forum in advocacy role to support geothermal developments
- Environment Waikato, territorial local authorities, links companies, Ministry of Social Development.

What are the next steps to turn this recommendation into action

- Develop working examples which showcase the appropriate use of geothermal resources.
- Seek government and industry funding for demonstration projects to highlight innovative technologies for the utilisation of geothermal energy (including heat as well as power, on both a small and large scale).
- Develop an umbrella brand to highlight the importance of geothermal energy to New Zealand, and the fact that 80 per cent of the resource is based in the Waikato region.
- Encourage progress in the re-categorisation of specific geothermal zones for appropriate application.
- Encourage flexibility in the use of unassigned geothermal fields.
- Encourage the inclusion of appropriate policies in relevant planning documents and consenting processes.
- Promote and encourage the removal of regulatory barriers and investigation, research and uptake of cogeneration.

Where should actions be focused

- throughout the Waikato region, but specifically within the geothermal zone around Taupo
- with potential funders for demonstration projects
- advocacy and support for geothermal development at the consenting stage
- in Regional Policy Statement and plan development process

When should the action occur

- ASAP

b) Hydro generation

With hydro generation, the dominant source within the region is the Waikato River – New Zealand’s longest (425 km) and most utilised river. An integral part of the Waikato hydro system is Lake Taupo, which although it is New Zealand's largest lake, only has about 1 per cent available for hydro storage⁷⁴. Control gates on the Lake Taupo outlet lead to eight dams and nine powerhouses (as there are two at Maraetai).⁷⁵

The overall installed capacity of the Waikato hydro system is 1040 MW, but the annual average production is only 4200 GWh (which equates to 480 MW of continuous output) – a 50 per cent load factor due to insufficient water in the system to enable continuous generation.

Map showing the major dams on the Waikato River



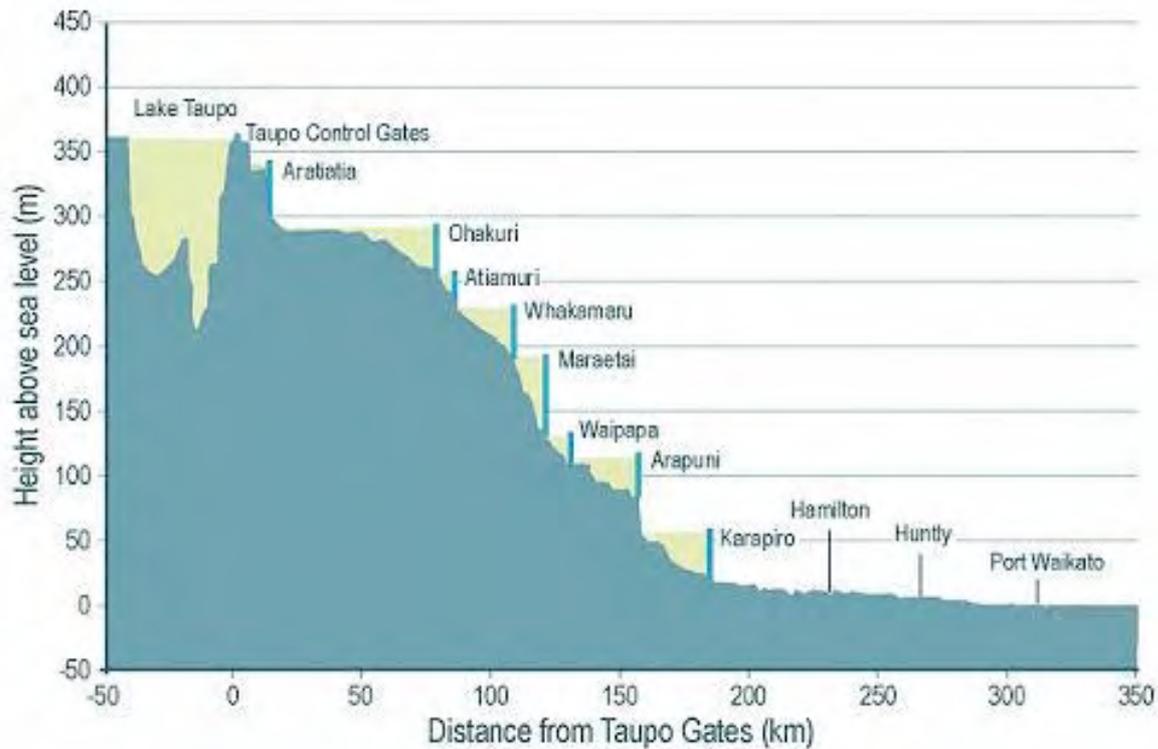
Source: Mighty River Power

⁷⁴ Lake Taupo's storage equates to about 600 GWh, according to MRP.

⁷⁵ Environment Waikato's Resource Users Group's Dennis Crequer – presentation to Union College 2006

History of hydro development

Most of the major hydro developments on the Waikato River have already been undertaken, with the river being dammed for electricity as far back as the First World War. The first hydro station was built at Horahora in 1913 to supply a gold mining company (initially supplying 6.3 MW, Horahora was later submerged by the formation of Lake Karapiro). The Arapunui power station was commissioned in 1929, followed by the Taupo Gates in 1941, and the remaining stations commissioned between 1947 to the 1970s.



Source: Mighty River Power

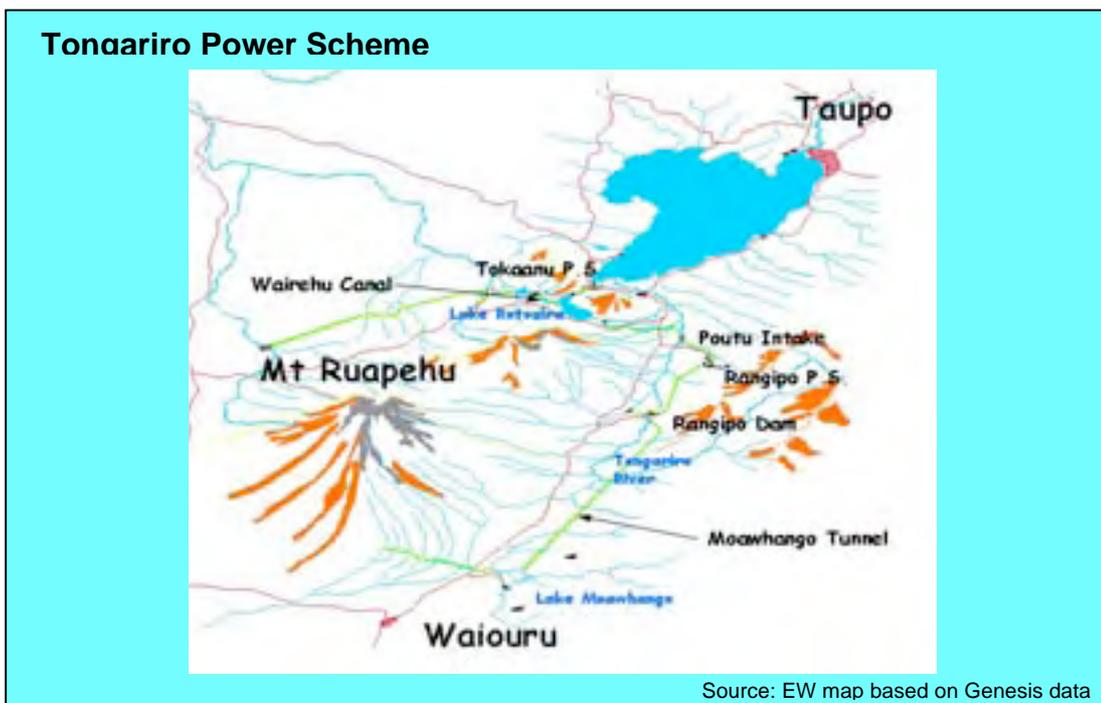
The geography of the Waikato River, with its significant fall in height once it leaves the Taupo Plateau, has made it an obvious site for hydro development.

The other major input into the hydro system is the Tongariro Power Scheme, which harnesses water flows diverted from the Tongariro mountain system south of Taupo. The scheme and its structures extend from the southern flanks of Mount Ruapehu in the south, to the southern point of Lake Taupo in the north, and along either side of the mountain range formed by Ruapehu, Ngauruhoe and Tongariro. The scheme taps a catchment area of more than 2600 km².

The scheme is operated to provide water to the Tokaanu (240 MW) and Rangipo (120 MW) power stations and uses a series of lakes, canals and tunnels to do so. Tokaanu Power Station is located on the slopes of Mount Tihia, near the township of Turangi. Rangipo Power Station is situated underground in the Kaimanawa Forest Park on the eastern side of the Tongariro Power Scheme.⁷⁶

The Tongariro Power Scheme typically contributes 1350 GWh (gigawatt hours) per annum – about 4 per cent of the country's total electricity generation. The Tokaanu power station is also used as a frequency control station (controls the power system frequency) when required.

⁷⁶ Information source: Genesis Energy's website



In addition to the Waikato and Tongariro schemes, there are a number of smaller hydro schemes operating throughout the region, which are mainly private or locally owned (see table).

Hydro power stations operating within the Waikato region

District	Generator	Station	Type	Capacity	Year Commission
Taupo	Genesis Power Ltd	Rangipo	Hydro	120 MW	1983
	Genesis Power Ltd	Tokaanu	Hydro	240 MW	1973
	King Country Energy	Kuratau	Hydro	3 MW	1962
	Trustpower	Hinemaiaia A	Hydro	2.4 MW	1952-58
	Trustpower	Hinemaiaia B	Hydro	1.35 MW	1952-58
	Trustpower	Hinemaiaia C	Hydro	2.85 MW	1952-58
Upper Waikato	Mighty River Power	Aratiatia	Hydro	90 MW	1964
	Mighty River Power	Ohakuri	Hydro	112 MW	1962
	Mighty River Power	Atiamuri	Hydro	86 MW	1962
	Mighty River Power	Whakamaru	Hydro	100 MW	1956
	Mighty River Power	Maraetai I and II	Hydro	360 MW	1952 and 70
	Mighty River Power	Waipapa	Hydro	58 MW	1961
Middle Waikato	Mighty River Power	Arapuni	Hydro	188 MW	1929
	Mighty River Power	Karapiro	Hydro	96 MW	1947
Waitomo	Mangapehi Power Ltd	Mangapehi	Hydro	3 MW	1962
	King Country Energy Ltd	Mokauiti	Hydro	1.9 MW	1963
	King Country Energy Ltd	Wairere	Hydro	2 MW	1925

Source: MED Energy Data File 2006, and Environment Waikato's Background Report: Energy for the Waikato Region – Electricity 2006.

Potential development of new hydroelectric generation

The Waikato Regional Renewable Energy Assessment concludes that most of the main productive sites on the region's major rivers have already been developed.

The assessment report noted that installed hydro capacity within the Waikato is about 1400 MW – of which 99 per cent is on the Waikato and Tongariro rivers. The report also concludes that the potentials for hydro generation in the Middle Waikato River have been substantially explored – although opportunity exists for upgrading the efficiency of existing plants.⁷⁷

However the report does suggest that hydro power potential of about 280 MW may exist in mini, small and medium scale projects. The report identifies the following areas as sites worthy of further investigation:

- the large rivers and streams draining into Lake Taupo
- the Kaimanawa area southeast of Taupo where there exists potential for small hydro generation
- on the Waikato River, the Huka Falls is identified as a potential site, along with opportunities above and below Papariki, and at the Narrows downstream of Karapiro
- some streams in the upper reaches of the Waipa catchment
- areas of the west coast such as Marakopa, Awakino and Mokau
- some of the steep streams on the western side of the Kaimai and Coromandel
- ranges flowing towards the Waihou River
- some significant tributaries around the Tairua and Wharekawa rivers, which might be capable of conventional 'diversion type' development associated with a weir and penstock feeding a powerhouse.



Source: Environment Waikato

The Awakino River is one area identified as a potential power generation site by the EECA-SKM Regional Renewable Energy Report.

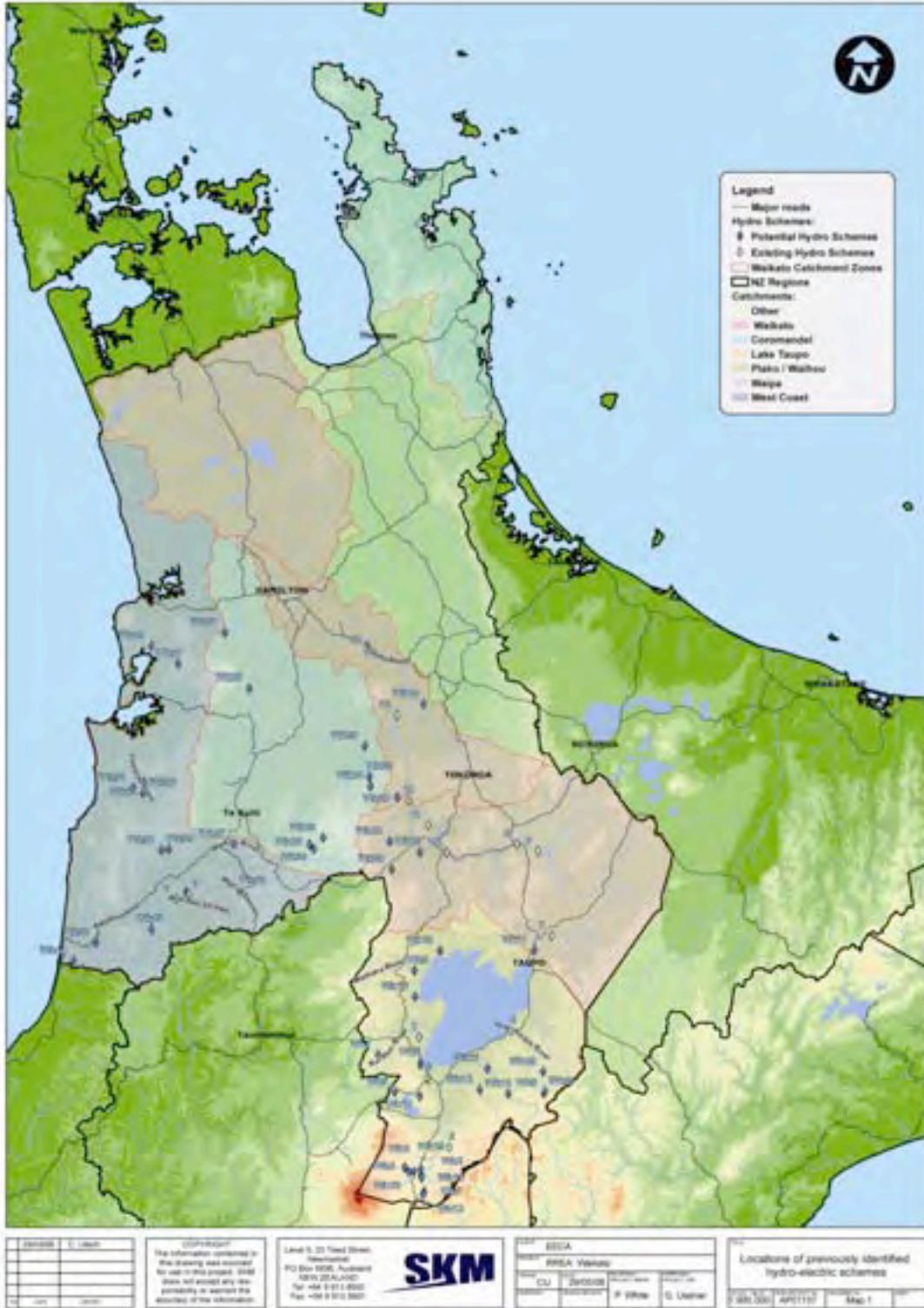
As the Renewable Energy Assessment is essentially looking at renewable energy production, some projects were included which may not pass environmental, social or cultural hurdles to becoming a reality. For example, the study noted that the Huka

Falls area had the potential to generate 40 MW of electricity. However the iconic nature of the natural environment around the falls, and the tourism operations which function in the area would preclude this area from any serious consideration as a hydro generation site.

⁷⁷ SKM-EECA Waikato Regional Renewable Energy Assessment (page 40)

Waikato Regional Energy Strategy

Map showing potential sites for new hydro generation



The Waikato Regional Renewable Energy Assessment identifies a range of sites which have potential for mini, small and medium scale hydro projects within the region, with an estimated generating potential of 280 MW (if they were all implemented). The potential hydro schemes can be seen in the map as the blue diamonds, while existing hydro schemes are shown with a clear diamond.

Development of renewable electricity

In the map, the Waikato Regional Renewable Energy Assessment identifies a range of sites which have potential for mini, small and medium scale hydro projects. While not all of these projects will necessarily prove feasible, there is clearly some potential for further hydro development within the region.

One of the functions of the Regional Energy Strategy is to provide a mechanism whereby members of the Waikato Regional Energy Forum can work together to identify why these renewable opportunities have not been developed, and to explore whether these reasons are technical, economic or regulatory.

One of the potential barriers to the ongoing development of the hydro resource is the certainty of water supply. Hydroelectric generation is just one of the competing demands for allocation of water, along with irrigation, agriculture, industrial operations and domestic use.

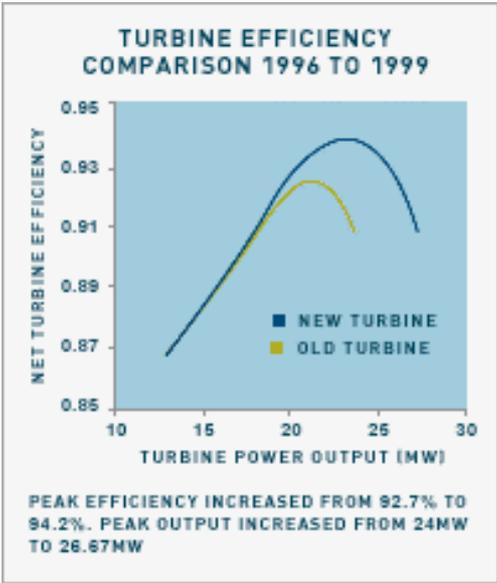
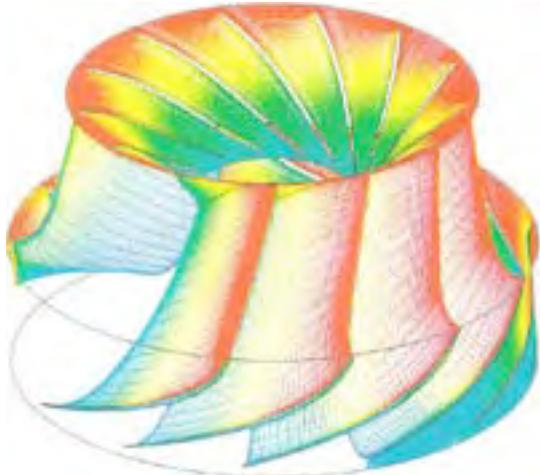
Environment Waikato has recently undertaken an extensive consultation process regarding the proposed variation to the water allocation rules. Under this proposed variation, priority would be given to domestic users (who need water for drinking), and for hydro stations (which generate power from this renewable energy source, but do not ultimately consume the water).⁷⁸

This categorisation priority is reinforced by the government’s NZES, which places high importance on renewable energy, as does Section 7(j) of the RMA.

Upgrading existing dams

One way of improving hydro generation capability is to encourage further efficiency upgrades of existing plants. Upgrades to turbines and generators on existing plants can result in small efficiency gains – which can translate into generation increases.⁷⁹

Efficiency upgrade at Arapuni by Mighty River Power



Source: Mighty River Power

A turbine efficiency upgrade at Arapuni increased peak output by 2.6 MW

For example, Mighty River Power has undertaken a major overhaul of the oldest and largest single station on the Waikato River, Arapuni. The overhaul, which was completed in 2002, included the station’s generators and turbine runners in order to improve both its efficiency and environmental performance. The upgrade increased peak efficiency from 92.7 per cent to 94.2 per cent, and peak output increased from 24 MW to 26.67 MW.⁸⁰

⁷⁸ Environment’s Waikato’s proposed Water Allocation Variation 2007.
⁷⁹ SKM-EECA Waikato Regional Renewable Energy Assessment (page 42)
⁸⁰ Source: Mighty River Power website

The station has undergone numerous enhancements over the years, including a new forebay and intake structures, new spillways, new governors and control systems, automation, generator rewinds, modified tubes, circuit breakers and transformers.

The decision to undertake this kind of efficiency upgrade is clearly a commercial one made by the generation owners on a cost-benefit basis.

Run of river systems

On the smaller generation scale, ultra low head turbines operate in the stream flow and extract energy from the stream velocity. River flows where the velocity reaches more than 1 m per second can provide potential sites for such machines. In the United Kingdom, former mill sites have been utilised for this type of mini-hydro system.⁸¹ It is possible that an adaptive form of 'run of river' turbine may prove suitable for some of the rivers within the Waikato catchment area.

An example of 'run of river' turbine from American-Canadian company, Verdant Power, which promotes a three-blade free-flow turbine. Its downstream rotor is designed to capture energy from the natural flow of tidal or river currents. KHPS Turbines are installed and operate fully underwater, invisible from the shore. They are scalable to various sizes depending on site characteristics, and can be grouped into small or large clusters to produce village or utility-scale power.

KHPS Turbines rotate at a slow rate (32 revolutions per minute, compared to conventional hydropower turbines which can turn at rates of up to 600 - 700 rpm). The company states this allows for safe fish passage and causes minimal environmental impact



Source: Verdantpower.com

One NZ generator cautions that while 'run of river' systems might seem feasible in theory, they would face high maintenance costs, and consenting issues. Therefore it could be 10 years or more (if at all) before such systems are likely to become operational in New Zealand.

⁸¹ "Half Gone" by Jeremy Leggett (page 203)

Recommendation 4: The Regional Energy Strategy recognises the importance and value of existing and potential hydro generation infrastructure, within the Waikato region and its essential contribution to regional and national energy needs and security of supply.

The Regional Energy Strategy advocates for policies and actions that promote maintenance and appropriate development and use of this valuable natural resource.

When new proposals for water allocation are being considered in the consenting process, the Regional Energy Strategy recommends that hydro generation should be considered a desirable renewable low-emission source of electricity essential to regional and national energy needs and for security of supply.

Who is involved

Environment Waikato, EECA, New Zealand Clean Energy Centre, Waikato Regional Energy Forum, Ministry of Economic Development and related agencies, local authorities, generators

What action is required

- Give appropriate recognition to the importance of existing generation assets to the national electricity infrastructure.
- Ensure recommendation is considered in the second generation Regional Policy Statement, including concerns regarding existing and future generation capacity being restricted or prevented by water allocation policy and decisions.
- Obtain support for existing hydro generation at consent and planning hearings by national agencies such as the Ministry of Economic Development.

Where should actions be focused

- The Waikato Regional Energy Forum helps promote the development of renewable electricity generation to assist in nationwide security of supply.
- In particular with the development of policy, Regional Policy Statement and planning instruments.

When should the action occur

- As determined by planning and policy processes.

c) Coal

The Waikato region is the predominant source of coal in the North Island, with production primarily sourced from the Huntly East and Rotowaro mines, and on the west coast in the Mokau area.



Source: MED Energy Data File

This map shows the annual production from the major coal mines in both the North and South islands.

Waikato coal resources

The Waikato region, which contains some 14 coalfields extending from Maramarua in the north down to Mokau in the south, is estimated to have about 2 billion tonnes of coal in the ground. This compares with the NZ total recoverable coal reserves, which are estimated to be around 8.6 billion tonnes. In the NZ context, Southland's lignite reserves are extensive, and are estimated to have energy content around 20 times greater than the Maui field.⁸²

In the Waikato, the 2 billion tonnes of coal are a strategically important energy resource, particularly as they are close to New Zealand's large centres of population. However a significant part of this resource is more than 300 m deep, and extraction to date has mainly been of the shallow coal resources. Significant shallow coal resources exist in the historically important coal fields of Rotowaro, Huntly and Maramarua, with significant underground opportunities in the other major coal fields at Waikere, Kawhia, Mangapehi and Mokau.

Underground mines in Huntly have reached a maximum depth of 300 m. But about 40 per cent of the region's coal resources are deeper than this, and are therefore inaccessible by technology currently used in the region. New technologies and utilisation methods are currently being investigated to allow access to deeper resources; this includes underground gasification and coal bed methane.



Source: MED Fact Sheet on Coal – GNS Science photo

This photo shows the southern part of the Huntly coalfield, with the coal-fired Huntly Power Station on the western bank of the Waikato River. The Huntly mine, which produces over 400,000 tonnes per annum, is the last remaining underground mine in the North Island.

⁸² Information source: "Options, Choices, Decisions" - background paper produced by Meridian Energy (page 35)

Production

Coal has been mined in the Waikato since the late 1840s. By the 1950s, production was over 1 million tonnes a year, and now stands at about 2.5 million tonnes a year. According to the Ministry of Economic Development (MED), the Waikato's output represents about half of New Zealand's total output, and about 70 per cent of the coal produced for domestic consumption.

Waikato coal is vital to several key industries – and because of the scale of these users, the MED states that it is a crucial part of New Zealand's energy security.⁸³

Most production is by opencast mining at the Rotowaro mine, which produces more than 1.2 million tonnes a year. However, with only 14 million tonnes still available within the mine, it is nearing the end of its life.



Source: MED

The Waikato coal fields produce more than half of New Zealand's total production, and 70 per cent of production for domestic consumption. The major coal fields are at Maramarua, Waikare, Huntly, Rotowaro in the north and Kawhia, Mangapehi, Tihiroa and Mokau in the south.

⁸³ Ministry for Economic Development fact sheet on coal (page 2)

The Huntly East Mine produces approximately 400,000 tonnes of coal and is the last remaining underground mine in the North Island. Huntly East has approximately 2 million tonnes of 'measured resource' available, with further and extensive volumes at indicated or inferred status.

The Ministry of Economic Development notes that development of underground mining was hampered by difficult conditions. Improvements in underground mining, particularly in roof support techniques and extraction technology, have improved productivity and enabled access to deeper coal reserves.

Users of coal

The Waikato (especially from the northern part of the region) produces a high-quality thermal coal. This coal is used in the New Zealand Steel mill at Glenbrook where the plant has been specially designed to produce steel from west coast iron sands and Huntly coal.⁸⁴ About 90 per cent of the 400,000 tonnes produced at the Huntly East mine is railed directly to Glenbrook, and about one third of the 1.2 million tonnes produced at Rotowaro also goes to New Zealand Steel.



Source: New Zealand Steel website

New Zealand Steel is a major user of Huntly coal. It is railed directly to Glenbrook. The plant consumes about 800,000 tonnes of Waikato coal for direct reduction iron making

In addition to being used for steel production, coal is used for industrial steam raising, particularly in the Waikato dairy industry. It is also used by lime manufacturers, meat works, timber processing, hospitals, light industrial and horticultural businesses – with a small proportion bagged for household use.

But the major user of coal in the Waikato region is the Huntly Power Station, which consumes over 2 million tonnes of coal a year. Much of this coal is produced at the Rotowaro opencast mine, and is trucked by private road to the power station.

⁸⁴ Information source: Solid Energy website

Huntly Power Station

The Huntly Power Station, which is operated by Genesis Energy, is a dual-fuel plant, capable of operating on both coal and gas. The original 1000 MW coal and gas-fired steam plant was originally built between 1982 and 1985 when four 250 MW units were commissioned. It was supplemented with construction of a 48 MW open-cycle gas turbine generator – giving an installed generating capacity of 1048 MW. The plant has been further expanded with the opening of the e3p 400 MW combined cycle gas turbine (see the next chapter on gas). Huntly plays a critical role in the country's electricity supply as it can provide guaranteed output during times of low lake levels which reduce hydro capacity.



Source: Coalnz.com

Huntly Power Station is a dual-fuel plant built in the 1980s. It has been predominantly running on coal since the decline in Maui gas production. The Huntly plant, which has a capacity of 1448 MW (including e3p), provides 16 per cent of New Zealand's installed generation capacity.

Huntly Power Station was traditionally run on gas as its primary fuel, however as Maui gas supplies began to run out in the early 2000s, coal has increasingly become the major fuel source. About 50 per cent of this coal is locally mined, while the remaining 50 per cent is imported from Indonesia – with Genesis importing nearly 1 million tonnes of coal a year through the Port of Tauranga.

Water temperature factors

While Huntly provides an important security of supply role during times of low hydro flow, this capacity is limited by the temperature management of the Waikato River, which provides water for cooling the condensers.

Existing resource consents require that the maximum temperature of the river downstream of the station shall not exceed 25 degrees (calculated as a one hour average). To alleviate over heating the river, Genesis Energy constructed a 'helper' cooling tower, which cools the water before it discharges back to the river. This tower will enable 140 – 180 MW output (depending on atmospheric conditions) irrespective of the river upstream temperature.⁸⁵

⁸⁵ Information source: Genesis Energy's website on the Huntly Power Station.

The construction of the new e3p gas-fired power plant adjacent to the original Huntly station has also helped alleviate this problem. The e3p plant, which came into operation in 2007, does not require cooling water from the Waikato River, which means it is not subject to resource consent conditions about temperature discharge into the river. (For more details about the e3p plant, see the following chapter on gas utilisation within the Waikato region.)

Future potentials for coal

Solid Energy is currently investigating, as an energy source, the commercial viability of extracting clean, high-quality methane gas trapped in coal seams.

Coal seam gas (which is also known as coal bed methane) is a form of natural gas which occurs deep under the ground in coal beds. The gas is generated either by microbes which create the gas from a biological process, or from a thermal process as a result of increasing heat as the coal is buried. In the Waikato, the gas present in the coal bed is largely as a result of the microbes, which can live several kilometres deep.

Solid Energy has drilled five wells in the North Huntly coalfield, which has shown that there is a quantity and quality of gas for a viable commercial field.⁸⁶

Exploratory drilling for coal seam gas in the Waikato



Source: Solid Energy

Solid Energy has drilled five appraisal wells in the North Huntly coalfield to provide information about the quality and quantity of gas flows in the area.

Initial work has indicated that the methane resource in the North Huntly coalfield could contain gas equivalent to 25-200 PJ of energy. As a comparison, the Pohukura gas field is estimated at 500-1200 PJ, and the Kupe field at 300 PJ.

According to Solid Energy, coal bed methane in the Waikato is very clean high quality natural gas with less than 2 per cent carbon dioxide on extraction. This compares to some conventional gas extracted in New Zealand with up to 50 per cent carbon dioxide.⁸⁷

Coal seam gas can be used for industrial energy, electricity generation, and can be injected into gas transmission lines to supplement gas resources. Though not as well-known in New Zealand, the exploration and mining of coal seam gas

⁸⁶ Information source: Solid Energy pamphlet on coal seam gas – October 2006

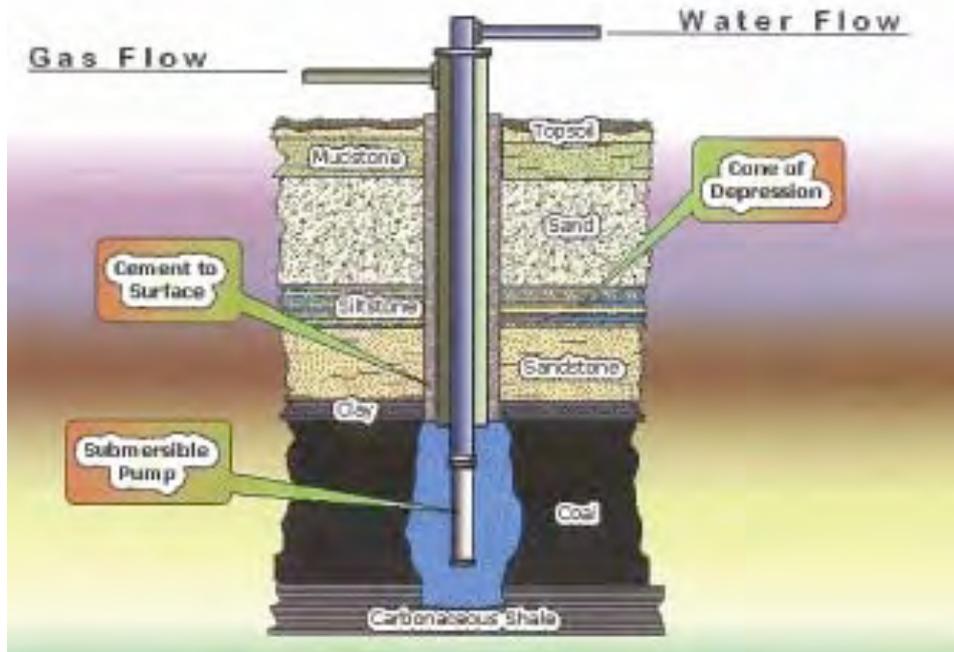
⁸⁷ Information source – Solid Energy

Waikato Regional Energy Strategy

is well-established in Australia and the United States, and is being developed extensively in China, India and South-East Asia,

Coal seam gas extraction uses wells similar, though much smaller in scale, to those used in the petroleum industry. The final footprint of such a well would be around 5 m by 7 m. Production wells run for approximately 8-12 years.

Simplified diagram of a coal seam gas well



Source: Solid Energy

The well is drilled, and the casing is set to the top of the targeted coal seam. A submersible pump moves the water up the tubing, and gas separates from the water as pressure is reduced. The gas is passed to a central compressor station, where it is measured, and then added to a pipeline network for delivery.

The drilling of the appraisal wells in the North Huntly coalfield is still at an exploratory stage. If a decision is made to proceed, field development would take five to seven years.

Carbon footprint of coal

Coal has a high carbon footprint compared with other fossil fuels. Charges on the cost of carbon would impact the cost of electricity produced from fossil fuel sources such as coal, with a potential price rise for baseload generation.

NZ electricity sector greenhouse gas emissions 2006



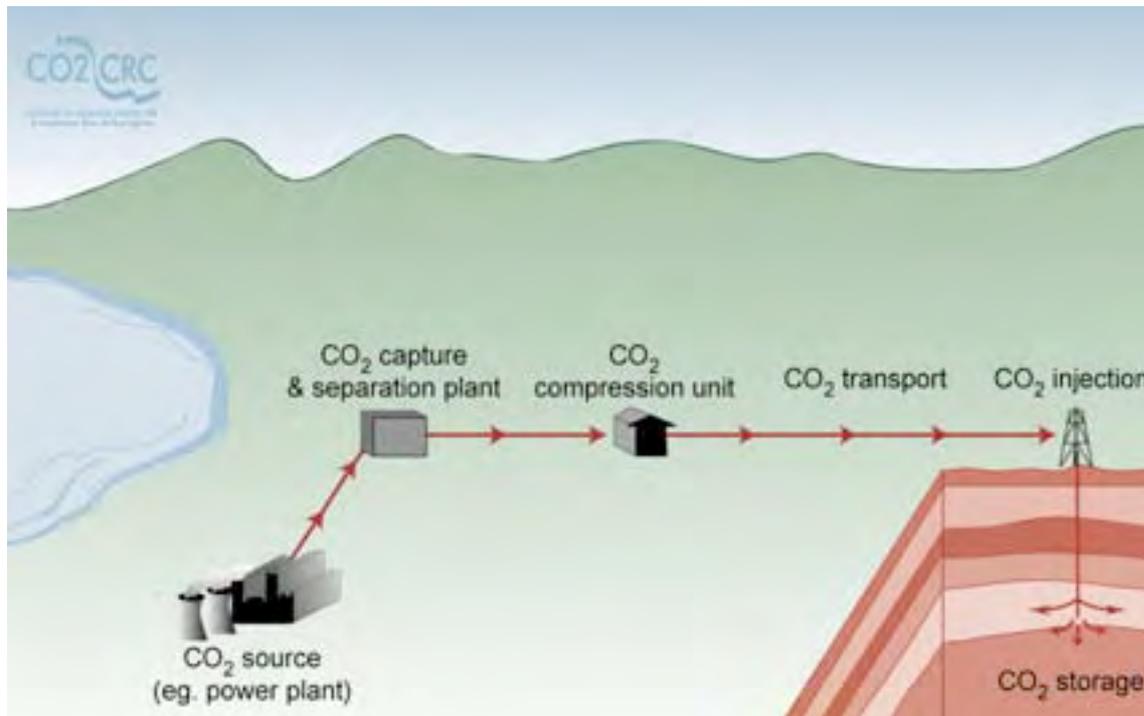
Source: Contact Energy

Coal is New Zealand's largest contributor to greenhouse gas emissions, followed closely by gas.

Development of clean coal technologies

More research needs to be undertaken on clean coal technologies, including carbon capture and storage.

Technology development for carbon capture and storage



Source: Co2CRC

Carbon capture and storage involves finding ways of capturing carbon from a power plant, and then storing it deep underground by a process known as geosequestration. Disused oil wells or coal mines are being considered as potential sites for this technology, which is still in its development stages.

In June 2007, the New Zealand government joined forces with the Queensland government in a scientific programme to address clean coal technologies. A number of New Zealand organisations including GNS Science, Solid Energy, the Foundation for Research Science and Technology and Genesis Energy are working with the Australians on the project. The issue of carbon capture and storage is regarded as an important move relating to climate change and energy security by the New Zealand government, with the former Prime Minister Helen Clark stating: "This is an issue of interest for us, because we have a thousand years of coal reserves, and we do export coal."⁸⁸

Solid Energy is a partner in an Australian company CO₂CRC, which is planning to inject carbon dioxide via geosequestration in a NZ\$55 million demonstration project in the Otway Basin, near Melbourne.⁸⁹ In New Zealand, it has been suggested that the depleted Maui gas field could be a potential site for storing about 100 years' worth of Huntly emissions. An alternative site could be disused coal mines near Huntly. At this stage, site locations are still being ranked on suitability – and no decisions have yet been made.

The government's NZES states that: "the variable nature of renewable electricity generation gives fossil fuels an ongoing role, although their greenhouse gas emissions will need to be addressed".⁹⁰

⁸⁸ New Zealand Herald 14 June, 2007 (page A7)

⁸⁹ Technology Article from New Zealand Herald "The Business" June 2007

⁹⁰ New Zealand Energy Strategy (page 80)

Recommendation 5: The Regional Energy Strategy acknowledges the importance of existing and potential coal resource and infrastructure within the Waikato region.

It acknowledges that the use of coal is essential to meet regional and national energy needs and security of supply.

The strategy also promotes the identification, research and appropriate development and use of this valuable natural resource. In particular, clean coal technologies and low-emission extraction and use techniques.

Who is involved

Environment Waikato and local authorities, EECA, New Zealand Clean Energy Centre, Waikato Regional Energy Forum, Ministry of Economic Development and related agencies, Solid Energy and generators

What action is required

- Ensure the Regional Policy Statement recognises the significance of coal resources within the Waikato region, and provides appropriate direction to territorial local authorities.
- Encourage regional and district councils to give special consideration to clean coal technologies and low emission extraction techniques, especially in regard to trial pilot plants.
- Encourage district councils to acknowledge the location and role of the coal resource (and its potential for utilisation) in their district plan and zoning processes to avoid impeding or preventing future development of known coal resources.

Where should actions be focused

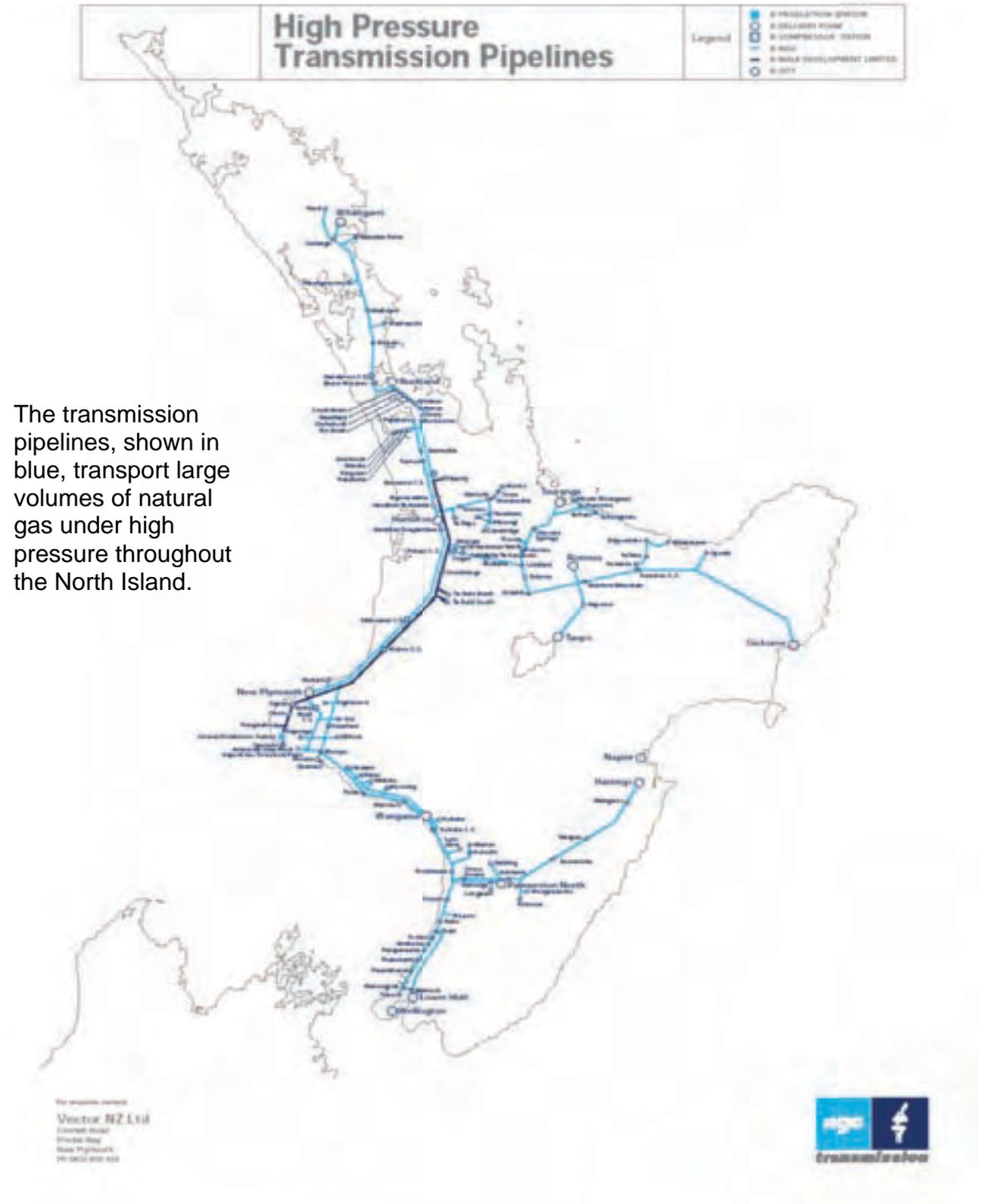
- Regional Policy Statement and district plans should acknowledge the potential for the development of clean coal technologies and low emission extraction.
- Regional Policy Statement and planning instruments should provide recognition for the significance of coal resources.
- In recognising the importance of coal in maintaining security of supply and promoting the development of clean coal technologies.

When should this happen

- As determined by planning and policy processes and the evolution of technology.

d) Natural gas

The Waikato region is a major consumer of natural gas, as well as an important conduit for the gas pipeline from Taranaki.



The transmission pipelines, shown in blue, transport large volumes of natural gas under high pressure throughout the North Island.

There are over 3400 km of high-pressure transmission pipelines which are predominantly owned by Vector (which acquired the Natural Gas Corporation), and the Maui pipeline extending from South Taranaki to Huntly is owned by Maui Development Ltd. More than half the distribution pipeline and service connections are in the Waikato region.⁹¹

⁹¹ Information source: Vector website, and Gas Industry Co Ltd website

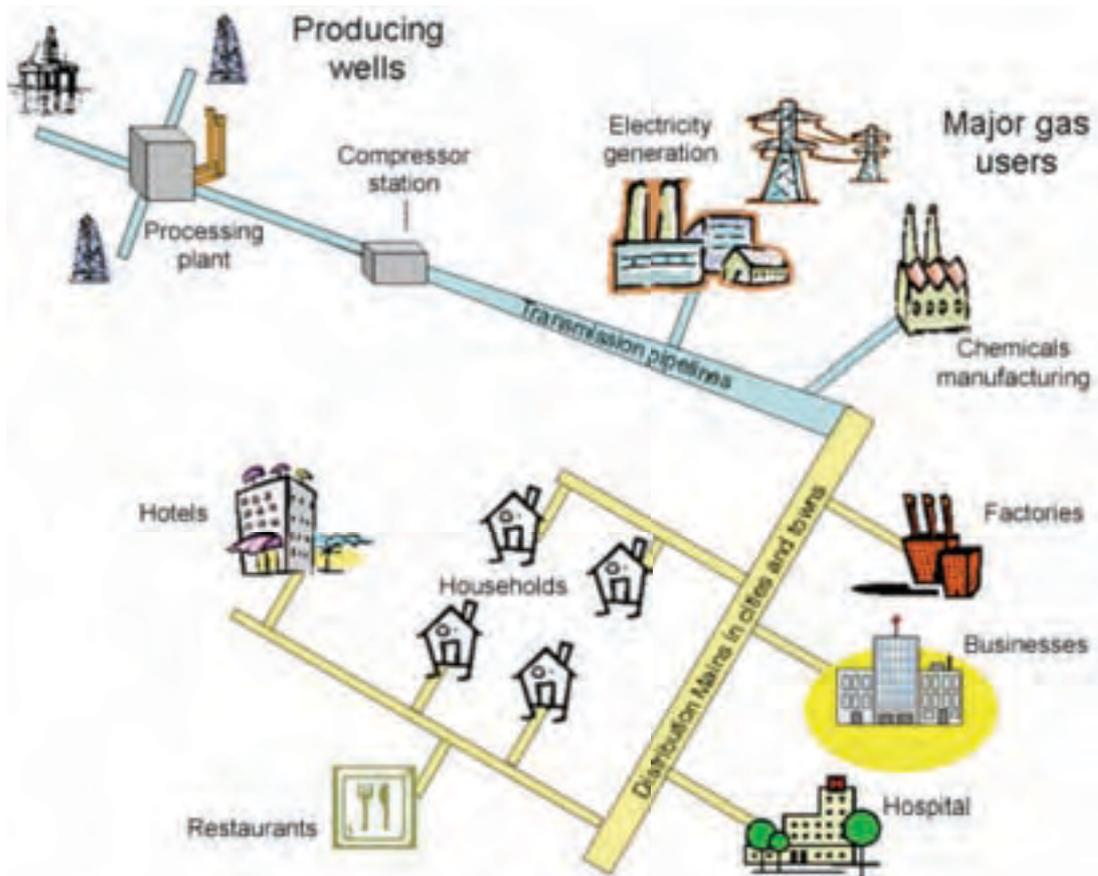
“In fact, e3p will lead to a reduction of around 1.8 million tonnes of carbon dioxide emissions per year, which would otherwise have been emitted from the coal-burning Huntly Power Station. That amounts to around 20 per cent of the carbon dioxide emissions from all power generation in New Zealand.”⁹³

Other users

Apart from Huntly, gas is also used in dual-fuel operations (along with coal) at a cogeneration plant, operated by Contact Energy at Fonterra’s Te Rapa dairy factory.

On a national scale, Contact Energy also announced in October 2007 that it would build a flexible, fast start 100 MW gas-fired peaking plant in the company's Stratford power station site. The NZES, which is against the building of large new fossil-fuel-fired plants, nevertheless delineates between ‘baseload’ and ‘flexible’ thermal plants. The flexible thermal plants are seen as important for supporting increasing levels of wind generation by providing backup during peak demand, or low wind or dry-year hydro.⁹⁴

Apart from electricity generation, gas is used in a range of industries from fertiliser production through to the dairy industry.



Source: Gas Industry Co Ltd

Apart from electricity generation, gas has a wide range of uses such as providing fuel for industrial processes, and energy to factories and businesses, as well as domestic heating and cooking.

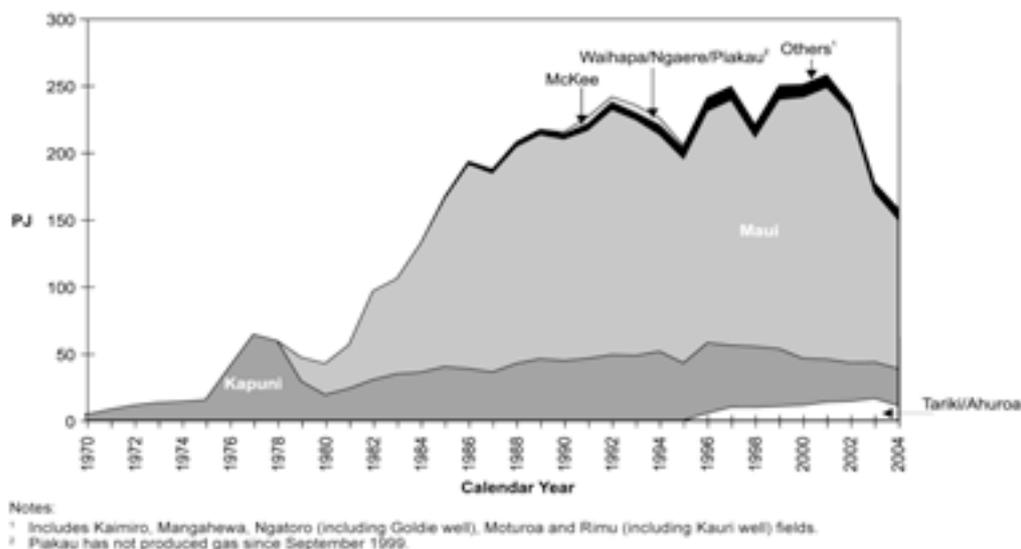
⁹³ Speech by Hon Trevor Mallard at the opening of e3p – 31 August, 2007

⁹⁴ Contact Energy media release (18 October, 2007)

Maui gas

The supply of natural gas in New Zealand is produced in the Taranaki region from 11 fields – with production dominated since the late 1970s by the Maui field. With the decline in the Maui field, industry analysts say that New Zealand's gas situation is likely to remain tight. This is predicted to have a flow on effect to electricity prices, which tend to be shaped by the economics of new gas-fired generation.⁹⁵

New Zealand's gas supply profile 1970-2004



Source: NZ Energy Data File 2006

New Zealand's gas supply has been dominated by the Maui field, which is now in decline. This profile of fossil fuel depletion mirrors the depletion curve proposed by peak oil analysts, as described in Chapter 1. Unless significant new fields are discovered, analysts predict a projected gas shortfall date of 2015.

At the time Maui was discovered in 1969, it was one of the largest gas discoveries in the world. However New Zealand's demand for gas at that time was largely limited to domestic customers. In its analysis of New Zealand's energy sector 'Options, Choices, Decisions', Meridian Energy comments:⁹⁶ "With the discovery of the Maui field, New Zealand's gas supply substantially exceeded demand, although several 'Think Big' projects were developed to harness some of this newly discovered fuel".

"Given these market conditions, the Maui Gas Contract between the Crown and Maui Mining Companies was struck with what has turned out to be a relatively low price. This price has set the wholesale gas market price..... the low price has also led to relatively low electricity prices by world standards. The delivery flexibility provided by the Maui field has also been used to offset hydrology variability in the electricity industry."

Gas supply issues

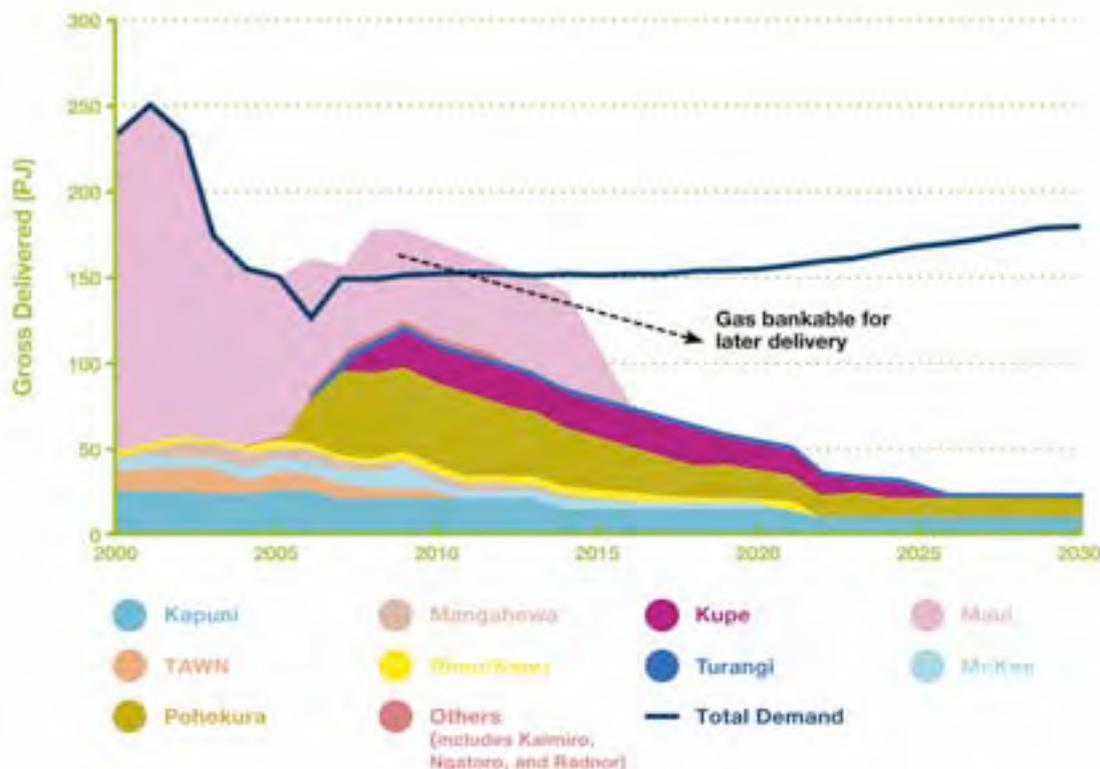
Meridian's 'Options' paper notes that New Zealand's wholesale gas market was "turned on its head in 2003, when an independent expert concluded that the remaining gas reserves in the Maui field were significantly less than previously thought. Downstream gas users' remaining gas allocations were scaled back, and they adjusted their operations. In the electricity sector, Contact Energy and Genesis Energy had to alter their operation of thermal plant".

⁹⁵ Comment sourced from Meridian "Options" paper

⁹⁶ "Options, Choices, Decisions" - a discussion paper by Meridian Energy (pages 27-29).

"New Zealand's gas industry remains in a period of flux, with gas supply remaining tight.... With a projected gas shortfall date of 2015, time is running out for indigenous gas reserves to be found."

Demand v supply profile for NZ natural gas - 2000-2030



Source: MED New Zealand Energy Outlook to 2030

New Zealand is facing a potential shortfall in indigenous natural gas supply by 2015. The dark blue line indicates projections of total demand for gas, while the coloured profiles indicate supply available from New Zealand gas fields.

Prospecting in the Waikato region

Prospecting for natural gas reserves is being undertaken in the seas off the Kawhia coast. An Australian company Geokinetics is undertaking seismic testing on behalf of Genesis Energy in the Mangatua prospect, which stretches from the Awakino River to Tirua Point.

Natural gas deposits were discovered in the area in 1986, but the changing economics of gas exploration and gas-fired power generation is causing Genesis Energy to look again at the deposits. If a decision is made to drill, this is likely to occur late in 2009.⁹⁷

Re-starting of the Motunui plant

Methanax is restarting its Motunui methanol plant in Taranaki, with revenue expected to be around \$650 million. Analysts caution that this may also hasten the expected national gas supply gap, which is predicted for around 2015.

The plant is expected to produce about 900,000 tonnes of methanol, using 34 PJ of gas a year. Methanax is trying to get more gas to run the plant until mid 2010, and could reopen its Waitara Valley plant if it succeeds. If both plants are running, Methanax will need more than 50 PJ of gas – equal to about one third of New Zealand's present national demand.

⁹⁷ Waikato Times 16 August, 2008 (page 8)

According to newspaper reports, the plant is expected to be highly profitable for Canada's Methanex, with annual production revenues of about \$650 million dwarfing the estimated \$200 million a year cost of gas, and the \$70 million cost of restarting the plant. Methanol is used in a variety of products from recyclable plastic bottles, plywood floors to paint, silicone sealants and synthetic fibres.⁹⁸

Energy analysts have warned that New Zealand's 'gas gap' – while predicted for 2015 – could occur several years sooner (around 2012) if Motonui is running. McDouall Stuart's head of research, John Kidd, commented that in order to be standing still in terms of gas reserves in five years time, the country would need to find another 350 PJ of gas, if both Methanex plants were running at full capacity.

While it is possible that major new gas discoveries could be made within New Zealand, the 'New Zealand Energy Outlook to 2030' cautions against relying upon such discoveries. "Although Crown Minerals has adopted an aggressive strategy to encourage exploration, it would not be prudent to plan NZ energy's future based on assumptions of major discoveries."

"This is especially true given that it would most likely take several years to bring gas from a major new Taranaki discovery to market, and considerably longer from almost anywhere else, as existing gas infrastructure would be lacking. For example, the first gas from the Maui field was not delivered until 1979, even though the discovery was made in 1969."⁹⁹

Imported natural gas

If New Zealand's domestic gas supplies seem unable to meet demand, natural gas could be imported from overseas. Australia, Indonesia, Malaysia and Brunei are gas exporters in the South Pacific region.



Importing liquefied natural gas (LNG) by ship is being considered as one way of meeting New Zealand's potential gas shortfall as Maui gas runs out. Liquid-fuel carrying tankers, like this one carrying LPG, are already used extensively around the world.

Source: Wikipedia

Contact Energy and Genesis Energy have jointly explored the potential for building a *liquefied natural gas* (LNG) terminal in New Zealand as an option if New Zealand runs short on gas.

⁹⁸ Waikato Times 15 August, 2008.

⁹⁹ NZ Energy Outlook to 2030 (page 81)

The NZ Energy Outlook states that: “Although LNG is a proven technology, with 25 countries currently importing or exporting gas, building an import terminal would be a big commitment for New Zealand. Contact and Genesis believe the minimum viable scale for LNG imports would be 60 PJ per year – about 40 per cent of New Zealand’s 2004 demand. A terminal of the size would cost hundreds of millions of dollars, which investors would be unlikely to provide without long term sales contracts.”¹⁰⁰

However Contact Energy has recently announced that it is also investigating a new proposal for using a depleted offshore well (Ahuroa, off Taranaki) for gas storage.¹⁰¹ This well could be used for two purposes – firstly for storing indigenous gas produced during the summer months and siphoning it out again to meet winter demand. Secondly the well could be used for storing imported gas brought in by ship.

The advantage of this process is that it would obviate the need for building the expensive LNG terminal, and would mean that Contact could buy on the spot market, rather than being caught in long term overseas supply contracts (which would be necessary to justify the high capital costs of an LNG terminal).

The NZ Energy Outlook suggests that an alternative to LNG would be compressed natural gas (CNG), where the gas is simply compressed and loaded on a ship.

Regardless of whether LNG or CNG is considered, the NZ Energy Outlook warns that while the world has enough gas supplies for about 67 years, most of the gas tends to be in Russia or OPEC countries, which means that any supply problems in the oil market would also have a potential impact on the world gas market.

Energy price implications

Liquefied natural gas prices are historically linked to the price of oil. This means that if New Zealand was hit with rising oil prices, it is likely that imported LNG prices would also ratchet up. Furthermore the NZ Energy Outlook predicts that without major new domestic discoveries, wholesale gas prices are set to increase significantly over the next 10-15 years.¹⁰²

Meanwhile the Meridian Options paper points out that there is a strong link between electricity prices in New Zealand, and the economics of gas-fired generation of electricity. “New Zealand’s future wholesale electricity price tends to be shaped by the economics of new gas-fired generation. These economics are driven primarily by the wholesale price of gas. In turn, this price is driven significantly by the amount of indigenous gas reserves.”

So while some companies are looking overseas to the potential for importing liquefied natural gas, as LNG contracts are typically benchmarked to oil markets, the price of imported gas will tend to vary with oil prices – which are trending upwards. This has long term implications for energy prices within New Zealand.

¹⁰⁰ NZ Energy Outlook (page 82)

¹⁰¹ Contact Energy’s CEO David Baldwin in a speech to Energy Summit September 2008

¹⁰² NZ Energy Outlook (page 83)

Recommendation 6: The Regional Energy Strategy acknowledges the importance of the existing and potential of natural gas resources and infrastructure within the Waikato region and supports the importance of this contribution to regional and national energy needs.

The Regional Energy Strategy acknowledges the importance of distribution (including pipelines) for gas, and the key role that natural gas plays in industrial processes, electricity generation and domestic use within the region and nationally.

The Regional Energy Strategy advocates for policies and actions that promote research and appropriate development, distribution and use of this valuable natural resource.

Who is involved

Environment Waikato and district councils, gas network companies, Solid Energy, Gas Association of New Zealand

What action is required

- Ensure that the development of the second generation Regional Policy Statement considers this recommendation.

Where should actions be focused

- The Waikato Regional Energy Forum help to promote the development of natural gas infrastructure to assist in nationwide security of supply

When should this happen

- Within the appropriate planning timeframes

e) Wind energy

The global situation

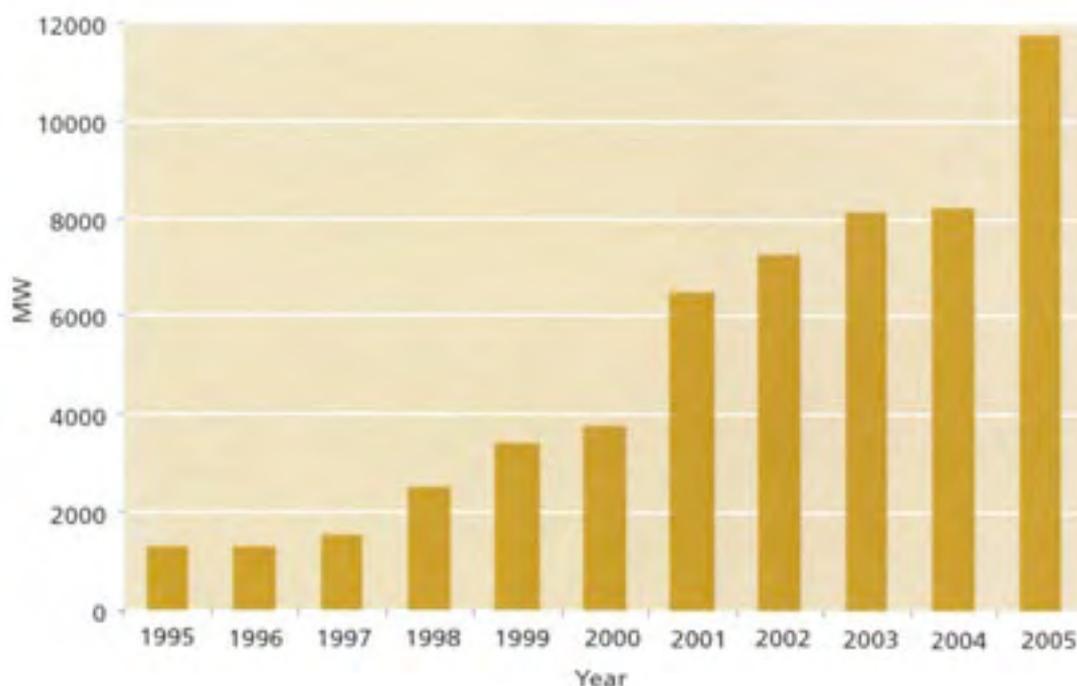
Internationally wind energy generation has undergone a significant renaissance in the past decade. Global wind capacity has soared 1000 per cent since 1995 to stand at 70,000 MW by 2007, and the World Wind Energy Association expects 120,000 MW to be installed by 2010. By comparison, New Zealand's total electricity generation from wind, hydro, geothermal, coal and gas is only about 8600 MW¹⁰³.

This phenomenal international growth originally occurred largely in just five countries – Germany, Spain, United States, India and Denmark (which together account for 76 per cent of total capacity installed), with recent strong growth in China, Canada, Italy and France. In Denmark, for example, already 20 per cent of its electricity is generated from wind alone, while Germany has 31 per cent of the world's total installed capacity – with 17,500 turbines providing more than 18,000 MW.¹⁰⁴

¹⁰³ The 8600 MW figure is based on Transpower's 2007 Annual Planning Report, which is based on operating capacities of grid-connected electricity generation.

¹⁰⁴ Parliamentary Commissioner for the Environment "Wind power, people and place" 2006 (page 29-31)

Global annual installed wind power capacity 1995-2005



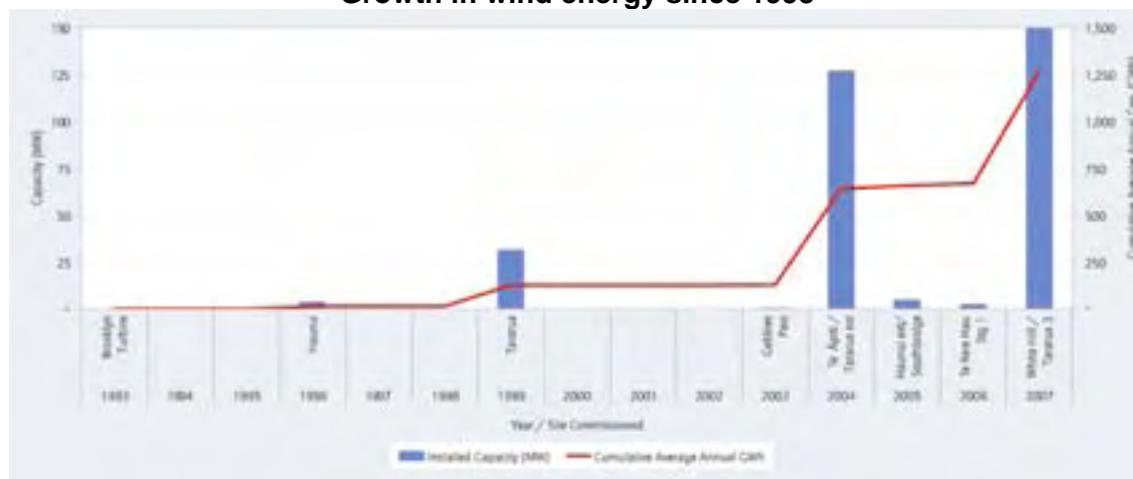
Source: Parliamentary Commissioner for the Environment's "Wind Power" report
This graph shows the increasing growth in the world wind power industry.

The development of wind energy has also spurred economic growth. Scandinavian and European companies have established significant competitive advantage through the design and build knowledge of wind power technologies, now exported around the world. For example, the wind industry provides around 45,000 jobs in Denmark – and Danish turbine manufacturers have a market share of around 40 per cent of global sales. Industry analysts believe opportunity exists for New Zealand to utilise 'Kiwi ingenuity' in specialist niche markets, such as software and wind measurement technologies.

The New Zealand situation

In New Zealand, the wind energy sector is beginning to show signs of real momentum, with installed capacity now at 321 MW (mid 2008) – which the NZ Wind Energy Association says is twice as much as 24 months ago.¹⁰⁵

Growth in wind energy since 1993



Source: Meridian "Options, Choices, Decisions" paper
Wind generation has grown significantly in New Zealand since 1993.

¹⁰⁵ NZ's installed wind capacity stood at 170 MW at the end of 2006

Waikato Regional Energy Strategy

While 151 MW of new wind generation has been installed during 2007, the percentage of New Zealand's total energy needs generated from wind has remained at 1.5 per cent, the same as 2006. This unchanged percentage is due to the large new gas-fired capacity of e3p (400 MW) which came on stream in 2007, significantly boosted New Zealand's overall electricity capacity.

Apart from the 321 MW of installed capacity, there is another 172.6 MW under construction. This includes Westwind's 142.6 MW in Wellington, and a 30 MW upgrade of the Te Rere Hau wind farm in the Manawatu. In addition, resource consents are in process for a further 2054 MW throughout New Zealand.¹⁰⁶

The development of some form of market for carbon in New Zealand¹⁰⁷ (such as a carbon emissions trading scheme) may provide an incentive for investment. Industry analysts say New Zealand's wind energy uptake could also be enhanced by more specific incentives such as targets for new renewable generation (as in the USA) or tax advantages. However the strong demand for wind energy technology in the international market, coupled with rising prices of raw materials such as copper and steel, is ensuring that prices for the large scale wind turbines have not fallen significantly despite increased production. The cost of imported wind turbines could also increase if there is any fall in value of the New Zealand dollar.

Map showing wind farms in New Zealand (2006)



Source: NZ Wind Energy Association

¹⁰⁶ NZ Wind Energy Association website

¹⁰⁷ Wind energy in NZ showed an initial upsurge in growth which was fostered by carbon credits awarded in previous years when New Zealand believed it would have excess Kyoto credits. These credits, which were allocated to renewable generation such as wind, created a one-off boost to the installation of wind capacity. However with the re-calculation of New Zealand's Kyoto obligations in 2003, and the discovery that New Zealand was actually in a deficit position led to a review of NZ's domestic climate change policy, and the curtailment of the carbon credit incentive scheme. The NZ Wind Energy Association says that growth in 2004 and 2007 was essentially entirely due to the former carbon credit system.

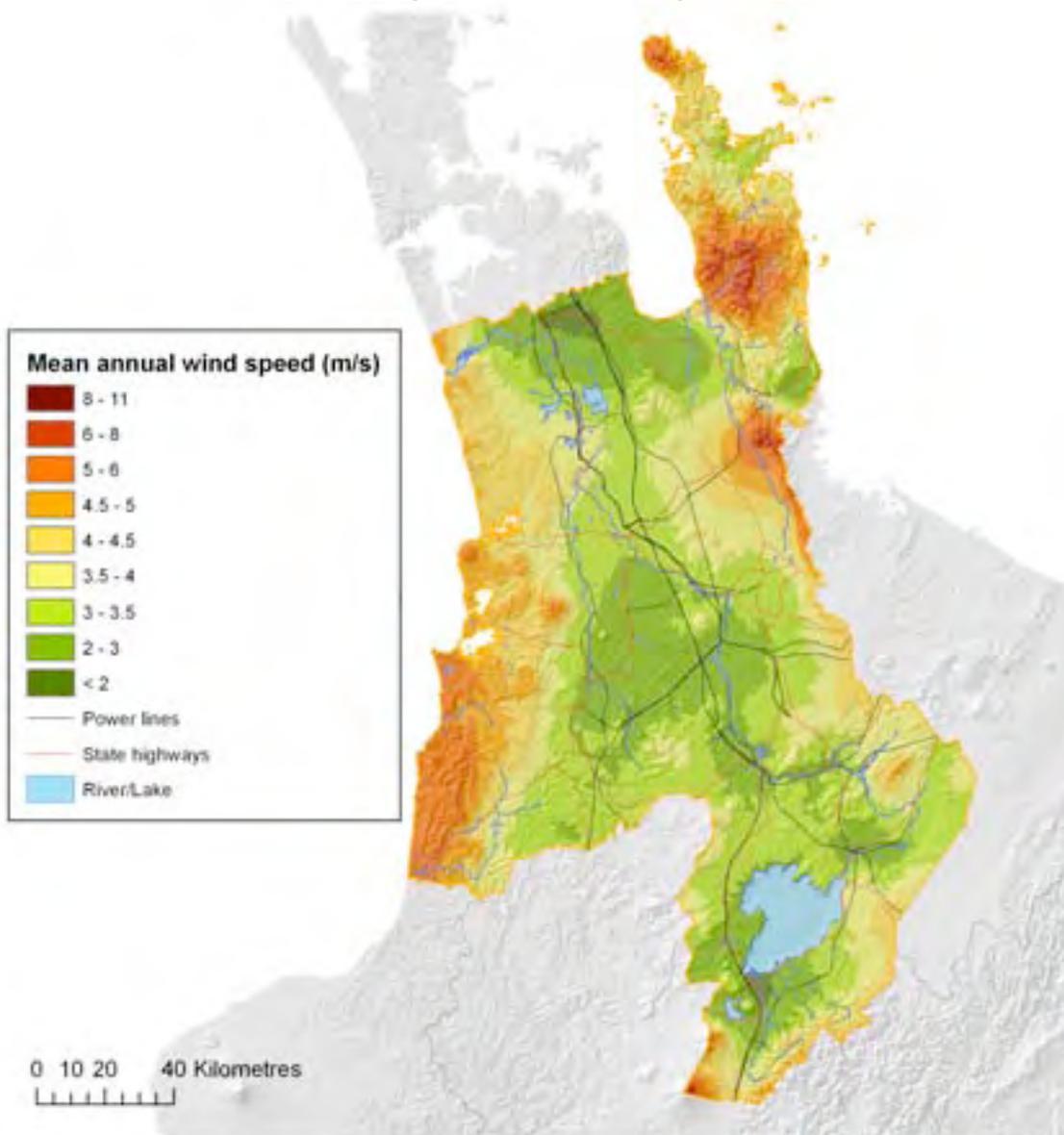
The Waikato situation

The potential for wind power generation of electricity in the Waikato region is positive, with the northwest Waikato having reasonably strong wind, along with the added advantage of being close to the major demand centre of Auckland. Furthermore it is anticipated that wind strength on the west coast may increase over time due to the impacts of climate change.

While the following Waikato wind speed maps can give indications of potential generation, decisions on the sighting and development of wind energy are dependent on a range of other factors, including:

- closeness to demand (major cities), or access to the transmission grid
- ease of consenting
- suitability of the site for construction access.

NIWA map of Waikato wind speeds



Source: NIWA

This NIWA map of wind speeds tends to indicate that the highest annual average wind speeds exist on the Waikato's west coast (especially between Kawhia and Mokau), and in the Kaimai and Coromandel ranges. Another potential area exists near the Mamaku Ranges.

Waikato developments

According to the NZ Wind Energy Association, wind power is currently economic at 8.5-9 m/s. Some of the elevated areas within the Waikato region (at 50-80 m elevation above ground level) are likely to have suitable average wind speeds.

At present, there are no wind farms in the region, but the four developers are already at the consent process. These are:

- WEL Networks, Te Uku wind farm 84 MW (consent granted, but currently under appeal)
- Taharoa C Corporation, Taharoa wind farm 100 MW (consented, but not built)
- Ventus Energy, Taumatotara wind farm 20 MW (consented, but not built)

WEL's Te Uku wind farm

WEL Networks and Meridian Energy have agreed to jointly build and operate the 28-turbine Te Uku wind farm wind park. Under this agreement, Meridian will build and operate the turbines (estimated to cost \$160 million), while WEL owns and manages the lines and national grid connection (estimated to cost around \$40 million).

Contact's 540 MW wind farm

Contact's proposed large Waikato wind farm on farmland to the south of Port Waikato has been 'called in' by the government, as part of the consenting process. The wind farm will be known as 'Hauauru ma raki', meaning 'north-west wind'.

The proposed wind farm is considered to be strategically important as it is located in the North Island, and close to major load centres of Hamilton and Auckland.

"Hauauru ma raki is nationally significant both in terms of meeting New Zealand's growth in demand for electricity and for the development of clean, renewable electricity for current and future generations," Contact's CEO David Baldwin said in announcing the project. Contact says the proposed site is suited to a wind farm as it has a good wind resource, and the surrounding areas are very lightly populated.

Contact's proposed 540 MW wind farm near Port Waikato



Source: www.contactenergy.co.nz/waikatowind.

A photo simulation view of part of Contact's proposed 540 MW wind farm, as seen from Waikaretu Road looking south over Waikawau Stream.

Contact says that analysis conducted into the economic benefits of the wind farm suggests that in excess of \$100 million could be injected into the local Waikato economy over the approximately four to five year construction period, followed by millions of dollars each year when the wind farm is operating. Around 450 jobs are likely to be created in the area during the construction phase.

Distributed generation wind farms

Wind farms can operate on a distributed generation model, where they are not connected to the national grid. This can occur from the micro wind level of the lifestyle block owner right up to the large scale distributed generation model utilised in the Te Rere Hau wind farm in the Manawatu operated by NZ Windfarms Ltd. The company, which has recently attracted investment from Mighty River Power, is building comparatively smaller-scale wind turbines that connect into the local network and supply power to local communities (such as the \$80 million Te Rere Hau wind farm in the Manawatu).

The NZ Windfarms' model uses smaller turbines than used in the more traditional large scale wind farms. Its turbines stand 30 m high, compared with more commonly-used wind turbines which can reach 80-100 m. Consequently they generate smaller amounts of power (0.5 MW compared with 3 MW). However this may be offset by lower capital costs for infrastructure, and potentially less community objection during the consenting process.



Source: NZ Windfarms

The Te Rere Hau Wind Farm to have 97 Windflow 500 turbines, designed and manufactured in New Zealand. These 500 kW turbines have a rotor diameter of 33 m, and are designed for New Zealand's wind conditions.

However critics argue that in terms of appropriate development and visual amenity, more clusters of 0.5 MW wind turbines would be required in a given area compared with fewer numbers of the larger turbines. For example, to generate a capacity of 20 MW, they suggest it is better to have seven large turbines generating 21 MW, than 40 smaller turbines. This is clearly an ongoing debate.

The Waikato region would be ideal for utilising this distributed generation model, either on a community scale, or by promoting the use of individual wind turbines to help provide power generation for farms.

Certainly the Parliamentary Commissioner for the Environment in his report on local energy systems observes that smaller, community-owned wind farms have the potential to increase public acceptance of wind energy, and retain economic benefits within the district or region.¹⁰⁸ Analysts suggest that in terms of a community-owned model, the closest parallel in New Zealand is the lines companies – many of which are community-owned. Recent changes to the rules by the government now allow lines companies to get involved in electricity generation. This sets the stage for a greater uptake of renewable energy generation by the community-owned lines companies. However, contrary to the Parliamentary Commissioner's assertion, it appears that community-owned lines companies will not necessarily face less public opposition to their plans for renewable energy generation.

The renewable energy debate

Nationally one of the issues seen to be potentially constraining wind development involves obtaining suitable land area where consent can be obtained. In some cases there is opposition from local landholders to the siting of wind turbines in their vicinity. However a recent survey by Environment Waikato indicated that 51 per cent of residents surveyed "would not object to a wind turbine being visible from their window".¹⁰⁹

The issues of weighing up visual and associated impacts versus the public benefits of renewable energy are generally resolved on a case-by-case basis through the consenting process. The government sought to inject some clarity into the debate with a proposed National Policy Statement on renewable generation, which provides guidance to local authorities regarding prioritisation within the consenting process.

Coastal Policy Statement: One of the issues which is likely to have an impact on future wind energy development in the coastal environment is the revised New Zealand Coastal Policy Statement. This is because wind farms (particularly in the Waikato) are most likely to occur along the coastline, where wind strengths are traditionally stronger. However this is where there are also potential conflicts between visual amenity and the development of renewable energy.

The proposed NZ Coastal Policy Statement 2008's Clause 17 states that: "policy statements and regional coastal plans shall have regard to the Crown's interest in making land of the Crown in the coastal marine area available for infrastructure of national importance, and renewable energy generation – where such use and developments would meet the purpose of the Act".¹¹⁰

However the Coastal Policy Statement is also heavily concerned with the protection of visual amenity and preserving the open space nature of the coastal marine area – which means there are potentially conflicting values, which may have to be resolved at judicial level for specific consent applications.

¹⁰⁸ Parliamentary Commissioner for the Environment "Wind power, people and place" 2006 (page 113)

¹⁰⁹ Environment Waikato "Environmental Awareness, Attitudes and Actions survey 2006" page 105

¹¹⁰ Proposed NZ Coastal Policy Statement 2008 (Policy 17)

Recommendation 7: The Regional Energy Strategy acknowledges the importance of existing and potential wind generation locations and infrastructure within the Waikato region and advocates for policies and actions that enable wind energy to contribute to regional and national energy needs and for security of supply.

The Regional Energy Strategy advocates for policies and actions that identify and develop wind generation at suitable locations, including transmission and/or distribution.

Who is involved

Environment Waikato, district councils, electricity generators, lines companies and Transpower, NPS on electricity transmission/renewable generation, Wind Energy Association, EECA, Waikato Regional Energy Forum

What action is required

- Ensure that the Regional Policy Statement includes criteria where wind energy generation location should not occur.
- Ensure that the RPS makes provision for wind energy generation in remaining areas.
- Ensure the Regional Policy Statement has provisions for transmission and connection to the national grid that offer greater certainty for investor decision making.
- Design criteria to assist policymakers and industry to achieve an appropriate balance between competing values.
- Promote the importance of wind generation to meet New Zealand's renewable electricity generation needs.

Where should actions be focused

- Regional and district policy and plans including the Regional Policy Statement.
- The Waikato Regional Energy Forum promote the value of wind energy to assist in nationwide security of supply and obligation for renewable clean generation.

When should this happen

- During the revision of the Regional Policy Statement

f) Marine energy

New Zealand is a maritime nation, surrounded by vast tracts of sea, and with only 6 per cent of our territory as land area. Therefore it seems logical for this country to find ways of using the energy of the ocean to generate power.

Possible marine energy sources include tidal energy and wave energy.

- **Tidal energy**, which is generally harvested at harbour mouth, headlands or tidal straits, is diurnal (occurs twice a day) and is generated by the pull of the moon.
- **Wave energy**, which is generally harvested in open-ocean environments, is generated by swells caused by the impact of weather upon the ocean.

Waikato Regional Energy Strategy

Overseas projects are already underway to utilise the power of the sea, with large amounts of funding going into this emerging technology. For example, tidal power is already being harnessed in France with the 240 MW Rance tidal power plant, and the UK government is currently evaluating the potential to harness tidal power from the Severn River.



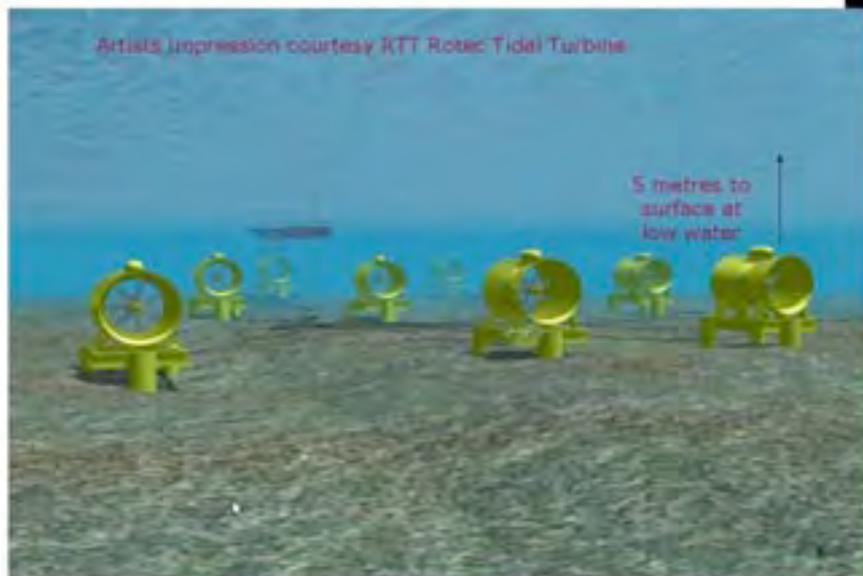
Meanwhile, wave technology is already providing power to the UK national grid through the Marine Energy Test Centre in the Orkney Islands. Recently the Scottish government granted \$10 million for the commercial application of Pelamis wave farm in the Orkneys, and three of these wave power machines are also being established in the seas off Portugal.¹¹¹

Source: Wikipedia

The Rance tidal power plant, which opened in 1967, is the world's first electrical generating station powered by tidal energy.

In New Zealand, the government has announced the formation of an \$8 million fund for the development of marine energy technologies. These technologies must be practical working examples and not just theoretical research projects. Funding is contestable, with the first round being awarded to Crest Energy, subject to the company getting resource consent.

Crest Energy have been awarded \$1.85 million for their tidal power project for Kaipara Harbour. The Crest Project is one of 22 active wave and tidal energy projects under development – including a tidal project in Cook Strait.¹¹²



Source: Crest Energy

Underwater turbines, such as those proposed at Kaipara, work on the daily tidal movement of the ocean through the estuary.

¹¹¹Dr John Huckerby – Aotearoa Wave and Tidal Energy Association (AWATEA) personal communication.

¹¹²Dr John Huckerby – Aotearoa Wave and Tidal Energy Association (AWATEA) report in IEAES newsletter (September 2006)

The Waikato region

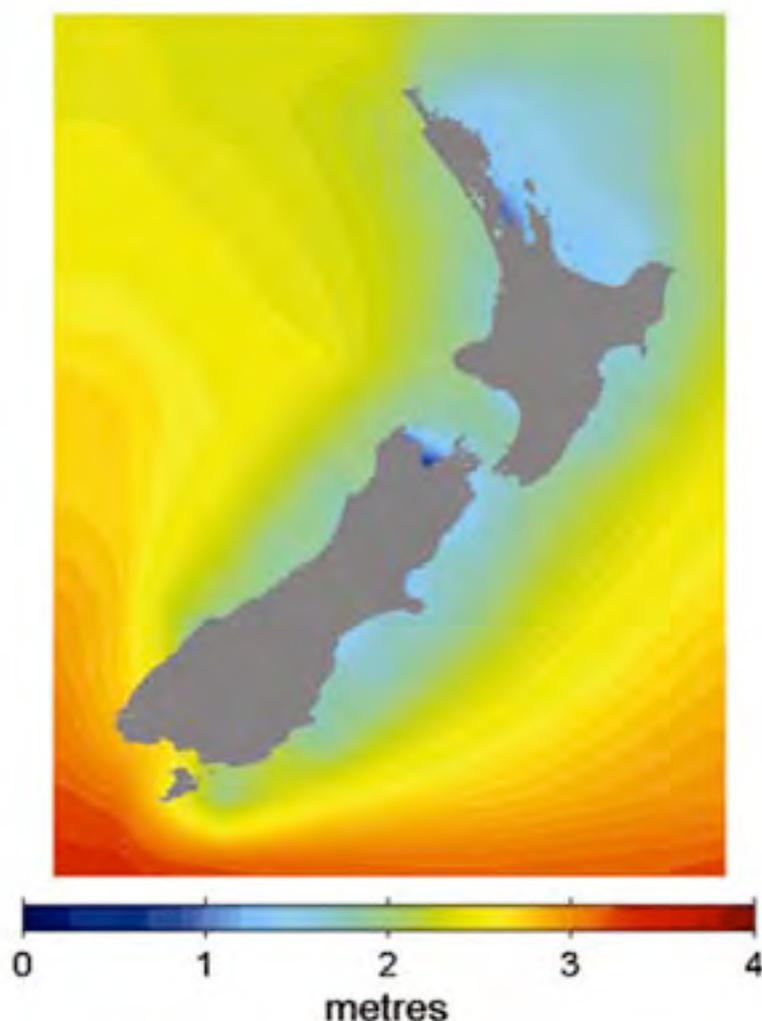
In the Waikato region, the Regional Renewable Energy Assessment has looked at the potential for both wave and tidal technologies.

Tidal: The Regional Renewable Energy Assessment concludes that tidal is not well-suited to conditions in the Waikato region. This is primarily due to the fact that the tidal range in New Zealand is low (2-3 m) compared with other places in the world (such as up to 10 m in the United Kingdom), and the fact that harbours in the region are relatively shallow.

The only harbour identified as having the potential for tidal energy generation is Kawhia, which has a wide entrance and a deeper harbour mouth than Whaingaroa/Raglan or Aotea – but even Kawhia is not considered economic at the present time, or in the near future.¹¹³

Wave: Wave resources are a different matter, with the west coast of the region having good wave energy, along with the added value of relative proximity to the Auckland market.

Map of wave energy intensities in New Zealand



The Waikato Regions Renewable Energy Assessment estimates that a wave farm array along the west coast has the potential to generate in the 1000 MW range.

Source: NIWA

Wave energy on the west coast of the Waikato region is considered as having a good potential for wave energy generation.

¹¹³ Waikato Regional Renewable Energy Assessment (section of marine energy potentials).

Waikato Regional Energy Strategy

One of the models with the potential for application in the Waikato region is the Pelamis wave power system. This 140 m long machine (named after a sea snake) consists of four hinged tubular modules, and uses wave motion to drive hydraulic rams which create pressure that turns a turbine, thereby generating power. In essence, the Pelamis system operates on the flexing motion caused by wave swells. The system is said to work best in large wave conditions, such as those found off Waikato's west coast.



Source: Pelamis Wave Power

The Pelamis system, when arrayed in a cluster of units, can produce 30 MW over a square kilometre of ocean, and has the potential to power 20,000 homes. It is already on trial in Portugal and the United Kingdom. There are proposals to import and manufacture this technology in New Zealand, which could be deployed off the Waikato's west coast.

The Pelamis module, which floats on the surface with about 70 per cent of its bulk submerged, is anchored in about 50 m of water. The Pelamis devices, which are arranged in clusters designed to always point into the waves, generate about 750 kW per unit.

The Pelamis system has been developed by a Scottish company, Ocean Power Delivery – and has been tested over the last year at the European Marine Energy Test Centre in the Orkney Islands. A New Zealand company, Power Generation Projects is currently investigating four sites on New Zealand's west coast for deployment of these systems. The company's intention is to manufacture the Pelamis units in New Zealand under licence.

The Waikato's west coast stands a positive chance of being selected as a test site, given the region's close proximity to Auckland, and relative ease of access to transmission lines.

Barriers to development

One of the key obstacles to development of these types of wave energy systems is the need for testing in New Zealand conditions, and uncertainties over resource consent issues relating to space allocation in the oceans. The Aotearoa Wave and Tidal Energy Association (AWATEA) has called for a defined space allocation in the oceans, similar to the oil and gas permitting regime.¹¹⁴

One potential limiting factor is the cost of cabling from a wave farm, particularly if wave energy is being harnessed several kilometres offshore. Closer sites may prove suitable, although these would need to be sited in positions which avoided navigational and visual aspects. The existence of Maui's dolphin along the west coast in an area stretching from New Plymouth to the Hokianga may also be a limiting factor in the deployment of wave farms. However one co-benefit of such systems trialled overseas is the creation of a haven for marine life. This would allow for the restoration of fish stocks for the recreational and traditional iwi fisheries.

Another wave technology currently under trial is an NZ-designed wave energy converter. Designed by the Wave Energy Technology consortium (which includes Industrial Research Ltd, NIWA and Power Projects Ltd) The group launched a newly-developed experimental wave energy converter in Lyttelton Harbour in December 2006. The device, is designed to sit below the surface, seeks to harness both the kinetic and potential energy from passing waves.



Source: www.wavenergy.co.nz

The experimental wave energy converter, which has been trialled in Lyttelton Harbour by Wave Energy Technology, seeks to harness both kinetic and potential energy from passing waves.

Uptake of wave technology

In order to promote the uptake of wave technology in the Waikato, potential wave resources could be mapped, and then correlated with existing land-based resources, such as transmission lines, port facilities, engineering repair

¹¹⁴ Aotearoa Wave and Tidal Energy Association (AWATEA) report in IEAES newsletter (September 2006)

Waikato Regional Energy Strategy

workshops, and marine support technicians. This could be undertaken through the development of the second generation Regional Policy Statement, whereby the regional council could identify appropriate servicing locations and facilities for marine energy, and ensure that regional, coastal and district plans reflect these zones.

This would allow the development of a coherent marine energy strategy, and would position the Waikato region as a front-runner for the deployment of new wave technologies, with the opportunity to reap flow-on economic benefits.

Establishment of a marine energy research centre

As electricity generation from wave energy is an emerging field, the Waikato region has the opportunity to take a leading role in research and development.

The establishment of a research network in the Waikato region could have the potential to attract government funding. This network could involve the university, the polytechnic, lines companies, the regional council and other interested parties to investigate the feasibility of developing working models for wave energy. The establishment of a research network would be focused initially on wave energy in the open sea, rather than tidal energy (as is being investigated in Kaipara Harbour).

As wave energy is a new and emerging field internationally, there is an opportunity for the Waikato to emerge as a research centre which could work with South Pacific nations in developing renewable technology solutions to their energy needs.

Recommendation 8: That the Regional Energy Strategy advocates for an investigation into marine energy generation in the region.

The Regional Energy Strategy encourages the coordination of Waikato agencies to promote the establishment of a trial project to identify the effects and value of new marine technologies suitable to the region.

Who is involved

Generators and lines companies, Waikato Regional Energy Forum, Environment Waikato, research agencies (including Wintec and Waikato University), generators and lines companies, research agencies, AWATEA (Aotearoa Wave and Tidal Energy Association) and EECA

What action is required

- Identify areas of the Waikato region and trial technologies that could be suitable for wave and other marine energy generation.
- Establish a project group for research and for trial projects.

Where should actions be focused

- The identification process should be included in provisions of the Regional Policy Statement.
- Trial needs to overcome perceptions about the maturity of the technology.
- Costs of transmission from offshore sites need to be assessed.

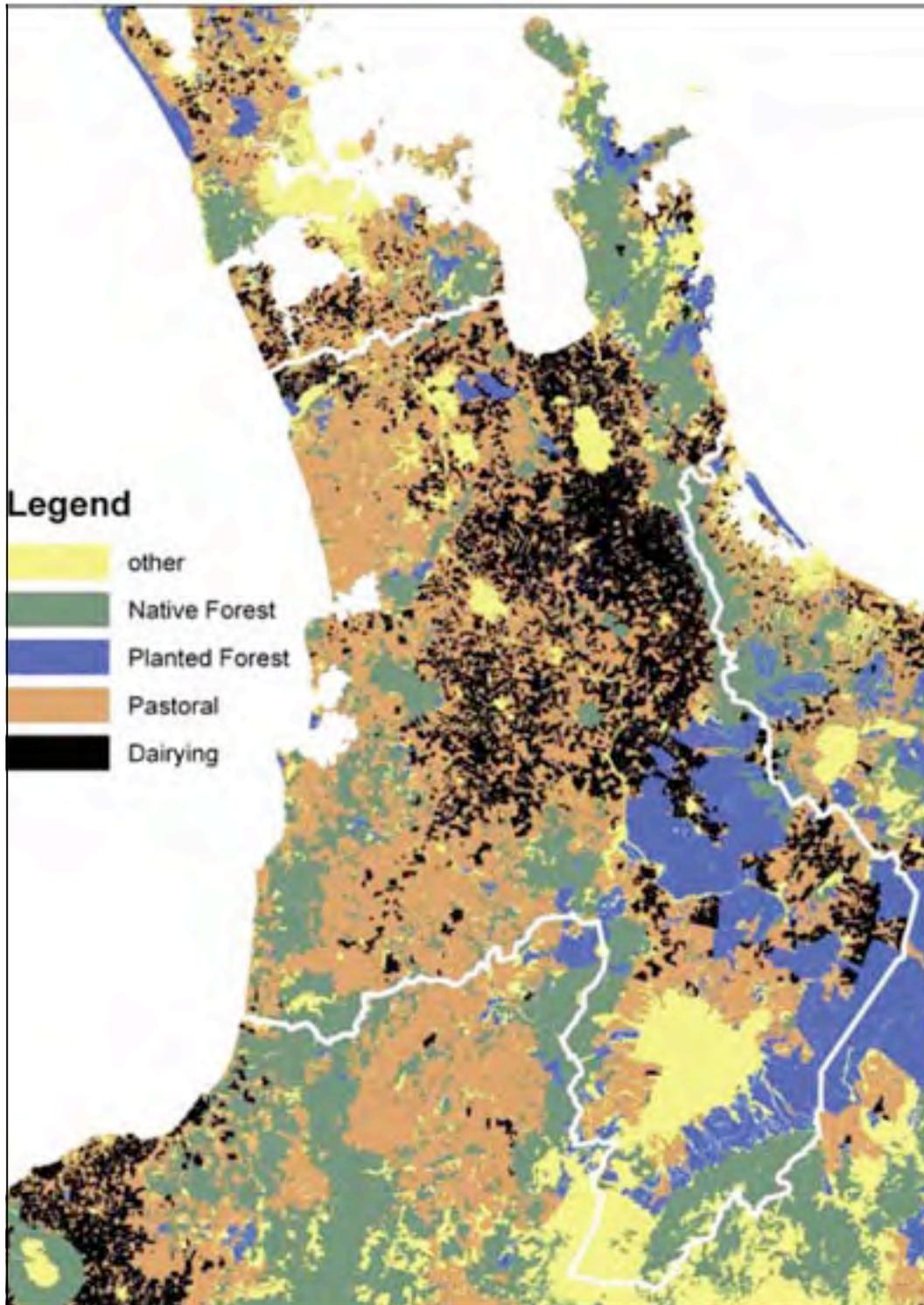
When should the steps be taken

- ASAP

g) Biomass and biofuels

The Regional Renewable Energy Assessment outlines a wide range of potential biomass products within the region. These include forestry residues and woody biomass, dairy and meat processing residues and biogas.

Land use in the Waikato region



Source: SKM-EECA Waikato Regional Renewable Energy Assessment

This map, which shows the types of land use within the Waikato region, offers an insight into potential biomass and biofuel sources of supply. Note the heavy concentration of dairying in the Waikato-Hauraki Plains area, pastoral farming in the west, and the high concentration of forestry around the Taupo-Tokoroa area.

Sustainability issues

Globally, the switch from growing crops like corn for food, to turning them into biofuels is already having an impact on world food prices. In his 2007 State of the Union address, President Bush called for the production of 35 billion gallons of renewable and alternative fuels by 2017, and proposed an ethanol subsidy of as much as US\$17.8 billion over a decade. This policy is already having an impact on New Zealand, as the American push to produce biofuels from grain is considered a significant factor in driving up world dairy prices. This is because grain is used as a cattle feed in major milk-producing countries overseas – so that the increased demand for grain caused by biofuels is driving up the cost of cattle feed. This increased price for dairy products is providing a substantial boost to New Zealand dairy farmers’ incomes – as our industry is based on grass-fed cows, and is thus not under pressure from rising grain prices.¹¹⁵

The increased planting of maize in the United States and South America to meet biofuel demand is also reducing the amount of land available for planting crops such as barley. This, in turn, has lifted world prices for barley – which is likely to result in price increases for products like beer and stock feeds, which use barley as an important ingredient.¹¹⁶ The use of corn/maize for biofuels in the United States has created flow-on effects to other countries which rely on maize as a staple crop. The Mexican peasants is facing soaring prices for corn treble or quadruple the price of tortilla in a year in some parts of Mexico.¹¹⁷

This has led to the start of a major policy debate over the impact of biofuel production from food crops, and the implications for the world's poor. There is now considerable research going into ‘second generation’ biofuels such as wood waste or algae, which do not displace food crops.

Bioenergy potentials in New Zealand

In the New Zealand context, there are several major types of biomass resources that can be converted into a range of products such as electricity, heat, chemicals and transport fuels. Among these bioenergy resources are:

- **woody biomass and agricultural crops**, converted into heat and electricity through either combustion, or through gasification via the Fischer-Tropsch process for transport fuels
- **agricultural residues, such as manure**, converted through anaerobic digestion into biogas for either electricity and heat, or transport fuels
- **food processing wastes, such as tallow or whey**, converted by processes such as transesterification into biofuels.

Bioenergy potentials for New Zealand		
Type of bioenergy	Waikato PJ	New Zealand PJ
Woody biomass	6.7	25.4
Biogas	1.0	5.9
Biodiesel	1.8	6.0
Bio-ethanol	0.1	0.8
Total	9.6	38.1

An NIWA/Scion analysis of bioenergy potentials within New Zealand shows that the potentials within the Waikato region are significant – making up almost 25 per cent of the available resource.

Source: NIWA/Scion presentation on biomass resources 5 August, 2008

¹¹⁵ “ Biofuel boon for dairy industry” - Waikato Times – 5 July, 2007.

¹¹⁶ “ Barley prices set to skyrocket” - New Zealand Herald – 17 July, 2007.

¹¹⁷ Energy Bulletin 28 January, 2007. – www.energybulletin.net

The potential of forestry residues

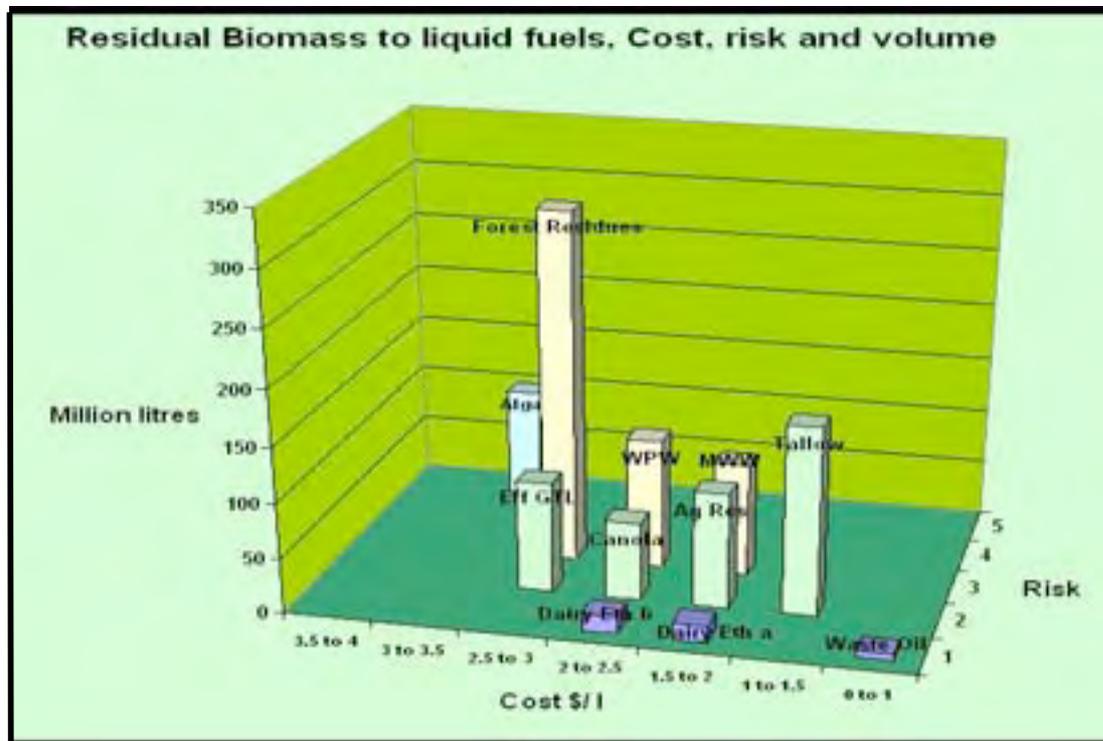
Woody biomass in the form of forest harvesting residue is one of New Zealand's largest untapped energy resources. In the biofuels field, other nations tend to use raw materials which they already grow – for example Brazil uses cane sugar to make ethanol, while America is using corn to create biodiesel.

New Zealand produces an abundance of forests often grown on steep or marginal land. One of the key advantages of using forestry for bioenergy is that it does not generally take over prime food growing land (as is occurring with food crops overseas such as corn in the United States of America) which results in an increase in global food prices.

The Regional Renewable Energy Assessment estimates that at present the Waikato region has 380,000 ha of planted production forestry (2004 figures), of which 130,000 ha is classified as 'unpruned and without production thinning', indicating that it may be suitable for pulping, fibre production or energy.

As plantation forests are now reaching maturity and waste becomes available for harvest, it has been suggested that this waste woody biomass from existing forests could supply up to 8 per cent of our petrol and diesel needs.¹¹⁸

If new forests were purpose-grown for biofuels, Scion has estimated that the cellulose produced could be sufficient to run the nation's truck and car fleet by 2040. Scion has estimated that the development of 'energy forests', which could be purpose-grown on marginal land, could supply enough fuel for land transport, from an additional 2.8 million ha of forest and If the plantings were expanded to 3.7 million ha, for jet fuel and fuel oil for planes and ships.¹¹⁹



Source: NIWA presentation on biomass potentials

Forestry residues from existing forests offer the greater amount of potential biofuels, compared with the current volumes of algae, tallow, dairy residues and waste oil available for production. This calculation is based on existing resources, and doesn't take into account the potential for new purpose-grown bioenergy forests.

¹¹⁸ NIWA's Stephan Heubeck regarding biomass resources in the Waikato region

¹¹⁹ Scion report on Bioenergy potentials – Waikato Times 30 August, 2008 (A12)

At present, wood biomass is used for home fires, pulp mill energy, heat for kiln drying, and a small amount of cogeneration. For example, Carter Holt Harvey's pulp and paper mill at Kinleith burns 200,000 tonnes of wood waste per year to produce high-pressure steam, to generate up to 40 MW of electricity.



Source: CHH website

Kinleith pulp and paper mill generates up to 40 MW of electricity from a cogeneration plant which burns wood waste from neighbouring forests.

Biomass recovery from forests

It has been estimated that about 12 per cent of the biomass obtained from a harvested forest is available as a residue.¹²⁰ This woody biomass residue could be used for energy production, but at present it is largely discarded as waste – often because it is in a raw form which is difficult to transport or use.¹²¹

There are several ways to utilize waste biomass as a potential energy resource. One way is to make the waste product easier to use and transport. The New Zealand Clean Energy Centre has been assisting (along with EECA and a local entrepreneur) with the importation of a speciality machine developed in Finland.

This machine, known as a PINOX828, utilises biomass which has been picked up from the forest floor using a grapple. The biomass is then placed in a chute which leads to a compression chamber. Within the chamber, the treetops and branches are compacted under intense pressure, which significantly increases the density of the compacted material exiting the chamber. Then twine is wrapped around the 'log', and as it exits the chamber, it is sawn up into 2 to 3 m lengths, which can be easily transported and stored using standard forestry log handling equipment. This type of innovative machinery makes 'waste' forestry products easily transported for use to places of high demand.

¹²⁰ Speech by Government spokesperson on energy efficiency, Jeanette Fitzsimmons

¹²¹ The NZCEC estimates that of the fibre available from plantation forests in NZ, only about 50 per cent of that fibre actually makes it to the mills. Of the approximately 50 per cent that is left on the forest floor, a percentage of this is non-recoverable for various reasons. But NZCEC believes this still leaves a vast energy resource to tap.



Source: Clipart

An under-utilised energy resource lies in the woody biomass residues left behind after harvesting, with estimates suggesting that upwards of 12 per cent of wood residues are currently wasted. These woody residues could be utilised in combined heat and power schemes in cogeneration for industry, or turned into pellets for domestic consumption and export.

Wood pellets

Another way to use this discarded wood resource is to manufacture wood pellets. Wood pellets have a number of advantages as they are a cleaner burning, more efficient fuel which helps to reduce air quality problems experienced in some parts of the region. Wood pellets are also more easily transported from the site of production (predominantly rural areas) to the place of consumption (primarily urban areas).



Wood pellets are a clean burning, efficient renewable fuel which is readily transportable. On an industrial scale, they may prove to be an alternative to coal.

Source:
Wikimedia public
domain image

The wood pellets are more usable by domestic consumers as the work has been taken out of chopping the wood, and the efficiency of home heating is greatly improved by the fact that the fuel is properly dry. On a larger scale,

wood pellets have the potential to become a viable alternative to coal. Wood pellets are also being trialled in public buildings such as schools and hospitals. At present there is a pilot project underway in Rotorua, where the coal boiler at the Girls High School has been converted to run on wood pellets. This has reduced carbon dioxide emissions by 100 per cent, reduced ash by 90 per cent, reduced sulphur dioxide emissions by 100 per cent, and particulate emissions by 60 per cent – as well as making significant savings on the maintenance required of the boiler. In addition, the project has the added advantage of simply converting the existing boiler to run on wood pellets, which means the capital cost of purchasing a new boiler or heating system is avoided.¹²²

Wood pellets also provide potential export markets, particularly to the colder European markets where wood is a primary heating source. This market will potentially grow as alternatives are sought in Europe for domestic home heating.

Extensive research in this field is being undertaken by EECA who are coordinating an initiative to support forestry bioenergy projects over the next three years, and Scion who are studying the wider potential of biomass as future energy sources.

EECA supports the Bioenergy Initiative of the Forest Industry Development Agenda (FIDA), which offers help by way of funding and information to those interested in using wood residue as a renewable energy source. This involves the provision of relevant information to sawmills, forestry owners and the general public on the use of wood residues via the Bioenergy Knowledge Centre.

The FIDA programme also provides financial assistance to businesses for feasibility studies that review the use of wood residue as a fuel, and provides financial assistance to businesses for demonstration projects. FIDA funding available for capital grants for demonstration projects may be up to 40 per cent of the capital cost of the project, with a minimum of \$5000 and maximum of \$100,000.

Funding is available for projects involving technologies that:

- have the potential to reduce carbon dioxide emissions
- have the potential for widespread industry adoption
- have an acceptable payback period or return on investment.

Combined heat and power

Combined heat and power projects offer another way of using forest residue as a fuel. Industrial and community biomass cogeneration plants are designed to use low grade (high moisture content and large particle size) biomass fuel. This type of low grade fuel is widely available on the forest floor and as a by-product from timber processing and other primary industries.

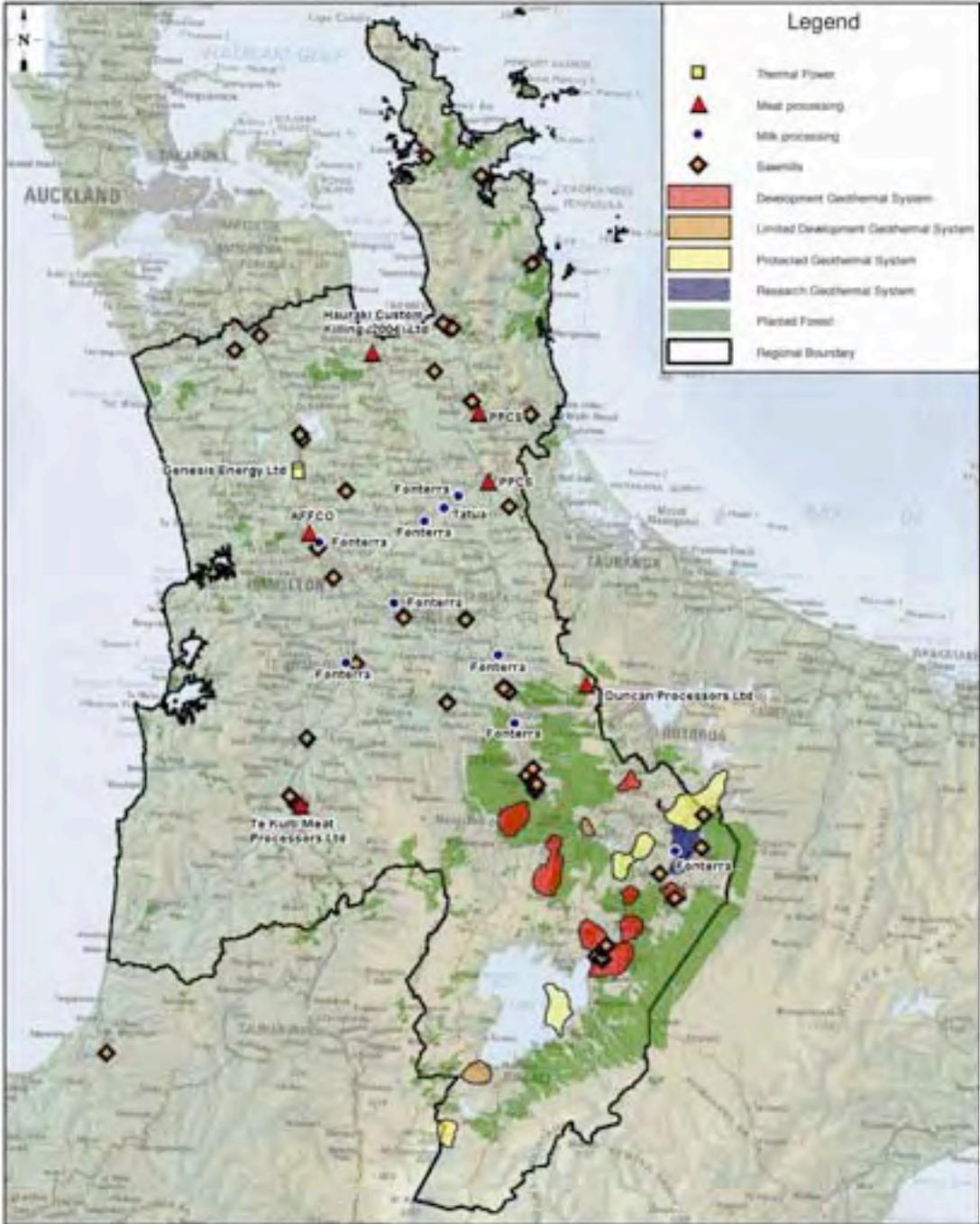
The New Zealand Clean Energy Centre believes this could be used in regional combined heat and power projects for the community or industrial users, thereby foregoing the high costs of drying this fuel in order to significantly reduce its size, or pelletise it. Instead it could be co-fired with other biomass originating from industrial applications.

¹²² EECA biomass case study – November 2006

In the highly forested areas of Waikato, there are abundant biomass resources in close proximity to industry. In some regions where the dairy industry dominates, woody biomass would need to be transported to the combined heat and power cogen plant (which would incur cost and use of fossil fuels).

The New Zealand Clean Energy Centre believes that a programme to create mixed-use of the land in such areas, with large patches of fast-growing biomass plantations would help to localise the availability of biomass in such regions, and hence to improve the economics and overall sustainability of both the dairy industry and energy sectors.

Potentials for combined heat and power utilisation



Source: Environment Waikato

The opportunities for combined heat and power utilisation exist throughout the region, such as direct use of heat, or several industrial processing plants cooperating by pooling waste streams that have calorific value, as well as adding waste from other sources (forest or mill waste for example). The NZCEC is currently in the process of inviting industrial energy users to join an initiative called ‘Synergies in Renewable Energy’, which aims to develop projects co-operatively that might not be feasible on an individual basis.

Morrinsville Clean Energy Cluster

The New Zealand Clean Energy Centre has brought together a cluster of primary processors in the Morrinsville area to work together on a combined heat and power project utilizing their waste streams. These processors include:

- Fonterra
- Wallace Corporation
- Inghams Chicken
- Tatua
- McIntyre piggery

These companies have come together in the spirit of co-operative competition to form the Morrinsville Energy Cluster, which aims to reduce their dependence on coal and natural gas by utilizing the waste streams from their products. While each industry may not have sufficient volume of waste product to generate an economically-sustainable energy source on their own, it is hoped that by working together and sharing the waste product and the capital cost of the energy generation plant that the combined cluster can reduce energy costs and minimize its environmental footprint.

The NZCEC has assisted members with completing energy and waste stream audits, and provided possible technology solutions.

Woody biofuels

Hong Kong-based Pure Power Global has purchased the Biojoule company, which is currently involved in growing willows (*Salix*) on marginal land near Taupo with the intention of creating bioethanol. At present, 110,000 plants are growing, with the intention of producing 2.5 million plants within two years. The next step will be the creation of a small scale test refinery – with future plans for a large scale refinery.



Willows (*Salix*) are being grown in the Taupo region to produce bioethanol.

The willow crops will be ready for harvest and production by 2011/12. There are proposals for a pilot plant likely to be located near Taupo. Estimated to cost between \$50 million and \$120 million, the refinery will use cascaded geothermal heat as an energy source.

.Apart from the creation of ethanol as a transport fuel, the *Salix* trials also aim to produce xylems as a food additive, and natural lignin which could be used for biodegradable plastics, resins and paint additives.

Source: Clean Energy Centre

Biofuels from agricultural crops

The Regional Renewable Energy Assessment outlines that the Waikato region is already the largest producer of maize grains at nearly 40,000 tonnes a year. Maize grains are predominantly used as a dry stock feed. The report comments that this level of production could be significantly increased, given that the maize currently grown is produced on 4000 ha, yet there is approximately 45,000 ha of arable land in the region.

Solid Energy (which owns the Huntly coal mines) has purchased a Canterbury biodiesel producer, which currently produces about 1 million litres of biodiesel a year from used cooking oil collected from restaurants throughout New Zealand.

The company is also investigating the potential for producing biodiesel from energy crops such as canola. Solid Energy plans to increase annual production to 70 million litres within three years, with the aim of meeting more than half of the government's 2012 target for biofuels.¹²³



Source: ClipArt

Production of biofuels from sources such as used cooking oil or tallow is already underway in New Zealand. Solid Energy is also looking at the possibility of producing biodiesel from energy crops such as canola.

Use of animal by-products

As the largest dairy producing area in the country, the Waikato region is already well advanced in the utilisation of animal wastes.

Milk production can produce lactose as a by-product, which is capable of being fermented and turned into ethanol.

The Tirau plant produces 5 million litres per year of distilled alcohol, which is of high quality and will continue to be predominantly sold for high-grade uses such as liquor manufacture.

In addition, animal processing plants produce tallow as a by-product, which can be used in the manufacture of biodiesel. The Regional Renewable Energy Assessment estimates that the Waikato region produces around 90,000 tonnes of animal fats per year that could be converted into biodiesel through a relatively straightforward esterification process.

Auckland-based company Ecodiesel Limited is planning the first commercial-scale biodiesel production facility in New Zealand. Based on converting tallow (a by-product of meat processing) into biodiesel, the company claims an initial production of 20 million litres of biodiesel by the end of 2008, increasing to 40 million litres of biodiesel per annum by the end of 2009.¹²⁴

¹²³ Waikato Business News

¹²⁴ Ecodiesel press release October 2007

Biogas from effluent

The idea of using effluent to create biogas, which in turn generates electricity, is not new. Most large domestic waste water treatment plants capture biogas, and many use it for cogeneration. This is certainly the case in Hamilton, where a cogeneration facility blends biogas from the waste water treatment plant digesters with natural gas to run gas engines.

This facility, which was installed in 2003, has secured low-cost power and heat for the site while maximising use of a renewable resource. The cogeneration plant produces over 33,000 GJ of biogas, which supplies almost 40 per cent of the plant's energy requirements.¹²⁵

In an innovative step, an Auckland-based company Lanzatech has recently been awarded \$12 million by FoRST to develop a second generation 'low-carbon petrol' biofuel from industrial flue gas waste.

Biogas from animal effluent

NIWA is undertaking a pilot project in the Waikato to produce electricity from biogas. The project, captures the biogas that comes off farm effluent ponds, has succeeded in running a converted generator at about 10 kW which is sufficient to power an assortment of electric lights and fans, and an electric motor.

The aim of the pilot scheme is to investigate the potential of creating small scale generation facilities suitable for individual farming operations. The study is funded by FoRST with the aim of demonstrating that simple, pond-based digestion technology, combined with off-the-shelf equipment will allow individual properties to convert to run on biogas.

Studies show that biogas coming off animal effluent treatment ponds contains about 70 to 80 per cent methane – which is strong enough to be used in the generator with little or no removal of impurities.



Source: NIWA

NIWA is investigating how to use farm waste as an energy source.

¹²⁵ Hamilton City Council - Milestone 3 Report (page 10)

Biogas is a popular option in Europe, where animal wastes are more readily available due to the internal housing of animals and easier collection of effluent. However in New Zealand, with its extensive outdoor pastoral farming, biogas has been under-explored. This is primarily due to the fact that only 20 per cent of the waste is captured, with the remaining 80 per cent lying out on the paddocks.

However NIWA believed that with more farmers using feed or wintering pads for their cows, a greater percentage of this waste will be collected – and with increasing electricity prices, this will become a more valued commodity.

Another potential hurdle to overcome for the mass utilisation of this technology is that few farm anaerobic lagoons are covered, or used for biogas collection. NIWA believes that the simplest and most cost-effective method of harnessing biogas would be to cover existing dairy effluent anaerobic lagoons. The cost of these covers is approximately \$5-\$20 per square metre. However the total cost could be recovered through energy savings within six years.¹²⁶

Biogas from landfill

Hamilton City Council, and its partner WEL Green Energy installed a landfill gas-powered engine at the Horotiu landfill in October 2004. The engine drives an electricity generator of 920 kW, which is used to provide power to a range of council facilities.

Biomass recommendations

Recommendation 9: The Regional Energy Strategy supports the work of agencies and developers such as Scion, EECA and New Zealand Clean Energy Centre involved in research and development and proposes working collaboratively with these agencies, developers plus policymakers to open opportunities for the continued research, trial and development of biomass and biofuels including appropriate amendments to local government policy and/or procedures.

Who is involved

Territorial authorities, Environment Waikato, New Zealand Clean Energy Centre, industry, distributors, MAF, BANZ

What action is required

- Develop enabling policies to support biomass and biofuel initiatives
- Find synergies with regional waste strategies to ensure best use of waste in regards to energy and useful by-products.
- Develop greater information about biomass potentials through demonstrations and education.
- Collaborations between industry groups.

Where should actions be focused

- Providing information about biomass opportunities to wider audience
- Encouraging collaboration between agencies to support biomass and biofuels initiatives

When should the steps be taken

In the LTCCP and Regional Policy Statement processes

¹²⁶ Information Source: NIWA's Climate-Energy Matters newsletter on biogas, and Waikato Times article 25 June, 2007.

Biofuels recommendations

Recommendation 10: The Regional Energy Strategy advocates the identification and removal of any unintended barriers to the production and uptake of biofuels within the region, provided externalities are successfully managed and production is undertaken in a sustainable way.

Who is involved

EECA, Territorial authorities and Environment Waikato, New Zealand Clean Energy Centre, BANZ

What action is required

- Undertake analysis of the barriers to the uptake of biofuels in the region.
- Investigate mechanisms for stimulating the market such as parking incentives for cars or vehicles using biofuels.
- Encourage councils and public agencies to commit to the use of biofuels, where appropriate, in order to lead by example.
- Investigate the enabling of biofuels production through land-use planning processes.

Where should actions be focused

- Need to overcome lack of public awareness about second generation biofuel options

When should the steps be taken

Within the timeframe of the Regional Policy Statement review

Animal by-product bioenergy

Recommendation 11: The Regional Energy Strategy supports the establishment of pilot projects to investigate the processing of animal by-products for bioenergy.

Who needs to take these steps

Research agencies, industry, farming sector, district and regional councils

What action is required

- Establish pilot projects.
- Work with NIWA and other agencies specialising in biogas and animal waste products for bioenergy.

Where should actions be focused

- Development of funding opportunities

When should the steps be taken

ASAP

Landfill and waste gas cogeneration

Recommendation 12: The Regional Energy Strategy advocates the capture of landfill and waste gas and its use for electricity cogeneration, wherever appropriate, throughout the region.

Who is involved

Territorial authorities, Environment Waikato, Ministry for the Environment, Electricity Commission, research agencies

What action is required

- Promotion of demonstration projects, such as Hamilton's landfill gas site
- Advocate for government agencies to provide leadership in the promotion of cogeneration options.

Where should actions be focused

- Need greater public and policymaking awareness of cogeneration potentials from waste.
- Legal issues may need resolution, as landfill sites are often contracted out, and may require a change of contract in order to incentivise greater energy efficiency.

When should the steps be taken

ASAP

h) Small and community-scale generation

The Parliamentary Commissioner for the Environment's 2006 report '*Get Smart, Think Small – Local energy systems for New Zealand*' makes a strong case for the development of small scale generation of electricity. The report concludes that small scale generation of electricity has the potential to displace 580 GWh per year of electricity from large power stations in 30 years time, or much sooner if there is government support.¹²⁷ This small scale generation encompasses a range of technologies including solar photovoltaics, micro wind turbines, fuel cells and micro hydro.

How should small scale generation be defined?

The issue of what constitutes small scale generation is a much debated topic – especially when the difference between distributed generation and micro generation is being discussed. The issue is complex because 'distributed generation' does not necessarily have to be small scale or domestic in nature. For example, a major generator could build a 20 MW hydro plant, which would be 'distributed generation' as it would be connected into the local distribution grid.

The example of a small off grid photovoltaic, hydro and diesel generator combination providing power to an isolated bach in the Coromandel would definitely be termed 'micro generation'. However some micro generation which is connected to the local lines network would be considered as distributed generation.

¹²⁷ The Parliamentary Commissioner for the Environment's 2006 report "*Get Smart, Think Small - Local energy systems for New Zealand*" (page 53)

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The following table has been produced by EECA to help clarify some of the definitions. Note that at the highest level, both the yellow and blue segments are deemed to be ‘distributed energy’, whereas the green segment is ‘centralised energy’.

High level	Category	Approx lower	Approx upper	Roughly equates to...
Small scale generation	<i>Micro generation</i>	0	10 kW	Domestic-scale
	<i>Distributed generation</i> <i>Mini or medium scale DG</i>	10 kW	10 MW	Business up to community scale
	<i>Cogeneration</i>	0	No cap	-
	<i>Off grid generation</i>	0	No cap	Can be anything from domestic-scale SAP to off grid islanded communities not connected to main transmission/distribution networks
Large scale generation	<i>Heat capture/storage</i>	-	-	
	<i>Cooling</i>	-	-	
	<i>Enabling technologies</i>	-	-	Things that control or manage the way you use energy
	<i>Energy efficiency</i>	-	-	Things that increase the efficiency of your energy use
	<i>Demand response</i>	-	-	Load that changes (drops or shifts) according to signals
	<i>Transport</i>	-	-	Most of our energy use
		10 MW	-	Large, centralised, generation of electricity that is transmitted via transmission grid

Source: EECA

Small scale and community generation

The NZES defines ‘distributed generation’ as any electricity generation facility that produces electricity for use either at the point of generation, or supplies electricity to other consumers through a *local* lines distribution network. This can mean electricity distribution occurs through electricity lines and associated equipment which are owned or operated by a distributor, but does *not* include the national grid, or an embedded network that is used to convey less than 2.5 GWh per annum.

Small scale and community electricity generation can contribute to security of supply by increasing overall generation capacity, and by providing a more diverse and geographically dispersed electricity supply. Improved energy efficiency through reduced transmission and distribution losses are also gained.

To facilitate the uptake of more small scale and community distributed generation, the government has brought in new regulations for connection of distributed generation (as of 30 August 2007). Distributed generation, for the purposes of the regulations, is generation connected to a *local* distribution network and can include local hydro schemes, landfill gas, small geothermal plant, wind and solar generation, and cogeneration, which uses spare industrial heat to produce electricity.

The new regulations have been developed to improve the clarity and consistency of terms and conditions applying to the connection of distributed generation. The regulations provide a process for generators to obtain approval to connect, specify terms applying in the absence of contractually agreed terms and set out pricing principles to ensure connection charges are fair and reasonable.

National Policy Statement

In the proposed National Policy Statement on Renewable Electricity, the government has been quite explicit in its intention to support small and community-scale renewable electricity generation.

Policy 5 of the NPS specifically states: “By 13 March 2012, local authorities are to notify, in accordance with Schedule 1 of the Act, a plan change, proposed plan or variation to introduce objectives, policies and, where appropriate, methods, into policy statements and plans to enable activities associated with the development and operation of small and community-scale distributed renewable electricity generation.”

This policy is included because small scale and community electricity generation is seen as a key part of energy resilience, and enhancing the nation’s renewable generation profile.

Types of small scale generation

Solar photovoltaics

While the Waikato region has good solar energy, the translation of this energy into electricity generation through photovoltaic (PV) panels is not considered a mainstream option at this stage due to the comparatively high cost of PV.

The relatively high capital cost (upwards of \$10,000 for a system capable of powering an average home, excluding battery and inverter)¹²⁸ is due to the fact that an array of PV panels is required for a distributed generation system, along with a specialised battery bank, an inverter, and a solar controller (and often with a backup generator). The initial capital cost means that this option for renewable energy is not likely to be taken up in a major way except in more remote situations, or where individuals make a lifestyle choice to be off the grid.

Alternative energy specialist, Michael Lawley of EcolInnovation states: “Generating your own electricity is unlikely to be a sensible option for you if you are already connected to the national grid. The main exception to this is if you have a good water resource close by. For most people wanting to generate from wind and solar it is normally prudent to do so if:

- the existing property does not have a power connection
- a new house is being planned remote from a connection
- the new connection is priced above \$10,000.

Michael Lawley, notes that many people are motivated by more than cost considerations (such as concerns about geopolitical instability, peak oil, or weather-related disruptions to supply), and install such systems even though

¹²⁸ This cost estimate is based on 10 solar panels rated 130 watts each, and costing approximately \$1000 per panel. It does not include the cost of batteries necessary to store the power generated, or the inverter which is likely to add an additional \$10,000 to the overall cost.

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the present day economics are not in their favour, because they wish to become self-sufficient.¹²⁹

In overseas countries such as Japan and Germany, governments have created incentives to make the price of solar power competitive with the residential grid power price by applying direct subsidies, and using a premium buyback rate. These policies have resulted in increased market uptake of solar photovoltaics. However there is no indication that the NZ government is considering similar schemes at this stage.

But the NZ Energy Efficiency and Conservation Strategy (NZE ECS) has a range of strategies to promote the uptake of solar micro generation. These are discussed in detail in the following chapter 'Micro generation'. However the NZE ECS does paint the example of a family on a lifestyle block utilising a 480 watt solar voltaic panel array, combined with a 1 kW wind turbine and a battery bank that can store enough power to supply the family house for five days. In order to make the solar voltaic system viable from a power output perspective, the family must top up the system by using LPG for cooking, and a wood fired stove for water heating.

The example in the NZE ECS notes that the family's electricity system has cost \$21,000 (compared with the average power bill of \$1600 per annum for a New Zealand home). The system has benefits in terms of self-sufficiency, with the family not experiencing a power cut during the past six years. In addition it is estimated the system has avoided approximately 12 tonnes of carbon dioxide.

The NZE ECS points out that the cost of such a system for a remote lifestyle block needs to be considered against the cost of establishing new connections to the grid, which can be in the region of \$18,000-\$24,000 per kilometre for lines.¹³⁰

Furthermore the price of solar panels may come down as worldwide production increases, and advances in technology could result in photovoltaics becoming a more cost-effective way for consumers to reduce their externally generated power consumption in the future. New technologies offer the potential for ultra-thin photovoltaics, which can be used as cladding on buildings.

The government is keen on enhancing the development of micro generation, and the NZE ECS has an ongoing work programme to provide guidance to councils regarding consenting issues around photovoltaic, micro wind, and micro hydro systems, so they can reduce compliance costs to householders installing such systems.

One of the important steps which local authorities can take to allow the potential future uptake of solar power is to ensure that regional and district plan rules do not unreasonably preclude domestic-scale renewable energy production such as solar panels on roofs, and that subdivision rules ensure that there is not excessive shading by neighbouring properties, which would limit the potential to harness solar energy.

¹²⁹ EcolInnovation website www.ecoinnovation.co.nz

¹³⁰ NZE ECS (page 69)

Mini and micro hydro

In the Waikato region, the micro hydro potential throughout the region could be significant¹³¹. However due to the dispersed nature of the resource the micro hydro resource has not been identified.

Mini and micro hydro systems can either be standalone off grid systems, or can work on the distributed generation model. This can involve electricity being generated close to the natural resource (such as a stream or waterfall), and the output used to power either an individual house, or a cluster of houses in a community-based scheme. Distributed generation provides the potential for additional flexibility in the generation of electricity, where excess electricity is sent down a local lines network to feed other consumers.

Most micro hydro generation tends to be a standalone, off grid system servicing an individual house or lifestyle block. In most cases, the household will need to have a range of micro generation systems, such as photovoltaics, micro hydro and wind, in order to obtain sufficient power output.

The Parliamentary Commissioner's report identifies a number of key barriers to the widespread adoption of local energy systems. These include a lack of public awareness, the market's failure to fully value all the benefits of local energy, its comparative expense, various institutional and regulatory barriers, and an absence of demonstration projects tailored to the New Zealand situation.

Cost barriers

There are a number of barriers to the development of mini and micro hydro, including the initial cost (which can range from \$10,000 for a basic micro system, through to the million-dollar range for community-based mini hydro).

Another issue is the fact that not every rural or lifestyle property has a good site, as access to a good water supply with a sufficient head is crucial, along with a relative proximity to the dwelling to ensure that transmission costs do not make the site uneconomic.

Regulations

At present, micro hydro systems are capable of being worked on by private individuals without registration, provided this relates to extra low voltage systems (i.e. any voltage not exceeding 50v AC or 120v ripple free DC).¹³²

However the Ministry of Economic Development is working on changes to the electricity regulations. The present definition of prescribed electrical work (Regulation 17 of the Electricity Regulations 1997) is in the process of being amended: "In order to meet safety outcomes with particular electrical installations, where the risk to persons and property is inherently greater than electricity utilisation in general, we are proposing to amend Regulation 17(2) to remove the exclusion for extra-low voltage where this is associated with hazardous area electrical installations and equipment (i.e. an ignition source) and medical electrical equipment (i.e. risk to life)," says Bill Lowe, Senior Technical Officer (Operations) with the Energy Safety Service of the Ministry Of Economic Development.¹³³

¹³¹ Regional Renewable Energy Assessment (page 43)

¹³² AS/NZS 3000:2000 Wiring Rules section 7.7 details the requirements for extra low voltage electrical installations.

¹³³ Personal communication with Bill Lowe of the Energy Safety Service of the Ministry of Economic Development, regarding the development of regulations associated with the 2006 amendment to the Electricity Act 1992.

Consenting issues

One of the key barriers to distributed generation above 50 volts involves consenting issues. For mini hydro, the Regional Renewable Energy Assessment notes that: “in some cases, it may be just as difficult to obtain consent for a small scale project that has a low level of environmental effects as for a large renewable energy project, as plans do not always make distinction between small and large scale effects.”¹³⁴

In the NZEECS, the government has identified that regulatory barriers can discourage developers from investing in renewable generation. It particularly notes that for small scale generation, obtaining consents under the RMA and Building Code “can be a challenge”.¹³⁵

The government intends to reduce compliance barriers, and will work with councils to provide guidance on consenting issues for micro generation such as photovoltaic, micro wind and micro hydro systems to reduce compliance costs. The proposed National Policy Statement on Renewable Generation (Policy 5) is an example.

One potential way of overcoming this issue is for small scale generation projects (for example a micro hydro that does not use dams or divert significant volumes of water) to be rendered subject to lower consenting thresholds than large projects.

Micro wind

The establishment of micro wind capacity, or the building of smaller community-based wind projects is an emerging trend which has the potential to benefit the Waikato region, particularly on the wind-rich west coast, some parts of the Coromandel Peninsula, and the Central Plateau.



Source: EcoInnovation

Micro wind generation, particularly in rural areas, can enhance self-sufficiency for farmers and lifestyle blocks.

¹³⁴ Regional Renewable Energy Assessment (page 73)

¹³⁵ NZEECS (page 69)

The Parliamentary Commissioner for the Environment favours the development of these systems, stating that smaller scale, distributed wind farms (around 10 MW or less) provide the following advantages:

less concentrated impacts on localities and communities

can be sited in locations that would be inappropriate for large scale wind farms

may not create the same tensions as larger-scale wind farms

add to local energy security by strengthening local electricity networks.

Urban micro wind

In Auckland, Vector is trialling a roof windmill designed for urban environments. The Swift turbines are designed to be mounted directly on buildings, and operate well within a relatively low wind speed and turbulent wind conditions that occur at rooftop level. They have five blades with a diameter of about 2 m, and weigh about 50 kg. The manufacturers say that the wind turbines have an output of 1.5 kW, which could provide between 2000 and 3000 kWh per year – about a quarter of the average New Zealand annual household's electricity needs.¹³⁶

The price of the turbines is currently in excess of \$8,000. Critics question whether turbines will prove cost effective. Columnist Brian Rudman states: "The makers of Vector's windmill claim it can pump out 2000 to 3000 kWh a year, or about a quarter of the average New Zealand household's needs. But independent tests reported in the London Observer suggest these micro turbines produced only 10-25 per cent of the output claimed. The BBC's Justin 'Ethical Man' Rowlatt, whose mission is to live an ethical life, wanted a windmill but was told by the experts that the wind power at his home on the highest hill in London was only enough to run a light bulb."¹³⁷



Source: Renewable Devices Energy Solutions UK

Local authorities will need to deal with micro wind, such as this array of five Swift turbines in Norfolk, United Kingdom. Individual turbines are now being trialled in Auckland.

¹³⁶ Reference from New Zealand Herald - 28 June, 2007 (page A4)

¹³⁷ Brian Rudman's column: New Zealand Herald - 29 June, 2007 (page A4)

Results from the Vector tests are ongoing, and should be observed by Waikato energy sector players to see if there are any advantages in transferring such technologies to the region.¹³⁸ Vector currently have an exclusive arrangement with the turbine manufacturer Swift.

Attitudes to small scale generation

As part of a government effort to increase the supply of renewable energy, regulations regarding the connection of distributed electricity generation were promulgated in August 2007. Previously mini or micro generation proponents complained that even if connection issues were overcome, there was a significant cost differential between the price that they pay to receive grid supply compared with the amount they receive for producing excess supply.

The electricity industry's response was that there are costs in hooking up individual distributed generation to the local network, and this type of supply requires additional management in terms of its intermittent nature.

The 2007 regulations have been developed to improve the clarity and consistency of terms and conditions applying to the connection of distributed generation. The regulations:

- provide a process for generators to obtain approval to connect
- specify terms applying in the absence of contractually agreed terms
- set pricing principles to ensure connection charges are fair and reasonable.¹³⁹

The government recognises the potential for distributed electricity generation systems. The NZEECS notes that: "Studies have shown that there is significant technical potential for renewable distributed generation to contribute to New Zealand's future energy supplies. However the markets for distributed generation, in particular for small scale generation less than 10 MW, are in the early stages of development due to their high costs when compared to conventional electricity supply."¹⁴⁰



Promoting the uptake of micro generation aligns with the government's strategy of promoting renewable electricity generation. However the establishment of such systems can create issues for local government regarding consenting. The government intends to provide guidance about best practice protocols in this area of micro generation and distributed generation.

Source: NZEECS

¹³⁸ An investigation into urban micro wind in Victoria Australia found low wind speeds and disrupted flows to be a significant impediment to inner-city urban wind micro turbines. See www.ata.org.au "The Viability of Domestic Wind Turbines".

¹³⁹ Electricity Governance (Connection of Distributed Generation) Regulations August 2007 - issued by the Ministry for Economic Development.

¹⁴⁰ NZEECS (page 69)

Attitudes towards micro generation vary across the industry. From the perspective of a major generating company, the development of mini and micro hydro can only be seen as an add on (and not as a replacement for) hydro generation capacity to serve the national grid. As one industry source put it: “mini and micro generators may be able to serve their own properties, and at times put electricity back into the grid, but the bottom line is that if their systems go down or suffer from water shortfalls, then we are expected to have capacity within our generation network to meet the needs of these properties”.

The Parliamentary Commissioner for the Environment comments on perceptions amongst the lines companies, and the electricity retailers regarding distributed generation and micro generation. “In the electricity industry, the lines companies seem most aware of the opportunities and risks of micro generation of electricity, although they tend to focus on larger scale distributed generation.”

¹⁴¹

“Distributed generation plants are often situated close to end-users who require larger amounts of energy (such as hospitals or large industrial plants). Our research suggests that lines companies are interested in DG because they can use it to strengthen their networks without investing in new line capacity. Orion is one example of a lines company that uses DG, in the form of diesel generator sets, to compensate for line constraints at times of peak load within their network in Canterbury.”

“Distributed generation also provides a way for lines companies to diversify out of the highly regulated core business of distribution networks where there are limited options to seek new profit opportunities. Unison’s and Eastland Energy’s wind farm proposals are examples of this type of diversification. Some forward-looking lines companies are also beginning to plan for the possibility.”

Retail companies

The Parliamentary Commissioner for the Environment notes that the attitudes of the combined generator-retail companies to distributed generation “are more difficult to determine”. Retailers are most involved when a household or business with micro generation capability wishes to sell their surplus electricity back into the network. The Commissioner comments that: “how easily this transaction can be undertaken is an indicator of how well a gentailer is engaging with the concept of micro generation.”

“For example, Contact Energy offers contracts to electricity micro-generators on its network. It also has an agreement with the NZ Photovoltaic Association (NZPVA) to buy surplus electricity from NZPVA members at the full retail price (i.e. the price the customer pays for their normal electricity). TrustPower has had a micro generation policy in place since July 2003. It gives customers metering and pays them \$50/MWh + GST for all exported electricity.¹⁴² Other gentailers are considering how they can integrate customer micro generation into their business.”

The Commissioner’s report ends with a recommendation that the Ministers of Energy and Commerce ensure there are no market barriers preventing the sale of surplus electricity produced by local energy systems, and that policies are

¹⁴¹ The Parliamentary Commissioner for the Environment’s 2006 report “*Get Smart, Think Small - Local energy systems for New Zealand*” (page 58)

¹⁴² PCE Report (page 63)

developed to address barriers facing lines companies wanting to be involved in such local systems.

NZEECS actions

Taking up the Parliamentary Commissioner's challenge, the NZEECS specifically provides a wide range of actions to enhance distributed generation. They include:

- the National Policy Statement on renewable energy, which is designed to provide high-level national guidance on renewable energy projects under the RMA
- providing renewable energy information for local government, including assisting with RMA policy and plan making, and Regional Energy Strategy development
- relaxing restrictions on investing in renewable generation by lines companies
- raising awareness of the benefits and costs of distributed generation. This will involve setting up a programme to raise awareness about the benefits of small scale generation for end use consumers and local government.
- capacity building for installers and suppliers of distributed generation in order to meet anticipated increased demand
- technical guidelines on small scale distributed generation, aiming to reduce regulatory compliance costs and improve safety in connecting to local networks
- studying the uptake of distributed generation in the primary sector, including forestry, and making recommendations on additional policies (including specific economic incentives) for encouraging the additional uptake of distributed generation.¹⁴³



Source: EcoInnovation

The government aims to raise awareness about the benefits of small scale electricity generation, such as from this micro hydro Pelton wheel. The NZEECS sets out a series of strategies, including proposals to reduce any regulatory compliance costs that may be preventing greater uptake of local energy systems.

¹⁴³ NZEECS (page 70)

Regional council and territorial authority approvals

The Parliamentary Commissioner for the Environment's report 'Get Smart, Think Small – Local energy systems for New Zealand' also makes a number of recommendations about strategies which local government can adopt to promote efficient energy use.

“Regional councils and territorial authorities are consent authorities under the Resource Management Act 1991 (RMA). Technologies that use water – such as micro hydro systems – may require resource consent from a regional council to use, dam, or divert the water. Also, resource consent may be required from a territorial authority if the local energy system produces excessive noise, impacts on visual amenity, or involves land use such as the construction of an unauthorised structure.

“An example could be the proposed installation of a micro wind turbine in an urban environment,” the report explains. “The RMA allows councils to include provisions in their regional or district plans that make certain activities permitted (with or without conditions). Permitted activities do not require resource consent. Usually the effects of such activities are known and considered minor. However, most local energy technologies are relatively uncommon in New Zealand, and council officials have limited experience with them. Officials often err on the side of caution and require additional conditions to reduce risk (and adverse impacts). Proponents of local energy technologies consider that some resource consent conditions are unnecessary and can add significant costs to some systems.

“Regional and territorial authorities also use their powers and functions under the Building Act 2004 to ensure that local energy systems comply with the Building Code. Any system that impinges on the structural integrity of a building may require such an approval. Solar hot water heaters, heat pumps, roof-based wind turbines and photovoltaics are technologies that fall into this category. Regional councils are also responsible under the Building Act 2004 for matters pertaining to dams.”¹⁴⁴

The Parliamentary Commissioner's report also goes on to discuss potential conflicts that can arise over the development of domestic scale renewable energy, and makes some recommendations on addressing concerns.

The report notes that as local energy systems using renewable sources of energy become more prevalent it is likely that there will be conflicts over rights of access to energy sources. For example, conflicts could arise when:

- An urban house has photovoltaic cells on the roof, and the next door neighbour constructs a building that blocks the sun for part of the day.
- An urban house has a micro wind turbine on the roof, and the next door neighbour plants trees that eventually grow and disturb the wind flow.
- A farmer has a micro hydro scheme and another farmer upstream wants to take water for irrigation.

The Commissioner advises that local and central government will have to consider how such conflicts are managed if local energy is taken up more widely. “Specific rules may need to be developed, and consideration given to

¹⁴⁴ The Parliamentary Commissioner for the Environment's 2006 report “ *Get Smart, Think Small - Local energy systems for New Zealand*” (page 84)

Waikato Regional Energy Strategy

permitted activity rules under local government planning frameworks, particularly those pertaining to the RMA,” the report notes.¹⁴⁵

The Commissioner’s report recommends that the Ministry for the Environment, with the Electricity Commission, EECA, and the Department of Building and Housing, develop guidance documents to help local authorities understand the implications of local energy technologies for the RMA and planning process.

Trade training

Another barrier to the development of distributed generation involves the lack of trained electricians capable of installing mini and micro hydro systems, or alternative systems such as wind power, or local energy systems such as solar hot water.



Source: ClipArt

Micro generation and larger-scale distributed electricity generation can only take off if there are sufficient trained and qualified installers to undertake the work.

The Parliamentary Commissioner for the Environment commented that: “The installation and maintenance of local energy equipment requires various trades people. Our investigation found that some promoters and retailers of micro generation and heat capture technologies often had trouble installing local energy equipment because many trades people did not have the necessary skills, and those that do are often busy on other work.”¹⁴⁶

Wintec currently offers some training to electricians in this field – but as demand grows with the development of the alternative power market, the need for this training is likely to increase. There is also currently a need for more trades people capable of working on mainstream power systems such as hydro and geothermal.

¹⁴⁵ Ibid (page 87)

¹⁴⁶ The Parliamentary Commissioner for the Environment’s 2006 report “*Get Smart, Think Small - Local energy systems for New Zealand*” (page 60)

Small scale generation recommendations

Recommendation 13: The Regional Energy Strategy advocates that local authorities consider providing clear rules for small scale and micro generation projects which reflect the size and scale of proposed electricity generation facilities.

The Regional Energy Strategy encourages the consideration of 'feed in tariffs' for stimulating uptake of renewable generation.

Who is involved

Local authorities, Ministry for the Environment, Electricity Commission, EECA

What action is required

- Work with local authorities and government agencies such as EECA and Electricity Commission and generators to standardise district plan and regional plan rules for small scale generation
- Government to consider 'feed in tariffs' and/or other incentives to encourage small scale and micro generation

Where should actions be focused

- Need to agree upon acceptable definitions of small scale and micro generation.
- In the first instance, adopt EECA definition of micro generation as domestic scale electricity generation up to 10 kW.
- Need for flexibility between rural and urban areas e.g. tower height for micro turbines and noise levels.

When should the steps be taken

ASAP

Recommendation 14: The Regional Energy Strategy recommends that investigation and trials of small scale electricity generation be undertaken in the Waikato.

Who is involved

Waikato Regional Energy Forum, Wintec and Waikato University, alternative energy companies, EECA's NZEECS programme of action

What action is required

- Coordination of trial project on small scale generation
- Promote feed in tariffs (FIT) to central government.
- Encourage consideration of FIT to stimulate the uptake of distributed generation.

Where should actions be focused

- finding of appropriate sites for trials of small scale generation technologies
- understanding the local authority rules for the specific location, and promoting standardisation where appropriate

When should the steps be taken

ASAP

Recommendation 15: The Regional Energy Strategy advocates that the regional council and territorial authorities consider modifications (where appropriate) to district and regional plan rules to ensure plans assist and facilitate micro generation and that consideration is given to allowing domestic-scale renewable energy production as a permitted activity.

Who is involved

District and city councils, Environment Waikato, EECA as advisory body

What action is required

- Local authorities to develop model plan provisions.
- Advocate for micro generation, where appropriate.
- Reduce or remove where possible consenting fees for solar hot water systems.

Where should actions be focused

- Development of model plan provisions

When should the steps be taken

Linked to the LTCCP process to ensure funding

Recommendation 16: The Regional Energy Strategy advocates the promotion of energy education as part of all learning, promotes the development of centres of learning that include energy training, demonstrations and practical assistance, and supports the training of greater numbers of trades people capable of working on energy systems.

Who is involved

Ministry of Education/Tertiary Education Commission, ETITO and ESITO, School Board of Trustees, Wintec/Waikato university, New Zealand Clean Energy Centre, industry

What action is required

- Work with community groups and local authorities to make the region's community more 'energy aware'
- Develop enhanced networks between education providers and industry.
- Strengthen links with ITOs involved in the energy sector.
- Work with Enviroschools to teach energy efficiency.

Where should actions be focused

- Development of framework and proposals for enhanced 'energy education' at tertiary level.
- Explore STAR and ITO funding options for teaching energy education.
- Develop 'School of Energy' concept.
- Development of training projects.

When should this happen

ASAP

Parliamentary Commissioner for the Environment's vision of future potentials

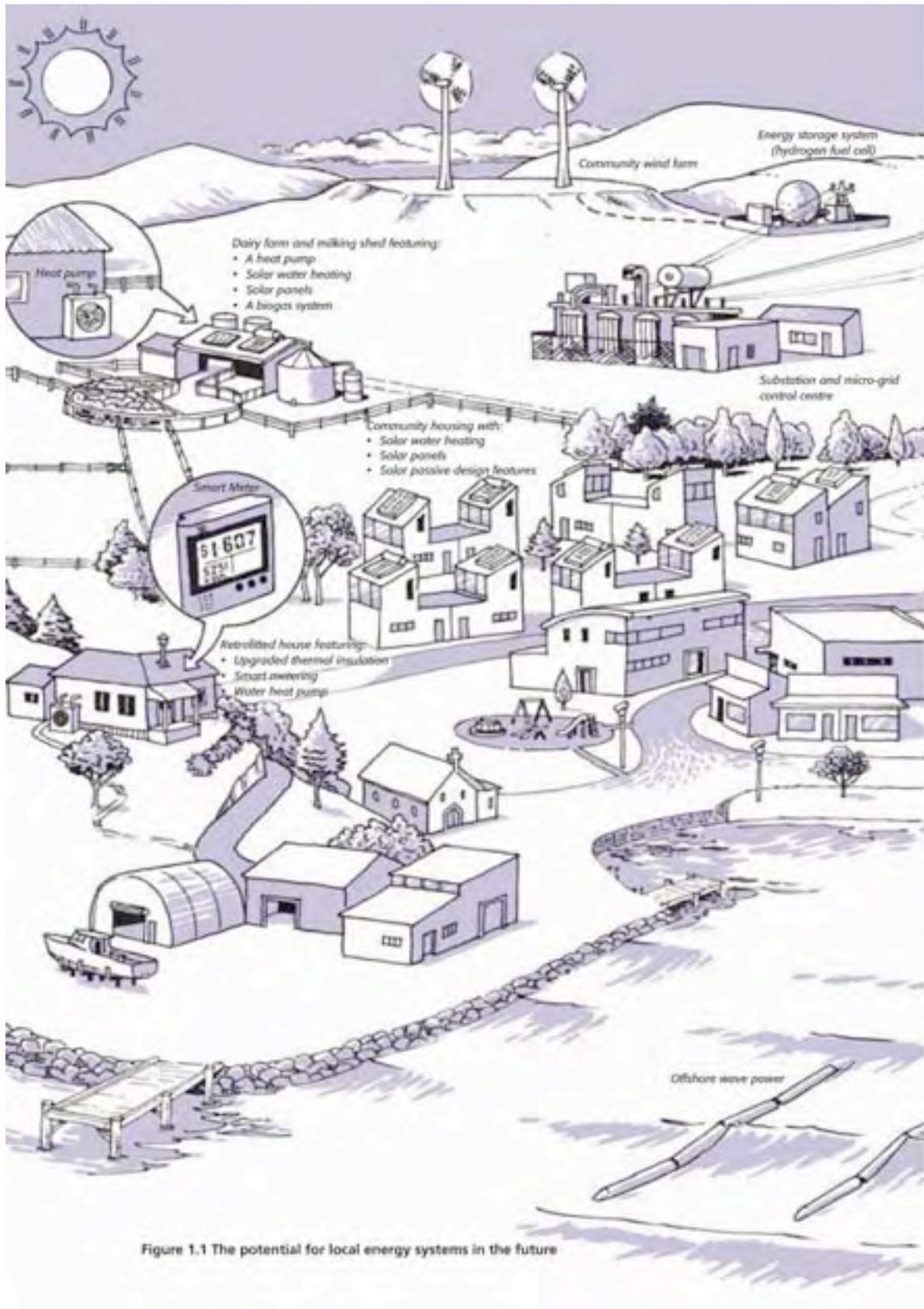
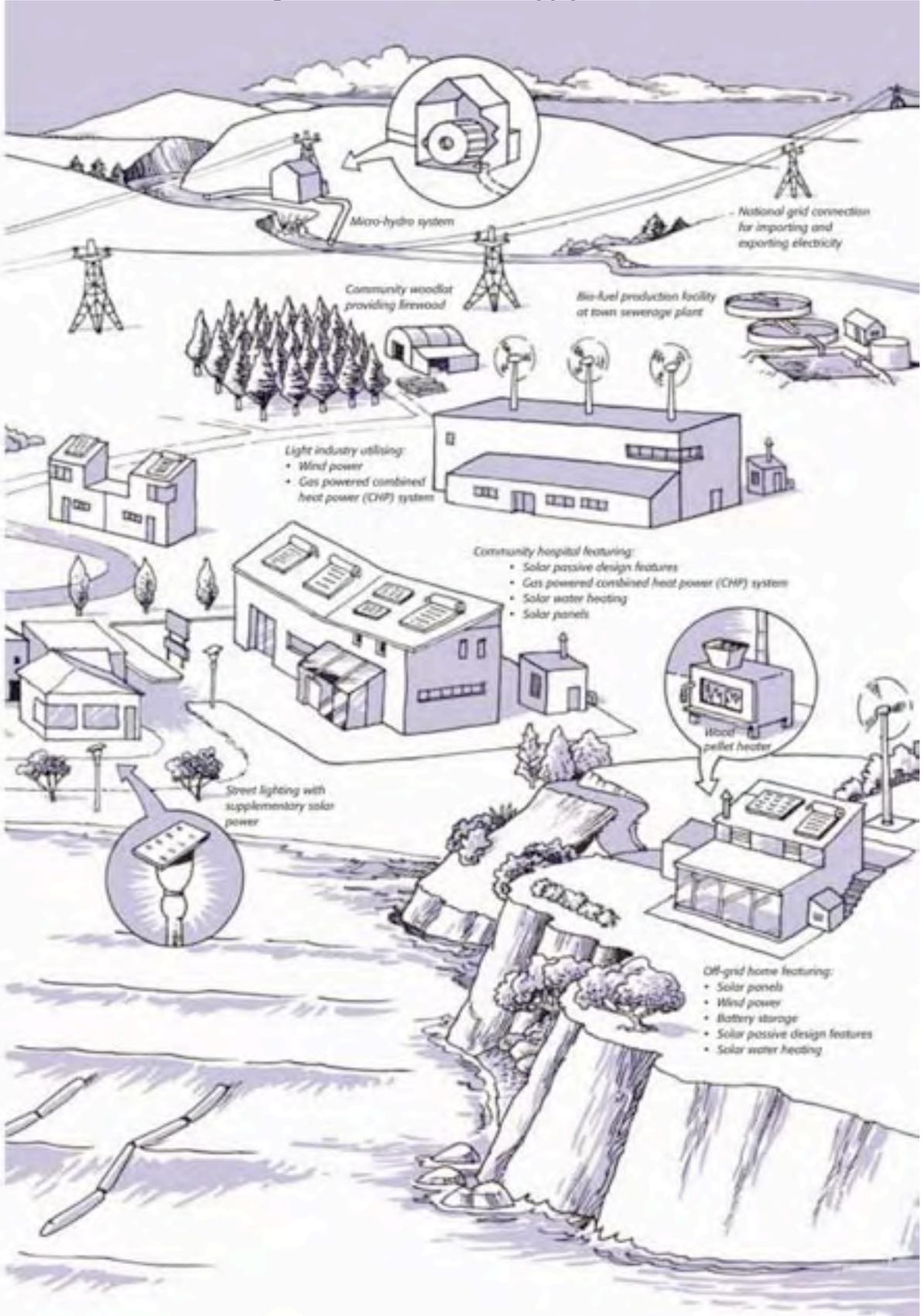


Figure 1.1 The potential for local energy systems in the future

Illustration: Courtesy of Parliamentary Commissioner for the Environment's report on Local Energy Systems. Illustrator: Trevor Plaisted, Design and Illustration Services.

Visual summary

Potential changes to domestic-level supply and demand



The Parliamentary Commissioner for the Environment's report on local energy systems provides this excellent visual representation of future options.

Part 7 - Demand-side energy efficiency measures

The importance of energy efficiency

The Waikato Regional Energy Strategy recognises energy efficiency as a vital component of achieving the strategy's goals. To this end, the principle of 'energy efficiency and conservation' is ranked as the first objective listed in the strategy's purpose statement. This purpose is stated in the following manner:

“Encourage and enable energy conservation and efficiency.”

One of the keys to improving energy efficiency lies in changing consumer behaviour – both at business and domestic level. An important strategy for achieving this change is by educating the public through social marketing campaigns which inform about the benefits obtained from energy efficiency. These benefits lie not just in dollar savings to the consumer, but also in the less tangible but equally important goals of achieving health, social and environmental improvements.

The benefits of demand-side driven energy efficiency are available to both the business and domestic consumer, as well as the providers of electricity infrastructure, and the environment.

- From the customer's perspective, saving electricity reduces power bills which leaves more money in their pockets. This clearly provides some incentive for adopting energy efficiency measures, provided they are well understood and meet cost-benefit expectations.
- From the electricity infrastructure provider's perspective, energy efficiency also has the potential to impact positively on the bottom line, because it offers the opportunity of reducing the costs of installing new infrastructure. This is because reduction in consumer demand through energy efficiency measures (such as better insulation of houses, or the installation of solar hot water heating) reduces pressure on lines companies to upgrade infrastructure within towns and cities to meet the demands of population and housing growth. And in rural areas, the impact of the spread of lifestyle blocks on the need to upgrade lines capacity can be offset by greater uptake of energy efficiency measures.
- The generation of electricity causes environmental effects – whether this is from thermal, wind, geothermal or hydro sources. So the less electricity that is required to be produced, the less the environmental effects. Hence promoting energy efficiency provides a win-win-win solution for the environment, the consumer and the electricity provider.

The Parliamentary Commissioner for the Environment's report on local energy systems estimates that energy efficiency has the potential to save 1101 GWh per year over the next five years – with savings rising to 7755 GWh a year over a 30 year timeframe. This figure rises significantly if solar hot water systems are added into the mix. Solar hot water, both in domestic and industrial use, is projected to save an additional 897 GWh a year over the next five years, rising to 8,201 GWh a year over the 30 year timeframe.¹⁴⁷ This represents 38 per

¹⁴⁷ The Parliamentary Commissioner for the Environment's 2006 report “*Get Smart, Think Small - Local energy systems for New Zealand*” (page 53)

cent of New Zealand's current net electricity generation of 41,622 GWh – and hence energy efficiency can provide a significant portion of New Zealand's future energy needs.

Demand-side energy efficiency recommendation

Recommendation 17: That the Regional Energy Strategy strongly advocates energy efficiency and conservation.

Who needs to take these steps

Waikato Regional Energy Forum, EECA, local authorities, EMANZ

What action is required

- Take a strong leadership role in promoting energy efficiency and conservation projects.
- Promote energy conservation by changing people's habits and purchasing routines.
- Product identification to promote energy efficient products.
- Identification of the best initiatives and promotion of these to the wider community.
- Promote energy efficiency and conservation projects.

Where should actions be focused

- Waikato Regional Energy Forum can help promote education programmes and workshops with other agencies.

When should this happen

ASAP

Part 7(A) - Business and industry energy efficiency for the Waikato

The Waikato region relies heavily on the business and industrial sector for its ongoing prosperity. Light and heavy industry, agricultural processing, manufacturing, construction, business and property services, health and community services, and retailing all contribute to the region's growth. And in all of these sectors, there is the potential to make significant savings in energy.

The current upward rise in the cost of energy, combined with central government's focus on reducing energy emissions, has increased the impetus towards energy efficiency. There are the obvious economic benefits – by being energy efficient a business can reduce running costs and increase profits. The Energy Efficiency and Conservation Authority estimates that between 10 to 30 per cent of the energy costs of most businesses can be reduced through improved energy management.

The business sector can appreciate the principle that every dollar of energy-saving represents a dollar that can go straight to the bottom line. And from the nation's perspective, every megawatt of electricity saved is one less megawatt we need to supply by building new generation.

Specific business measures

As part of improved processes for energy management, businesses can use energy derived from renewable sources or simply convert to more efficient

machinery to improve their operations. These include high efficiency motors, fans and boilers; variable speed drives; the use of renewable or waste products as fuel to power boilers; industrial refrigeration or more efficient drivers in heavy transport.



Photos: ClipArt

Improving the energy efficiency of industrial systems such as production lines or switching gear can result in significant business savings.

Making energy efficiency improvements can appreciably reduce the running costs of industry. Furthermore, as public awareness and support for energy efficiency grows, businesses can use their conversion to more energy efficient or renewable technology as a cogent marketing tool.

Government grants

The government provides a number of capital grants for energy efficiency projects and also offers businesses comprehensive energy audits. The grants are designed to help businesses fund measures that would otherwise be prohibitively expensive. Once installed, however, new energy efficient systems can often have a very short payback period.

Businesses are also in a good position to implement, on a large scale, measures that householders can implement on a smaller scale in their homes. In particular, energy efficient lighting in industrial buildings can reduce costs considerably.

EECA's Emprove scheme

In order to discover the 10-30 per cent of the energy costs which EECA estimates, are available in most businesses, the *Emprove* programme provides diagnostics through a qualified account manager, and a customised action plan for reducing energy use – as well as ongoing support.

In some cases, large energy users are eligible for a financial assistance to finance a comprehensive energy-use audit.¹⁴⁸

For businesses that spend a high proportion of their costs on energy, the *Energy Intensive Businesses* programme provides capital grants to finance the adoption of energy efficiency technology. This programme is designed to save money for the business involved, as well as providing other businesses with an example of the benefits of efficiency – with the added co-benefit of providing

¹⁴⁸ For more information about these schemes, see www.eecabusiness.govt.nz.

government with data on the performance of new technology. Grants are made of up to 40 per cent of the capital cost of an energy efficiency project, up to a maximum of \$100,000.

Energy efficiency projects

Energy efficiency projects for industry may involve:

- improvements to machinery
- more efficient heating or cooling systems
- cogeneration
- the use of renewable or waste product fuels
- refrigeration
- fishing equipment optimisation
- driver training
- the use of biofuels for transportation.

Other grants

Education sector: EECA administers the government's Crown loans to help assist government and education sector agencies to implement energy efficiency projects that would otherwise be deferred or unable to proceed due to lack of funding.

Renewables

- **Marine:** The *Marine Energy Fund* provides a contestable pool of \$8 million over four years to support the development and deployment of devices to generate electricity from New Zealand's marine and tidal resources.
- **Solar hot water:** The government believes that the *Solar Water Heating* programme can contribute to energy savings as well as reducing carbon dioxide emissions, and has agreed to make a significant investment to increase the uptake of solar water heating through a combination of information, promotion and financial assistance.¹⁴⁹

Products

- *Minimum Energy Performance Standards* (MEPS) have been implemented by the government for many types of appliances and ensure that only the most efficiency products reach the New Zealand consumer market. To date, MEPS covers eight types of appliances, including fridges and freezers, air conditioners/heat pumps and fluorescent lamps.
- *EnergyStar* endorsement labelling is a highly visible and well recognised international brand denoting appliances with outstanding energy efficiency.
- Mandatory *Vehicle Fuel Economy Labelling* will show consumers the efficiency of a new or used vehicle at point-of-sale.

¹⁴⁹ See www.solarsmarter.org.nz for details

Recommendation 18: That the Regional Energy Strategy advocates to Waikato Business the importance of energy-efficiency and conservation to reduce regional energy demand and to improve productivity and competitiveness by reducing business energy costs.

Who is involved

EECA, industry, New Zealand Clean Energy Centre, Waikato Regional Energy Forum, Wintec/Waikato University

What are the next steps to turn this recommendation into action

- Promote the provision of skilled staff in commerce and industry for energy efficiency programmes.
- Support local authorities in being more flexible in the planning processes for energy enhancement by industry, such as allowing small scale trials of energy efficiency within existing resource consents.
- Showcase best practice industrial sites highlighting advantages, such as heat recovery.
- Encourage the development of enhanced marketing for industrial energy efficiency and promotion of best practice ‘green standards’ and a ‘green tick’ in industry.”
- Develop innovative energy saving projects, with local and government funding for specific local industries and tourism facilities.
- Establish a trial project for energy efficiency within existing resource consents, to show the suitability of ‘limited variation’ concept.
- Support the New Zealand Clean Energy Centre’s proposals for ‘combined heat and power’ network clustering of industry to enhance energy efficiency.

Where should actions be focused

- Establishing a pilot energy saving project with EECA.
- Promotion of the ‘green tick’ concept for industrial energy efficiency.

Note: *A green tick to provide a better value proposition for the business owner than just energy savings. Offers branding opportunities for the business, which could incentivise an energy efficiency project to gain the green tick for sustainability reporting at corporate level, rather than just the energy savings involved – which tend to be long term.*

When should this happen

ASAP

Part 7(B) - Domestic energy efficiency strategies

There are a significant number of demand-side strategies and programmes set out in the NZEECS, which relate to the domestic consumer. These include the energy efficiency grants scheme.

EnergyWise Homes provides a suite of programmes aimed at reducing the energy use of households. *EnergyWise Homes* includes:

- promoting public awareness of energy efficiency and information on easy and low-cost ways to reduce energy use
- conducting and publishing research to help consumers identify the most efficient products including hot water systems, lighting systems and heating.
- an interest-free loan scheme to help finance the installation of insulation and clean heating devices in homes
- helping to finance the retrofitting of insulation in the homes of low-income households through the *EnergyWise Home grants*
- funding for new clean heating devices in the homes of low income households in areas affected by bad air quality
- promoting the *Home Energy Rating Scheme* (HERS), which assesses and rates homes at point-of-sale for their energy efficiency characteristics. This is designed to create an impetus for homeowners to improve the energy efficiency of their homes, and thereby potentially improve their sale prospects.
- supporting councils to implement energy efficiency legislation (including a new Building Code) and to support community energy efficiency.

The following pages contain a snapshot of some of these types of energy efficiency strategies which are already (or can readily be) implemented within the Waikato region.

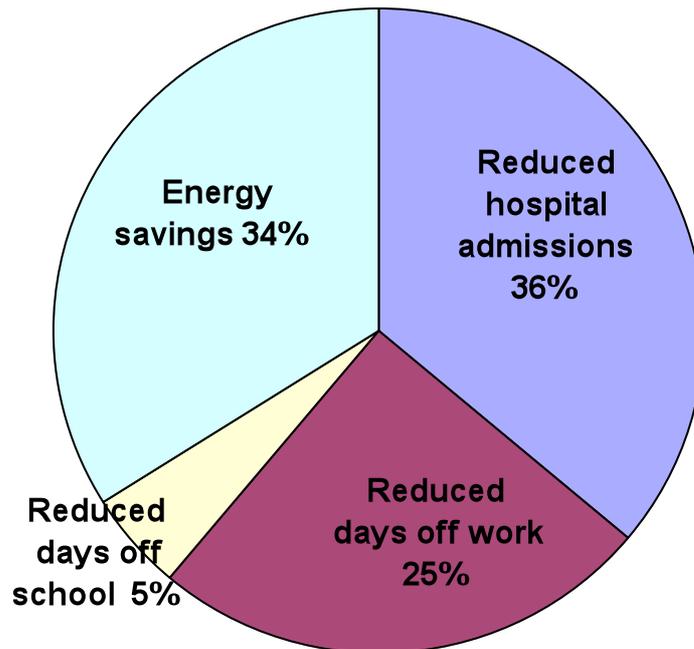
1) Insulation

New Zealand houses are considered amongst the worst in the OECD, with a lack of insulation meaning many are cold, wet and draughty. Estimates suggest the Waikato region has almost 80,000 homes that have been built prior to 1978 (the year the Building Code required basic levels of insulation), and would benefit from retrofitting insulation.

The energy savings from properly insulating a house are significant, as the average house leaks cold air equivalent to a 1 m² hole in the wall. The Energy Efficiency and Conservation Authority estimates that properly insulating houses on a national basis could save up to 1000 GWh a year.

However, apart from the energy benefits, insulation also provides significant health and social benefits. A Wellington School of Medicine study showed that insulating a pre-1978 house not only resulted in significant energy savings, but also reduced hospital admissions from conditions like asthma, minimized work absenteeism, and meant children took fewer days off school. The study concluded the total net present value of these accumulated benefits was worth \$3825 (2001 values) to society.

Wellington School of Medicine study 2001



Total net present value \$3825 per property

There are a number of community organisations in the Waikato¹⁵⁰ who are undertaking this retrofitting. When considering the results of the Wellington School of Medicine study, the cost-benefit ratios for retrofitting are clearly enhanced when these wider social and health issues are taken into account.

Retrofitting insulation



Community organisations such as the HEET Energy Efficiency Trust are involved in the retrofitting of older houses for energy efficiency, including installing underfloor and ceiling insulation to reduce heat loss.

Source: HEET

The government has recently undertaken a series of steps towards greater energy efficiency by making changes to the Building Code requirements which will require houses to have more insulation and double glazing. Government estimates suggest that savings of around \$550 per household per year are possible from better insulation of houses in the upper North Island.

¹⁵⁰ For example: The Healthier Homes Programme, which is managed by WEL Networks on behalf of WEL Energy Trust, provides assistance to people on low incomes with health issues to help bring inadequately insulated houses up to acceptable building standards.

In the Waikato, a grouping of organizations involved in the improvement of energy efficiency has come together to form an umbrella organization known as HEC! (the Healthy Homes, Energy Efficiency and Clean Air group). This group is working on ways of enhancing regional cooperation between organizations coming from slightly different perspectives (such as health, community, local authority and energy sector viewpoints), yet with a similar goal of improving community outcomes in energy efficiency.

2) Enhancing energy efficiency

Campaigns to save energy play an important role in reducing demand amongst the general public and business community. It is generally accepted that saving energy in the first place is a more efficient strategy than increasing demand and having to build new capacity. Energy Efficiency and Conservation Authority staff quote an anecdotal example of a hotel which wishes to save \$10,000 from its annual energy bill. The manager gives the staff two options, either:

- help to cut back on \$10,000 worth of energy consumption by turning off lights, spa pools, heaters etc when they are not in use, or
- work harder to attract \$50,000 worth of additional guest stays (based on the assumption that after tax expenses, this is the amount of additional revenue that must be earned to create \$10,000 profit).

Naturally the staff chose the simpler option of reducing energy consumption. And the NZEECS is based on this principle at a macro level, stating that one of its key guiding principles is that investment in energy efficiency measures should occur where this is cheaper than the long term costs of building extra generation capacity, including environmental costs.

In the Waikato, efforts are already underway to help reduce energy consumption. The Hamilton Environment Centre, in conjunction with Hamilton City Council, Environment Waikato and EECA launched a month-long 'Energy Blitz' campaign in May 2007. The campaign involved energy efficiency projects and retrofit projects. In March 2009, the Waikato Times- with support from Hamilton City Council,

Environment Waikato and WEL Networks organized Hamilton's inaugural Earth Hour event. The global event, which aims to inform and create awareness around environmental issues, particularly global climate change, saw some 40,000 people attend, who came to listen to acoustic music, visit a 'solar lounge' and sign a giant pledge cube for change. Citywide, Hamilton recorded the largest energy savings of any New Zealand City on the night, with savings of 10.3 per cent (or 26.45 MWh).

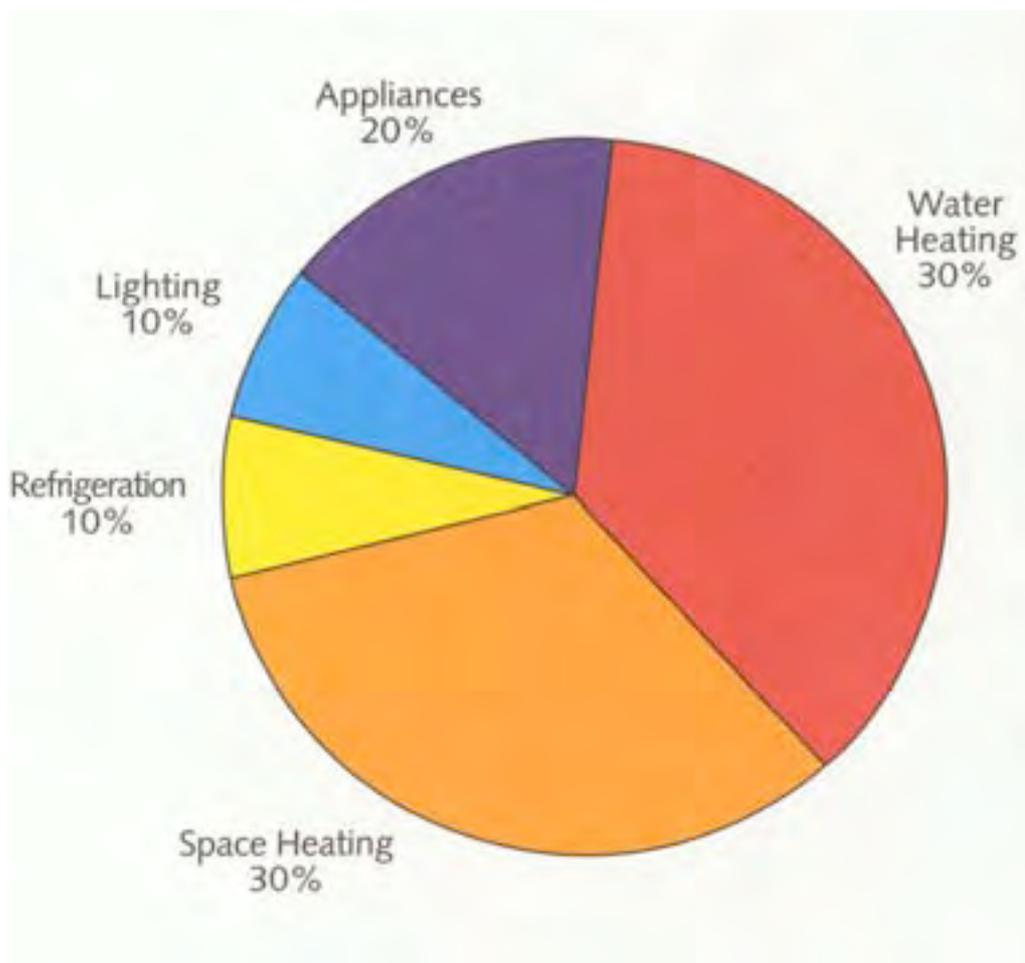
The increased profile of energy issues was highlighted by a subsequent article about energy consumption of domestic appliances as front-page news.¹⁵¹ EECA production manager Terry Collins warned consumers that power-hungry televisions and other electronic gadgets are pushing home power bills through the roof.

"While home water heating remains the biggest electricity user, large-screen televisions are fast pushing aside refrigerators and freezers as power hogs," he said, saying that many newer products use more power than earlier models, yet stubbornly wait on standby rather than turning off."

¹⁵¹ Waikato Times 14 July 2007 – (page 1)

3) Promoting energy conservation

Hamilton City Council has been active in campaigning for energy efficiency, and has produced a booklet on energy conservation which is available to consumers. The booklet gives a breakdown of the typical spending on energy of an average four-person city household.



Source: Hamilton City Council sustainable living booklet on energy

Water heating and space heating remain the highest consumers of electricity in the domestic environment.

Water heating accounts for the highest equal proportion of the household power bill at 30 per cent, with another 30 per cent going on space heating. Running appliances represents 20 per cent of energy consumption – with almost 5 per cent of energy used to run appliances in standby mode.¹⁵²

Local campaigns can also dovetail in with national campaigns. For example, the Electricity Commission has launched a scheme aimed at getting one million energy saving eco-lightbulbs in New Zealand homes. Working with Shell, Trustpower and Housing Corp, the promotional campaign has offered the opportunity to purchase five eco-bulbs for \$10 at Shell service stations. Promoters say that achieving an uptake of one million eco-bulbs would save enough electricity to power a city the size of Hamilton – while also saving New Zealanders \$130 million in electricity bills over the 10,000 hour lifetime of the bulbs.¹⁵³

¹⁵² Hamilton City Council energy booklet (page 8)

¹⁵³ Waikato Times 30 June, 2007 (page 9)

Waikato Regional Energy Strategy

Increased public awareness of energy conservation has also led to a strong demand for heat pumps. Genesis Energy and WEL Energy Trust have been offering significant discounts for the purchase and installation of heat pumps for residential and small-business customers on the WEL network in the Waikato.

Promoters say that heat pumps use up to 75 per cent less energy than other heating methods, which means people installing them can save up to \$740 a year on average on electricity bills.¹⁵⁴

	PROFESSIONAL COUPLE OR FLAT OF 2	FAMILY WITH 1 CHILD (2 adults, 1 small child)	FAMILY WITH 3 TEENAGE CHILDREN
Average cost of power per month (summer/winter average)	\$80	\$100	\$175
How YOU can save			
Lightbulbs Replace with energy efficient ones	\$8	\$10	\$15
Use heater less	\$6	\$9	\$15
Towel rail Switch off once towel is dry	\$4	\$5	\$5
Hot water cylinder Reduce the temperature to 60°C (but not below for health reasons)	\$5	\$5	\$5
Shower Install low flow shower head	\$4	\$4	\$7
Appliances Switch them off at the wall	\$9	\$9	\$12

Source: Hamilton City Council energy booklet

The average household could make a saving of around 30 per cent on their power bills, which can amount to between \$300 and \$500 per year by undertaking the energy efficiency steps listed above. While this might not seem a great deal on an individual basis, at a national level this would result in significant savings.

4) Solar hot water

In the Waikato region, solar hot water heating (particularly in new houses) is seen as a cost-effective way of reducing energy demands and saving on power bills.

Hot water heating uses about one third of household electricity use, and an effective solar system will reduce electricity consumption for water heating by 50 per cent or more over the course of a year. In summer months, the reduction of electricity consumption for water heating is estimated to be more than 80 per cent, but in winter months it will be less due to the reduced sunlight. An effective solar system in a four-person home saves about 2200 kWh of electricity consumption a year. At current electricity prices, that represents a national average saving of around \$350 to \$450 a year, as well as reducing carbon dioxide emissions through a reduced demand for electricity.

At present, there are about 35,000 solar water heaters in homes in New Zealand, saving about 77 GWh per year, and the industry is installing about 3000 per year.

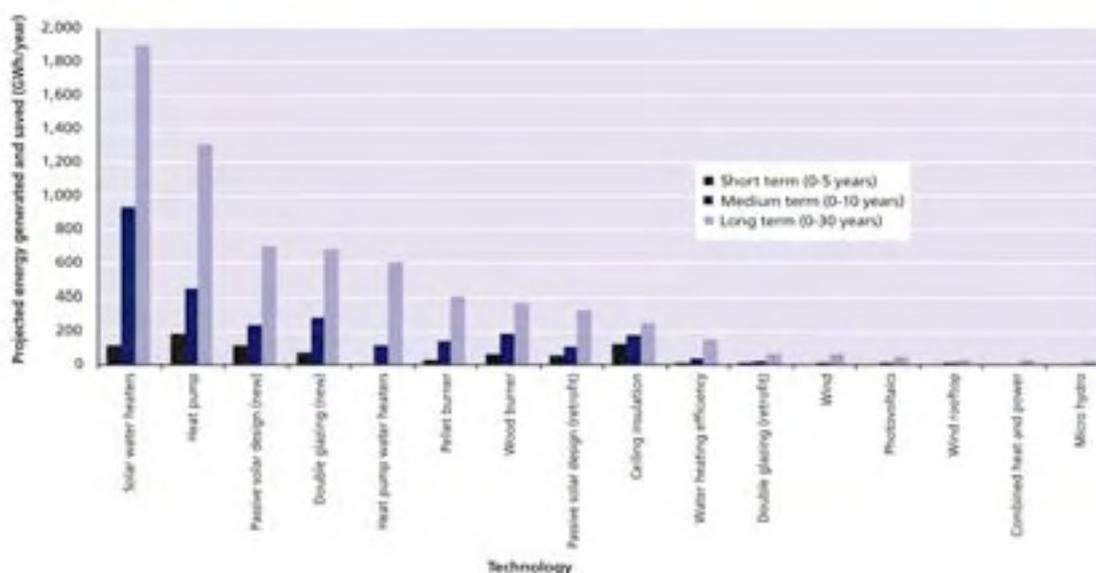
¹⁵⁴ Waikato Times 30 June, 2007 (page 9)

The government is keen to increase the uptake of solar hot water, and has recently increased the grants scheme to \$1000 for residential installations, along with a new website to help householders reduce their greenhouse gas emissions through the installation of solar hot water heating.

The government is also working with the building industry to encourage solar water heating on new housing, particularly volume-build developments, assisting with the costs of training solar water heater installers, and encouraging solar water heating systems on publicly owned buildings.

As compliance costs have previously been cited as an impediment to the more rapid introduction of solar hot water, the government is also intending to provide guidelines for local authorities to reduce the cost of building consents. Hamilton City Council and South Waikato District Council are two local authorities within the region to waive consent fees for solar hot water installation in order to promote its uptake.

Comparison of heat pumps and solar hot water for energy efficiency



Source: Parliamentary Commissioner for the Environment report on micro-energy systems

The rapid uptake of solar hot water heaters is seen to be the best medium to long term solution to saving energy. In the short term, the installation of heat pumps, ceiling insulation and passive solar design for new houses are seen to be more cost-effective solutions. However long term, as the graph shows, solar hot water remains the best energy efficiency option for New Zealand.

Trained installers

The Parliamentary Commissioner for the Environment’s 2006 report ‘Get Smart, Think Small – Local energy systems for New Zealand’ points out that a lack of trained trades people is another barrier to the rapid uptake of local energy systems, such as solar hot water.

“A problem for someone wishing to install a local energy system is that installation and servicing may require several trades people. For example, installing solar hot water heaters requires a plumber and often an electrician. This adds another layer of complexity and planning which may deter some people,” the report notes.¹⁵⁵

¹⁵⁵ The Parliamentary Commissioner for the Environment’s 2006 report “ *Get Smart, Think Small - Local energy systems for New Zealand*” (page 68)

Roof mounted solar hot water heating



Source: EECA

The Energy Efficiency Conservation Authority is currently running a number of promotions to encourage the uptake of solar hot water, including a \$1000 grant for consumers installing a system.

The Commissioner comments that integrated and comprehensive training and certification schemes are needed for local council officers, employees of lines companies, trade certifiers, electricians and plumbers so that they are qualified to approve or install local energy systems.

The report goes on to praise the short course run by the Waikato Institute of Technology (Wintec), which trains plumbers who wish to develop skills to install and maintain solar water heaters. The Commissioner recommends that qualifications for local energy technologies would address the problem of taking multiple trades people to install micro generation technologies.

“Appropriately qualified trades people could install and repair particular types of technologies (e.g. solar hot water heaters, photovoltaics, micro wind turbines) even though this work may require the skills of more than one of the traditional trades (e.g. the electrical and plumbing trades).”

5) Smart metering

In Britain, the government has announced it wants every home to have a ‘smart meter’ within 10 years. These meters give householders a clear display of how much energy they are using – and how much it costs at any given moment. This information helps encourage people to reduce their unnecessary power use, such as not leaving appliances on standby.

The Parliamentary Commissioner for the Environment’s report on local energy generation is critical of the lack of smart metering systems in New Zealand’s electricity system.

The report describes the lack as “not just a major technical barrier to the adoption of on-grid local energy systems, but also a major source of inefficiency in the electricity market.”¹⁵⁶ This is because research has shown that

¹⁵⁶ The Parliamentary Commissioner for the Environment’s 2006 report “*Get Smart, Think Small - Local energy systems for New Zealand*” (page 66)

information about power usage influences consumers' behaviour, and causes them to use energy more wisely.

In New Zealand, smart metering is being rolled out to 100,000 homes in Christchurch. In August 2006 Arcinnovations, a subsidiary of Meridian Energy, announced the start of an Advanced Meter Management Programme, which is a 2-year programme to introduce smart meters. The programme aimed to reduce costs through remote meter-reading, eliminate the need for meter readers to have access to consumers' properties and offer comparative information to guide customer decisions about electricity use.



Smart meters such as this Cent-a-meter can be purchased by individual domestic consumers to check on their household's electricity bill on a detailed basis.

Genesis Energy has recently announced that smart meters will be rolled out free to 500,000 homes and business over the next five years.¹⁵⁷ Genesis aims to have the meters installed for most electricity accounts over the next two years – and high demand centres like Hamilton are likely to get priority during this period. Other companies are also looking at the rollout of smart metering in the city.

6) Green urban planning

It is important to not only consider how we generate, store, transmit and use energy in our homes and business, but also the fuel efficiency of the cars we drive and the energy efficiency of the numerous household appliances we have come to rely so deeply on. However, a growing body of literature also points to the importance of where we live – in particular where we live in relation to where we work, shop and recreate – as a key determinant of per capita energy use.

Throughout the 20th century, the rise and spread of the private motor vehicle coupled with relatively cheap fossil fuels (particularly in low-density 'economically developed' nations such as the United States of America, New Zealand and Australia) has largely given rise to car-dependent development and urban sprawl.

In an ever more resource constrained world, not only does this represent an inefficient use of productive agricultural land, urban sprawl also threatens the viability of efficient public transport systems. According to the Urban Land Institute, future urban sprawl, if allowed to continue unabated, will likely undercut any future technological advances in vehicle-fuel economy towards 2030¹⁵⁸

Smart growth and integrated land use and transport planning

In light of these findings and the increasing concerns around peak oil and climate change, concepts like 'smart growth' and 'integrated land and transport management' are presenting a new and alternative vision to traditional sprawl.

¹⁵⁷ Waikato Times 30 August 2008 (page C4).

¹⁵⁸ Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen (2008); 'Growing Cooler'; Urban Land Institute, Utah

Waikato Regional Energy Strategy

Emphasising higher density development around key nodes (e.g. town centres, CBDs, amenities, transport hubs) and concepts like ‘mixed use’¹⁵⁹, smart growth aims to produce well-planned, pedestrian friendly, compact living environments which in turn support multi-functional, multi-modal transport options. Studies show that smart-growth can reduce vehicle trips by around a third relative to conventional diffuse development.

Smart growth in the Waikato

Throughout the Waikato, a number of territorial authorities are increasingly looking to ‘smart-growth’ concepts as a means to create more compact, less motor-vehicle dependent cities. Hamilton City Council has employed a number of smart growth concepts and principles in several key strategic documents. FutureProof, working with Waipa and Waikato district councils and Environment Waikato, and the Hamilton Urban Growth Strategy (HUGS) are complementary strategies that seek to ensure future growth occurs within prescribed and manageable limits through increasing residential densities particularly around key development nodes.

Complementing these strategies, the Hamilton Environmental Sustainability Strategy advocates for steps to ‘optimise the use of land’ through developing existing sites and encouraging land-use patterns that ‘facilitate viable sustainable travel’. The Access Hamilton strategy supports this through the development of an integrated transport plan that will help make greater modal choice a reality. The soon to be completed Hamilton Active Communities encourages, among other things, people to embrace existing transport opportunities as a way of both staying healthy and reducing vehicle emissions. Whilst serving the multiple goals of a compact, well-connected, liveable and vibrant city by helping to decouple growth from motor vehicles, these city strategies will also help contribute to a less carbon-intensive city.

Fostering the supply of renewable energy

Increased use of renewable energy can be fostered within the Waikato region by local government policies which facilitate the uptake of emerging technologies. For example, Hamilton City Council has generated about 13 million kW from the city's waste water and landfill generating sites, while also saving about 8.5 million kW in energy efficiency measures.¹⁶⁰

Local government policies which look to long term future sustainability can support renewable energy through a range of measures, such as ensuring that property owners who wish to install new technology on a domestic scale do not face undue barriers or restrictions (provided such installations do not unreasonably impinge upon neighbouring properties).

Local authorities can also promote the use of renewable energy through encouraging new subdivisions to utilise renewable sources for a percentage of their energy needs within the development. For example, this concept of a green subdivision is currently being considered by Hamilton City Council in its proposed Rotokauri subdivision. In addition, Hamilton city has run a series of successful green building workshops which provide information on passive solar design, site selection, and house plan interpretation.

¹⁵⁹ i.e. development that combines residential, commercial, and/or office uses, within a commercial or office zoning district, into one development or building

¹⁶⁰ Hamilton City Council energy booklet – page 8

Hamilton City Council has been active in this area, with the Sustainable Urban Design Programme providing seminars for people wanting advice on retrofitting, alternative energy and domestic water, and eco-home design workshops.

Waikato architects have also embraced this emerging trend for green buildings, with the new \$35 million Braemar Hospital incorporating environmentally sustainable design. The hospital will feature reduced energy consumption, use of environmentally friendly materials, high-efficiency motors, and solar panels on the roof. The building will attract a green star rating of 4.5 under the environment for building rating system.¹⁶¹

Another new building in the city – a \$12 million office block planned for Bridge Street – will be equipped with double glazing, low energy lighting and air-conditioning, designed to save about 30 per cent of the energy costs of a similar sized building.¹⁶²

7) Whole-of-life purchasing approach

In order to meet the changing parameters of a carbon constrained world, local authorities and other organisations have the opportunity to show leadership through their purchasing policies. Whereas in the past purchasing decisions may have been made with a greater weight on the purchase price as the primary determinant, the whole life cycle of the product and its carbon footprint now need to be considered.

Central and local government actions

The NZEECS makes a number of recommendations about governmental responses to energy efficiency. These include:

- Govt³ agencies to have a sustainable procurement policy, including energy efficient products, in place by 2008.
- All new government buildings and leases above a threshold size must meet an energy efficiency standard that delivers best value over the whole-of-life by 2012.
- 70 per cent of Govt³ agencies to purchase vehicles in the top 20 per cent of fuel efficiency for class by 2009.
- 70 per cent of Govt³ agencies to have a workplace travel plan in place by 2010.
- 10 per cent reduction in energy use per full-time employee of premises occupied by Govt³ tenants by 2012 (compared with 2006).
- Stabilise the net emissions of air travel by Govt³ agency staff at 2006 levels by 2012.

The NZEECS aims to “provide central government input into the development of local government policy statements and plans to endorse the objectives of the NZEECS strategy,” and to “monitor the progress of local government in addressing sustainable energy objectives in their land-use planning activities”.

¹⁶¹ Waikato Times 20 June 2007 – page 5

¹⁶² Waikato Times 11 July, 2007 – page 13

8) Community engagement

Since Hamilton City Council established an energy efficiency programme, it has obtained savings of over \$1 million.

The positive steps in the council's corporate action plan on energy include:

- maximising biogas electricity generation, and exploring options to utilise other renewable energy sources
- assessing energy efficiency for all new waste water pumping stations
- ensuring consideration of energy efficiency is given to all aspects of the central business district upgrade
- replacing street lighting and under-veranda lighting with energy efficient technology where possible as part of routine maintenance and upgrade
- undertaking annual audits of the museum, Waikato Stadium, Claudelands events centre, libraries and theatres with a focus on reducing lighting costs
- installing pumps in the swimming pool leisure centre with variable speed drives which use less energy, and installed heat recovery units on boilers
- ensuring all tender processes consider energy
- giving consideration to solar water heating where possible as part of routine replacement of existing hot water supplies.

Hamilton City Council had also been involved in working with the community as part of the CCP process. This has included:

- working in partnership with the Building Research Association of New Zealand, residents and local building companies to improve performance ratings for Hamilton homes
- delivering community education programs to promote energy efficiency and water conservation practices
- promoting EECA's loans for householders who purchase solar water heaters
- showcasing business practices and technologies that use energy efficiency, reduce water consumption, produce less waste, and promote transport alternatives
- working with industries to find more sustainable alternatives to traditional utility services, and to encourage improved design of industrial complexes.

Additionally, Hamilton City Council, in conjunction with Environment Waikato and the Energy Efficiency and Conservation Authority, contributes to the WEL Energy Trust's 'Healthy Homes' programme via 'Breathe Easy'- a flagship project under the city's Environmental Sustainability Strategy. Breathe Easy aims to retrofit low income, pre 1978 houses within Hamilton with insulation and clean air devices (i.e. heat pumps) in order to conserve energy, offset carbon emissions, reduce PM10 levels, and create warmer, healthier homes.

The experience of Hamilton City could be shared with other territorial authorities so that the local government sector in the Waikato as a whole takes a leadership role in reducing their institutional carbon footprints, while acting as a mentor to other organisations within the community. This will foster a climate across the region that encourages energy efficiency and carbon reduction.

Region-wide energy efficiency initiative

Recommendation 19: That local authorities within the Waikato work together on a region-wide implementation of energy efficiency, conservation and increased use of renewables.

Who is involved

Local authorities, Environment Waikato, Waikato Regional Energy Forum, EECA

What action is required

- **Local authorities to work together to align local action plans across the region.**

Where should actions be focused

- Promotion of education programmes and workshops

When should this happen

ASAP

Household energy efficiency for healthy homes

Recommendation 20: The Regional Energy Strategy supports forum partners in their efforts to secure greater sources of funding for the Waikato region for household energy efficiency retrofit projects and to promote design and construction regulations and practices to ensure the regions homes are healthy and energy efficient.

Who is involved

Household energy efficiency community groups, EECA, local authorities, Waikato Regional Energy Forum partners

What action is required

- Educate potential funders about the benefits of household energy efficiency.
- Establish a conference to link opportunities with funding to develop case studies.
- Waikato Regional Energy Forum partners to consider supporting the Waikato rollout of the energy advice line (which is being proposed by the Energy Efficiency Community Network on a national basis).
- Support councils in establishing eco-design advisor positions.
- Promote skills development, innovation and implementation of retrofitting of homes to improve health and wellbeing of occupants.
- Secure greater sources of funding (such as government, corporate and independent not for profit) into the Waikato region for household energy efficiency projects.

Where should actions be focused

- Facilitate networking to promote the importance of household energy efficiency to health and local government sectors, with personal case studies from individuals who have benefited from insulation.
- Development of a business plan to attract government funding for energy efficiency within the Waikato region

When should this happen

ASAP

Smart metering

Recommendation 21: That the Regional Energy Strategy supports systems to help users monitor electricity usage to enable consumers to use energy more efficiently, and to reduce their peak time demand usage.

Who is involved

Gentailers and distributors, EECA, Waikato Regional Energy Forum, energy efficiency groups

What action is required

- promotion and deployment of user electricity usage monitoring such as with smart metering
- greater community education about the value of demand-side reduction

Where should actions be focused

- encouraging gentailers to speed up the rollout process
- liaison with EECA to learn from overseas examples
- develop mechanism for community participation and information regarding the benefits of smart metering

When should this happen

ASAP

Green urban planning

Recommendation 22: The Regional Energy Strategy advocates for local authorities to put in place international best practice for energy efficient planning and development.

Who is involved

Local authorities, Waikato Regional Energy Forum, planners, builders and contractors, EECA

What action is required

- Promote the HERS and Green Star energy rating schemes.
- Show leadership through the development of workshops.
- Establish demonstration projects to promote environmentally conscious urban planning.
- Seek funding opportunities to provide workshops and demonstration projects.
- Encourage Environment Waikato to adopt guidelines for best practice in its regional policy.

Where should actions be focused

- Work with local authorities and other agencies to set up demonstration projects and workshops on energy efficient planning, design and construction.

When should this happen

ASAP

Part 8 - Addressing the needs of specific sectors

As identified earlier in this document, the Waikato region has several key economic drivers. This section aims to consider a range of potential solutions to the energy related issues facing two of these sectors – transport and dairying.

Specific sector: dairying

Energy savings in manufacturing operations

Dairying is the backbone, not only of the Waikato economy, but also of the national economy. Dairy exports generated close to \$7 billion in merchandise trade returns – which represents 23 per cent of New Zealand's total. With this significant portion of New Zealand exports depending on dairying, it is important to make dairying's future as sound as possible in terms of energy planning.



As dairying is such a key part of the Waikato economy, making energy savings in this area is very important.

Source:
Environment
Waikato

Fonterra has taken major steps towards improving the energy efficiency of its operation. With energy costs sitting at third behind wages and depreciation (and the highest import cost item associated with manufacturing), Fonterra clearly have strong financial incentives to use energy efficiently. These measures include:¹⁶³

- cogeneration of electricity and heat (which is capable of achieving 79 per cent calorific efficiency, compared with electricity generation alone which typically achieves 55 per cent)
- the use of biogas at plants like Tirau
- a major corporate energy reduction project, which aims to save \$21 million per annum by 2008. This project is currently saving about 2 PJ per year. It has already achieved 8-9 per cent savings in 2005/06, and expects 10 per cent savings in 06/07 – increasing to 13.3 per cent by 07/08. The 2005/06 savings represented 82 per cent of the total recorded New Zealand business savings in that year. However achieving these savings required considerable

¹⁶³ Information from John Hutching's presentation on Fonterra's energy savings strategies at Waikato Regional Energy Forum in March 2007.

investment, amounting to \$3 million in operational costs and \$20 million in capital spending. The energy savings made by this investment will continue making a return to the company for years to come.

There are also opportunities for further innovations such as:

- trialling the use of solar generation
(for example the Crawford Street depot has 40,000 m² of roof area)
- trialling the use of farm dairy effluent for biogas
- trialling greater uptake of wood pellets as an alternative fuel source
- addressing energy security of supply in transport by the use of things like biofuels, increased rail transportation of milk, and increasing the load capacity of milk tankers.

Transport of dairy products

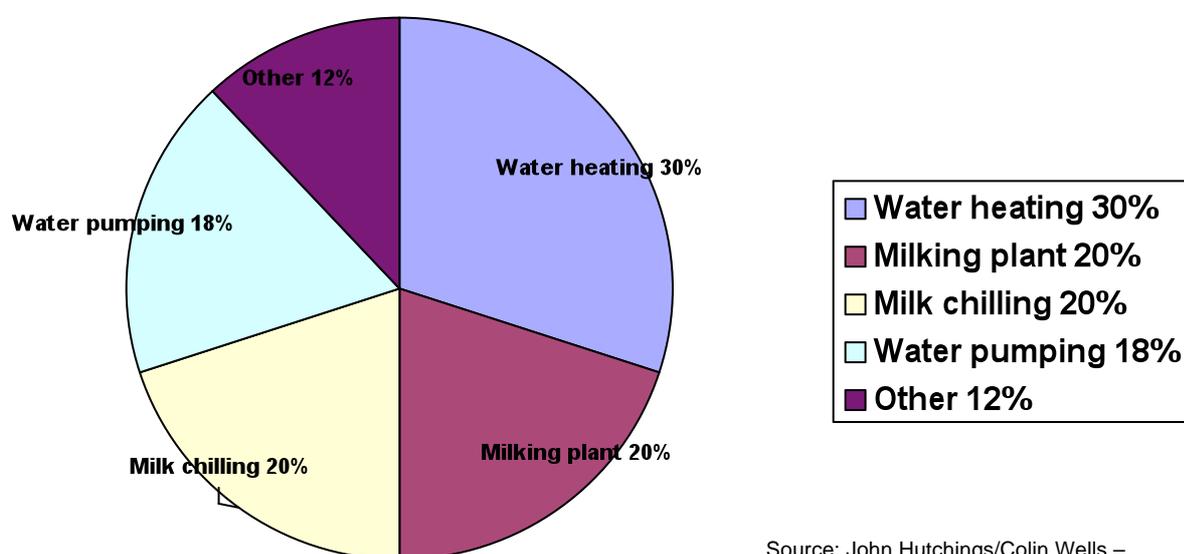
In terms of the reduction in fuel costs and carbon dioxide emissions from a major industry, one of the key steps is fostering efficient transport of dairy products. The development of the inland port at Te Rapa and the move towards shipping dairy products by rail for major export ports has also helped to meet the goals of reducing carbon dioxide emissions. In addition, such a move could provide potential fuel savings, as well as ensuring the industry is not overly reliant on oil as a transport fuel source.

Energy savings by individual dairy farmers

While corporate bodies such as Fonterra have in-house staff resources and the investment capital available for upgrading plant which can enable them to institute significant energy-saving measures, this option is not always available to individual farmers. However as the supply chain begins with the farmers, it is important to look at ways of promoting energy efficiency in on-farm operations.

Statistics show that energy costs (fuel and electricity) account for about 20 per cent of farm expenses.¹⁶⁴ Of this, electricity accounts for a \$40 per cow on a national average, with fuel costs \$28 per cow. However costs in the Waikato region are already lower than the national average, standing at \$28 per cow for electricity and \$27 per cow for fuel (due to factors such as lower irrigation costs).

Typical electricity use on a dairy



Source: John Hutchings/Colin Wells –

Waikato Regional Energy Strategy

On a national basis, dairy farms account for about 1 per cent of New Zealand's energy use (500 GWh) – but this is likely to grow with the continuing trend towards intensification and the current high price for dairy products.

On the average dairy farm, the biggest use of electricity goes to heating water for milk quality/cleaning purposes. Analysts believe that savings in the order of 10-20 per cent of energy use per kilogram of milk solids produced are achievable – with some studies suggesting that even bigger savings are possible with larger herds.

Potentials for energy savings

The areas where savings potentials may be realised include:

- heat recovery, such as using the heat released from milk cooling processes to preheat water, or using spent hot wash water to preheat the water entering the hot water cylinder
- installing variable speed drives, such as the vacuum pump or water pumps under variable load
- using spherical milk vats to improve milk cooling efficiency
- conserving the use of irrigation
- using natural lighting in dairy sheds and/or installing energy efficient light bulbs
- insulating milk vats and hot water cylinders
- developing on-farm electricity generation such as micro wind or mini hydro and/or biogas.

Solar water heating is another of the potential energy savings on individual dairy farms. Given that water heating is a significant percentage of a farm's electricity bill, the expenditure on a solar hot water system is potentially a cost-effective investment.

Among the perceived barriers to greater energy efficiency are the initial capital cost, the lack of understanding amongst farmers about the best energy solutions for their individual farming situations, and the need for more trained specialists in energy efficiency.

Altering the tax treatment for the installation of energy efficient systems has been suggested as an important step towards encouraging the switch to greater energy efficiency on the farm.

It is important to note that the New Zealand Energy Efficiency and Conservation Strategy proposes to "establish best practice model farms, orchards and vineyards using existing energy efficient and renewable energy technology". The Waikato region is well placed to take a leadership role in this field.

Dairying recommendations

Next page:

Recommendation 23: That the Regional Energy Strategy acknowledges the ongoing energy innovation projects in the agricultural sector, and supports the trialling of new energy-saving projects within the Waikato.

Who is involved

Waikato Regional Energy Forum, EECA, dairy sector, Fonterra, NIWA, AgResearch, Dairy NZ, CRIs

What action is required

- Engage with the dairy industry to find the appropriate trials for energy efficiency and micro generation projects.

Where should actions be focused

- Consider developing contract provisions which enable the farm owner to share in the benefits of energy efficiency, and therefore become incentivised to promote cost-effective electricity solutions.
- Establish a farm energy rating scheme (similar to the home energy rating scheme) which would provide an incentive to attract top sharemilkers to a farm.
- Promote the importance of energy security of supply to the farm owner to encourage greater interest in energy issues.

When should the steps be taken

As soon as pilot project has been developed

Recommendation 24: The Regional Energy Strategy advocates that Waikato Regional Energy Forum partners work with EECA and other agencies to provide education and resources on improving energy efficiency on individual farms.

Who is involved

Waikato Regional Energy Forum, EECA, dairy sector, lines companies, alternative energy suppliers, farm advisers

What action is required

- Work with EECA and dairy sector to develop communication strategies.
- Promote embodied energy efficiency e.g. fertilizer and transport fuels.
- Develop a pilot project for farms going off grid, or with alternative energy backup.
- Work with the lines companies interested in promoting distributed generation under the new Section 62 requirements.
- Provide greater education on energy efficiency and energy security of supply options to farm advisers.

Where should actions be focused

- Develop a targeted campaign aimed at promoting energy efficiency within the dairy sector at the individual farm level.
- Ensure information is easily digestible, attractively presented and preferably visual and practical. (Note: Given the busy nature of a sharemilker's working day, it can be difficult to get them to read information sent through the post on energy efficiency.)
- Provide greater information to farm advisers – and possibly train them on how to undertake energy audits and/or advise on potentials for biogas, or micro generation.

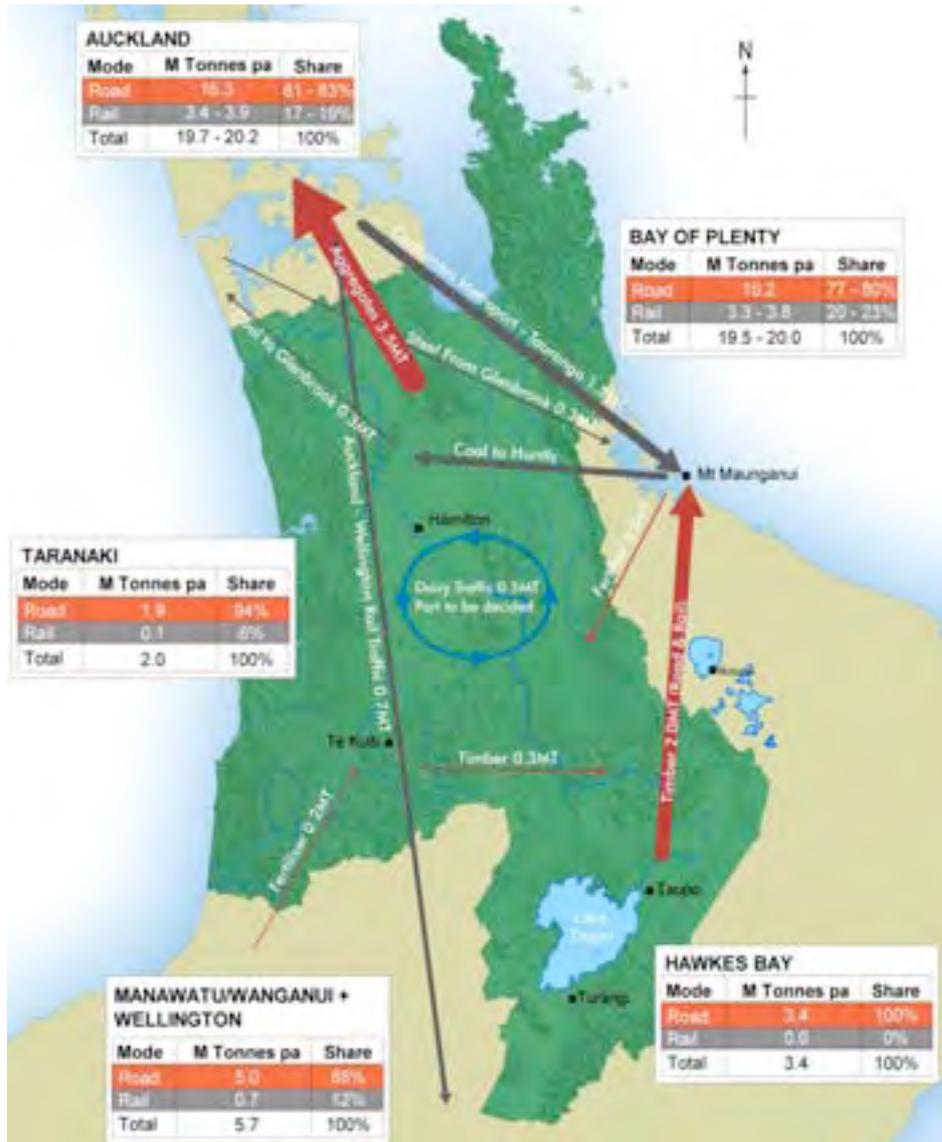
When should the steps be taken

As soon as pilot project has been developed.

Specific sector: transport

The Waikato region sits at the heart of the ‘growth triangle’ linking Hamilton-Auckland-Tauranga, which means that it acts as a hub for regional transport to and from the nation's major ports. This position at the centre of a transport nexus naturally involves extensive use of energy in truck, train and private motor vehicles.

Given New Zealand's reliance on imported oil, and the fact that the Waikato region has the highest number of truck movements per day¹⁶⁵, the issue of security of transport energy supply is important to the future economic prosperity of the region.



Source: Waikato Regional Land Transport Strategy

Situated at the heart of the ‘growth triangle’ linking Hamilton-Auckland-Tauranga, the Waikato region acts as a hub for regional transport connecting the nation's major ports. In terms of energy use, the Waikato is dependent on oil as a transport fuel source – and is therefore exposed to global fuel price rises.¹⁶⁶ Greater use of rail and coastal shipping, along with increased uptake of passenger transport provides potential solutions to security of supply issues.

¹⁶⁵ Waikato Regional Land Transport Strategy 2006

¹⁶⁶ See Waikato net consumer energy pie chart in Part 4 of the Regional Energy Strategy, which shows that transport (at 39 per cent) uses more energy than any other sector.

The Waikato situation

In the Waikato region, the Regional Energy Strategy takes its lead from the vision articulated in the Regional Land Transport Strategy 2006, and the Regional Passenger Transport Plan 2007.

The Regional Land Transport Strategy (RLTS) is a statutory document which covers a large range of transport issues, and provides an extensive list of policies and actions. As many of the key transport issues have already been addressed in the RLTS, the Regional Energy Strategy will focus on a number of the key issues specifically relating to energy.

In some cases, the energy strategy will propose additional steps which go beyond issues canvassed in the RLTS, where these could enhance security of supply, utilise renewable sources of energy, or increase energy efficiency. These steps include:

- encouraging greater use of alternative fuels
- energy efficient transport modes
- alternative methods of moving freight
- electric vehicle technology
- promotion of teleconferencing.

a) Encouraging greater use of alternative fuels

The Biofuels Sales Obligation, which requires petrol companies to supply 0.5 per cent of biofuels for combined petrol and diesel sales (and rising to 2.5 per cent by 2012), will certainly provide a mechanism to promote demand.

The Regional Land Transport Strategy (Action 8.6) states its intention to “work with central government to explore the promotion and development of renewable transport fuels including biofuels and other alternative fuels.”

The Waikato is already a leader in the use of alternative passenger transport fuels not based on imported oil, as up to one third of the Hamilton bus fleet currently uses CNG. The only bus service in a major metropolitan area in New Zealand to use CNG, the Hamilton fleet’s energy supply comes primarily from Taranaki gas, which is available through the North Island pipeline.



Hamilton is the only major metropolitan centre in New Zealand with up to one third of its buses running on CNG as an alternative fuel.

Source: Environment Waikato

CNG is considered to have a lower emissions profile than much of New Zealand's current bus fleet (although the new Euro 5 buses meet tough European emissions standards, and are considered to have a very low emissions profile). While the Waikato is well-positioned to maintain its CNG fleet (given that most of the infrastructure is currently in place, and additional capital investment is not required), there is some doubt about the ability to switch increasing numbers of buses nationwide to CNG, given the current supply constraints on Maui gas. If there was a large scale switch to CNG, the gas supply may need to be imported, which would then be subject to fluctuations in the global price.

The 2007 Regional Passenger Transport Plan (Action 8.5) also advocates investigating "the potential of, and where appropriate giving preference to, greater use of alternative fuels on passenger transport services."

The use of biofuels is already underway in other parts of the country. For example, a Canterbury tourism company is using recycled canola oil from fast food outlets and restaurants to power its vehicles. The company, Hasslefree Tours, has converted all its eight vehicles (including two six-wheel drives and a Unimog) to biodiesel. The company, which takes visitors on Lord of the Rings tours of the South Island, is thought to be the first tourism operator in Canterbury to make a complete switch.

The only expense to convert the company's small fleet was \$5000 for a new tank to store the biodiesel, and the vehicles needed new filters after the third tank. However the biofuel reduces carbon dioxide emissions by up to 50 per cent compared to regular diesel, and the owners believe this gives them a significant marketing advantage, particularly with tourists from green-conscious countries in Europe.

The biofuel is supplied by a Christchurch company, Biodiesel NZ, who supply about 40 commercial customers with 1.2 million litres of biodiesel a year. It plans to increase this to 70 million by 2011 by planting fields of rape seed oil.¹⁶⁷

Alternative fuel pilot for trains

One of the problems with establishing an alternative fuel network for motor vehicles is the high cost of infrastructure to provide new fuel sources (such as hydrogen) along the routes travelled by motorists.

This is why a blend of biodiesel or bioethanol are considered as viable solutions for powering vehicles through conventional service stations, while at the same time reducing the nation's dependence on imported fossil fuels, as per the government's biofuels requirement by 2012.

Trains offer the unique strategic advantage of being able to carry their own fuel source with them – thus making them largely independent of refuelling requirements over long distances. This provides the potential for a trial of alternative fuels on a modified train. In Britain, a test of the first biofuelled passenger train commenced in London in June 2007. The train, run by Virgin Trains, uses a blended fuel made up of 20 per cent biodiesel. Several British train companies are also considering testing biodiesel in their locomotives.

The Virgin trial will run for six months, during which time engineers will measure the fuel's effects on the engine. If successful, Virgin hopes to switch over all its

¹⁶⁷ Information source: Waikato Times 27 October 2007 (page C6).

diesel powered trains, which account for two thirds of its fleet – a move which would cut the trains' emissions by 14 per cent. Virgin eventually wants to run its diesel powered trains exclusively on biodiesel, rather than the current trial of a 20 per cent blend.¹⁶⁸

In New Zealand, a similar kind of trial could be undertaken either with the production of indigenous biodiesel, or its importation for the trial period. The development of the regional pilot project could involve the rail operator, or a major industry such as Fonterra, or a major provider of regional transport who has interested in trialling alternative approaches (such as a freight company).

Recommendation 25: That the Regional Energy Strategy advocates renewable energy forms of fuel, including:

- **advocating the uptake of renewable energy sources for public transport**
- **investigate and encourage pilot programme of Bioenergy including second generation biofuels**
- **promote use of forestry residues.**

Who is involved

Environment Waikato and Hamilton City Council, Regional Transport Committee, New Zealand Railways Corporation, Major freight users like Fonterra, Waikato Regional Energy Forum.

What action is required

- Liaise with Regional Transport Committee about the importance of low emission fuels (renewable energy).
- Make links with other planning documents and Passenger Transport plans such as via the Regional Policy Statement review.
- Talk with Ministry of Transport regarding uptake of renewable energy sources for transport including 'blending' options with the view to participating in a pilot project or programme.

Where should actions be focused

- Liaise with agencies and industry to establish pilot project for alternative fuels.
- Urge consideration that any 'green fuel' should be exempt from any future regional fuel tax.
- Financial incentives should be considered to promote use, such as lower tax.

When should the steps be taken

ASAP

b) Energy efficient transport modes

The RLTS promotes the use of energy efficient transport options, and in Action 8.1 advocates that: "road controlling authorities promote and develop more energy efficient transport options in the region, including passenger transport, rail, cycling and walking modes."

This covers a wide range of transport demand management strategies. One of the methodologies which is currently being used successfully in the Waikato is

¹⁶⁸ Information source – www.railnews.co.uk – 7 June, 2007

the 'walking school bus' scheme, whereby schoolchildren are encouraged to walk to school in organised groups. This eliminates the need for cars to drop them off at school, which reduces traffic congestion at peak times, and also has the added benefit of improving the children's fitness.

Passenger transport is another obvious way of reducing New Zealand's energy consumption in private motor vehicles, with the co-benefit of reducing greenhouse gas emissions. Another energy efficient transport mode is carpooling – with one transport expert pointing out that: "There's a very simple way of doubling the fuel efficiency of your car, and reducing your carbon footprint. Take a passenger!".

Another important step in improving the energy efficiency of transport is creating urban environments which encourage walking and cycling.



Cycling is a mode of travel which can be enhanced through the approved design of cities and roadways, driver education, and schemes such as the temporary hiring of bikes for tourists, such as has been proposed for Hamilton.

Source: Environment Waikato

c) Alternative methods of moving freight

The RLTS (Action 1.4) promotes the development of alternative freight modes in the region, such as coastal barging. Environment Waikato has been involved in a trial project to freight aggregate (rock fill for roading) from the Coromandel to Auckland.



Barging of aggregate from Kopu to Auckland

Barging freight from the Coromandel to Auckland is one of the "Alternatives to Roading" trials being undertaken in the Waikato region. Pictured is a barge taking road-fill aggregate direct to the

Source: Environment Waikato

This project, which loads barges at Kopu with aggregate, reduces the number of heavy vehicles on the roads, as well as delivering the cargo directly to wharves in Auckland.

Other potentials exist for barging, particularly between Coromandel and Auckland given the short distances involved, and the comparatively sheltered seas in the Hauraki Gulf. In addition, the RLTS (Action 11.11) proposes the investigation of opportunities for developing a rail strategy for shipping aggregate between Waikato and Auckland.

The Waikato's inland port

Another important way of ensuring energy efficient transportation of freight is to increase the use of rail. The Waikato is already a leader in this field, with the development of the Crawford St 'inland port' concept in Hamilton.

The Crawford St depot acts as a logistics hub and distribution centre for Fonterra's Te Rapa, Te Awamutu, Morrinsville, Waitoa, Hautapu, Waharoa, Lichfield and Tirau manufacturing sites.

Fonterra and Toll NZ are working together to make rail the primary transport mode for dairy products in the Waikato. They are taking around 45,000 truck movements off the road between Waikato, Auckland and Tauranga, thus reducing carbon emissions by around 3000 tonnes each year.¹⁶⁹

The company is also using rail to transport milk from the Hawkes Bay, Manawatu and Wairarapa regions to the Waikato processing plant at Waharoa. This results in saving an extra 6100 tonnes of carbon emissions each year.

In addition, the transfer of so many truck movements from the roads onto rail acts to reduce demand for roading, minimises damage to highways, improves safety, and reduces congestion, as well as reducing exhaust emissions that are harmful to health.

The Crawford St 'inland port'



The Crawford St depot in Hamilton acts as a logistics hub for the collection and distribution of dairy products throughout the Waikato. This shift from road to rail is estimated to take around 45,000 truck movements off the roads each year, as well as improving efficiency and reducing congestion. In addition, there are plans to construct a major coolstore adjacent to the dry goods store – which will double existing capacity.

Source: Environment Waikato/Fonterra

¹⁶⁹ Information source: NZEECS (page 55)

In the NZEECS, the government is promoting alternatives to roading by undertaking a freight efficiency study, developing a domestic sea freight strategy, and making recommendations on targeted changes to weight and size limits for road freight.

In the Waikato, the RLTS also commits to working with the regional council, ONTRACK and rail operators to encourage the use of rail for long distance freight movement.

d) Investigation into rail electrification

In the NZEECS (4.2) the government proposes to investigate options for improving the efficiency of the North Island main trunk line, including electrification. This is supported in the RLTS (Action 11.9) which proposes an investigation into the electrification of rail infrastructure between Hamilton and Auckland.

The North Island main trunk line is currently electrified between Palmerston North and Hamilton. However the link to Auckland was never completed. Furthermore, a significant percentage of trains utilising the Auckland and Wellington route are running on diesel rather than electricity.



The North Island main trunk line is currently electrified from Palmerston North to Hamilton, with the Wellington to Paraparaumu section operating on a DC link. With the proposed electrification of Auckland's rail network, and the importance of the Auckland-Hamilton export nexus, it is logical to complete the Waikato section.

Source: Wikipedia

Waikato Regional Energy Strategy

Given the importance of the Waikato for dairy exports, and Auckland's strategic position in terms of consumer demand and port access, electrification of the remaining part of the North Island main trunk between Hamilton and Auckland would enhance energy security and export efficiency. The NZEECS proposes an investigation of the electrification of the main trunk line as a key component of the government's energy strategies.



Source: www.n-sharyo.co.jp

As New Zealand has a high proportion of electricity generated from renewable sources, completing the electrification of the main trunk line is a way of future proofing the region's exports against any potential oil price rises – as well as providing an important commuter rail service (if high oil prices in the future should mitigate against private vehicle travel).

Therefore it is logical for the Waikato to support the NZEECS proposal to investigate electrification. In addition to the Hamilton to Auckland route, which would complete the original planned main trunk link, there is also logic to studying the electrification of the Hamilton to Tauranga route which provides important port access for the Waikato's exports.

Recommendation 26: The Regional Energy Strategy advocates that the Forum support greater use of rail and the NZEECS proposal to investigate electrification of the rail link between Hamilton and Auckland, and other possible routes.

Who is involved

New Zealand Railways Corporation, Ministry of Transport, freight users, Waikato Regional Energy Forum.

What action is required

- Liaise with Ministry of Transport, EECA and Regional Transport committee officials about the investigation process.
- Encourage the development of rail facilities, such as the inland port concept in the Waikato region.
- Promote study on electric vehicle technology and energy generation needs and provision of charge points for electric vehicles.

Where should actions be focused

- Make sure that investment in rolling stock and locomotives is consistent with future environments.
- Make provision for both passenger and freight.

When should the steps be taken

Begin working with MOT and other agencies ASAP.

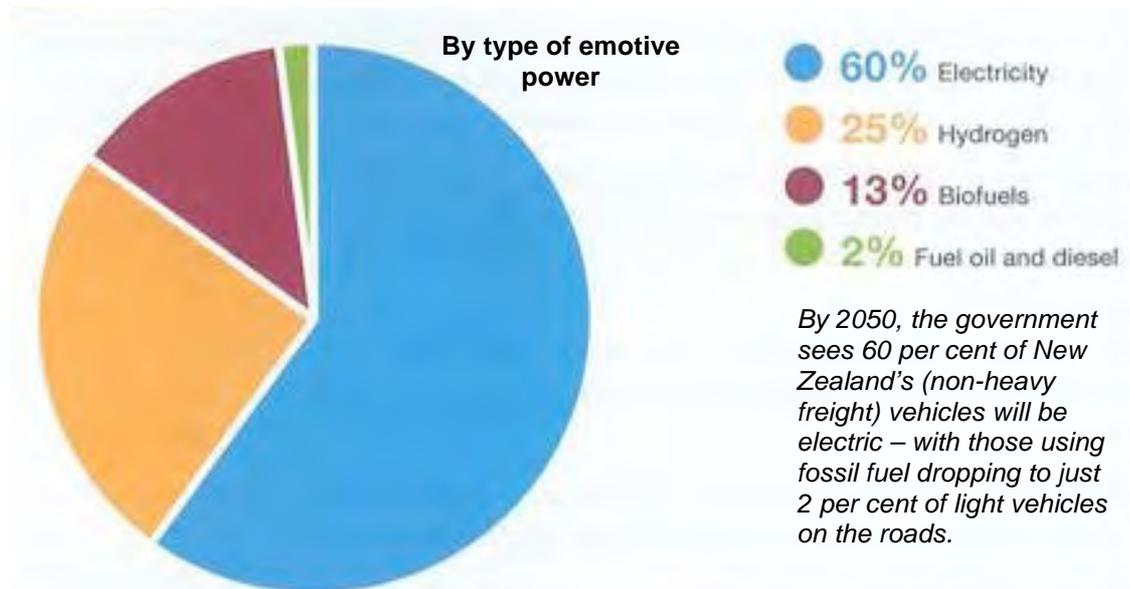
e) Electric vehicle technology

The government sees New Zealand as one of the first countries in the world to widely deploy electric vehicles. The NZEECS notes that a number of high-

volume manufacturers are currently undertaking multi-billion dollar investment programmes to bring cost-effective, plug-in mass market electric vehicles into the marketplace around the end of the decade.

As New Zealand is a technology taker, the government intends to put policies in place to accelerate the uptake of such vehicles as the market makes them available.¹⁷⁰

Government's vision of composition of light vehicle fleet in 2050



Source: NZES

To make this goal happen, the NZEECS (4.4) intends to accelerate the uptake of plug-in hybrid and electric vehicles.

In our region, the Waikato University is already undertaking work on electric car technology. Electric vehicles, which use electric motors instead of the internal combustion engine, are more energy efficient than traditional fossil-fuel powered vehicles. They produce no exhaust fumes and minimal pollution, they are quiet – and many are capable of acceleration exceeding that of conventional vehicles. In a carbon-constrained world, it is likely they will have a more prominent future.

History of electric vehicles

Historically, electric cars were amongst the earliest automobiles. The first electric vehicles were produced in 1830s in Scotland and Netherlands but it was the French development of the electric storage battery in the 1860s that they became practical. Prior to 1900, electric automobiles held many speed and distance records and were produced in commercial quantities by companies such as Detroit, Edison, Studebaker and others.

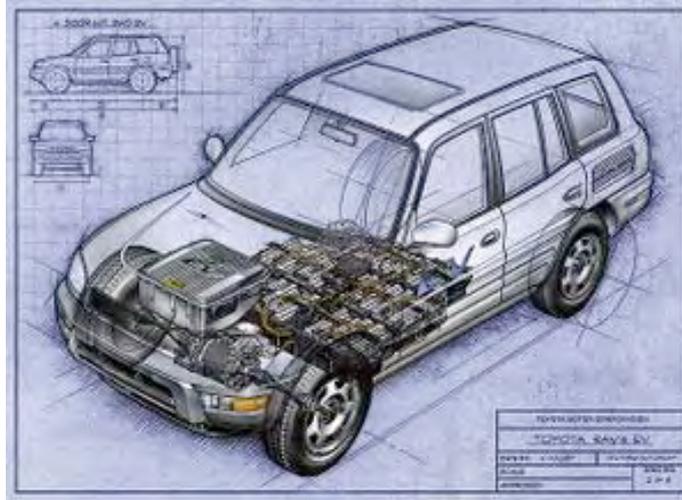
The flood of mass produced, relatively inexpensive Model T Fords with more powerful (but more polluting) internal combustion engines in early 20th century was a key factor in the downfall of the electric cars, as was the introduction of the electric starter motor by Cadillac in 1913 (which removed the need for the old hand-crank start method of petrol vehicles). Another blow was the loss of Edison's direct current power in the mains grid (which removed a convenient source of DC electricity to charge car batteries), as DC was superseded by the alternating current (AC) method of transmission for household electricity.¹⁷¹

¹⁷⁰ NZEECS (page 60)

¹⁷¹ Information source: Wikipedia – Electric vehicles

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In the early 1990s California Air Resources Board demanded that car manufacturers produce vehicles with zero emissions. Toyota, Honda, Ford and General Motors all produced electric vehicles to comply with the standard. The vehicles were leased to selected customers, but when the zero emissions mandate was withdrawn, most of the vehicles were recalled and destroyed by manufacturers (other than Toyota).



Source: Wikipedia

The revolutionary electric-powered Toyota RAV4 EV operated on 24 12-volt batteries. The car, like all other electric vehicles produced in the 1990s, is no longer in production, reportedly due to 'lack of consumer demand'.¹⁷²

A total of 328 Toyota RAV4-EVs were sold to the general public, and these are still supported by the company.¹⁷³ After the withdrawal of the all-electric vehicles by the manufacturers, Toyota launched the hybrid Prius, which combines petrol and electric technology to gain greater efficiency than a traditional vehicle.

The Waikato situation

While the major car companies overseas are obviously best equipped to produce mass market electric vehicles, the Waikato is already a leader in the field of developing specialist electric car technology.



Waikato University is at the forefront in the development of electric car technology in New Zealand, with the production of this one off specialist Eco Ultra-Commuter test model.

Source:
Mike Duke
Waikato University

At Waikato University, engineering students have designed a NZ Eco Ultra-Commuter electric car which aims to demonstrate New Zealand's potential for assisting with the development of sustainable electric car technology.

¹⁷² Information source: "Who Killed the Electric Car" movie

¹⁷³ Information source: "Who Killed the Electric Car" movie and Wikipedia

In New Zealand, Meridian Energy is set to announce a deal with a Japanese car manufacturer to introduce a small fleet of electric vehicles for trial and demonstration purposes. With strong demand overseas, the challenge for New Zealand will be to obtain sufficient cars in the face of overseas competition for the new vehicles. Hyundai has announced it will be the first vehicle maker to offer new electric cars for sale in any volume in New Zealand. Its full-electric plug-in version of the Getz, with a top speed of 120 km/h and a range of 120 km on a single charge, is predicted to be ready by the end of 2008.¹⁷⁴

Waikato University professor Mike Duke believes that New Zealand should be looking closer to home, and envisages the domestic production of electric vehicles in New Zealand by 2015. He says that small, two-person cars could be built here and sold for as little as \$10,000 each.¹⁷⁵

One way in which the Waikato Regional Energy Forum can help to promote the uptake of electric or hybrid vehicles is by encouraging forum partners to consider low emission, energy efficient vehicles when purchasing corporate or personal vehicles. These criteria for lower emission hybrid vehicles could be written into corporate procurement policies.

Hybrid buses

The government is also keen on promoting the uptake of low emission passenger transport options. The NZES states that the government “will encourage the deployment of low-carbon bus fleets, including hybrid and electric buses into the suburban passenger fleet.”¹⁷⁶

This strategy is echoed in the Waikato Regional Passenger Transport Plan (Policy 8.4) which aims to give preference to low emission passenger transport.

In other parts of New Zealand, Ashburton bus manufacturer Designline Ltd is producing hybrid electric buses, which are in use in Christchurch and Auckland, and have also been sold overseas. The buses, which fill a niche market for environmentally friendly, ultra-low emission passenger vehicles, generate electricity to charge batteries which run electric motors. The batteries are charged overnight, and the turbine system also recharges them when operating. In addition, energy from braking is used to charge the batteries.

Designline started work on the hybrid electric vehicles a decade ago after realising there was a market which the company could fill internationally.¹⁷⁷

The development of electric vehicles is clearly a niche market for New Zealand, compared with the potential for large scale investment undertaken by car manufacturers overseas. But given New Zealand's reputation for leading edge research and innovative solutions, there is an opportunity for breakthroughs in specific aspects of technology.

The Regional Energy Forum has the opportunity to help promote the research of Waikato University and others in this emerging field, and to lobby for funding in support of innovative steps taken in this direction.

¹⁷⁴ Waikato Times 30 September 2008 (page 12)

¹⁷⁵ Waikato Times 13 September 2008 (page A7)

¹⁷⁶ NZES (page 45)

¹⁷⁷ Information source: Trade and Enterprise's Market New Zealand website, and Christchurch City Council's archives.

Recommendation 27: Promote reduced transport energy consumption and encourage energy and transport efficiency such as for moving of freight and encouraging mode choices including public transport, walking and cycling.

Who needs to take these steps

Environment Waikato and local councils, town planners, architects, developers, Ministry of Transport, Waikato University and Wintec, Waikato Regional Energy Forum (as advocate)

What action is required

- Promote sustainable energy efficient urban design and development.
- Promote the development of electric vehicles such as the Waikato University work on electric car technology.

Where should actions be focused

- promotion of education events and workshops that encourage energy efficient travel
- promotion of sustainable urban design and growth strategies that encourage 'green' travel options and reduce the need for travel

When should the steps be taken

Within the next 12 months

f) Promotion of teleconferencing

One of the ways of reducing the use of vehicles is to promote alternative ways of doing business. The NZEECS aims to see 70 per cent of Govt3 agencies having a workplace travel plan in place by 2010, and to limiting net emissions from air travel by Govt3 agency staff (at 2006 levels) by 2012.

One mechanism for achieving these types of goals would be to foster the development of more telecommuting (such as video conference participation at meetings, as opposed to road and air travel), and the encouragement of more teleworking by employees.

In the NZES, the government advocates teleconferencing as an important step in reducing unnecessary travel: "Actions to reduce travel focus on reducing the number and length of motorised trips. Short term measures to reduce travel include teleconferencing instead of flying between cities, and encouraging drivers to combine trips. The government's digital strategy and its support for broadband will reduce pressure on transport services by promoting teleconferencing and other forms of distance-based communication."¹⁷⁸

When such teleworking or teleconferencing occurs, there should be some mechanism developed within an organisation's 'green' accounting and annual report processes to record these positive developments and acknowledge their importance in carbon offsetting for the institution.

¹⁷⁸ NZES (page 50)

Part 9 - Summary of recommendations

As stated in the introduction, this Regional Energy Strategy is a non-statutory, multi-stakeholder document. However it can act to inform decision making by local government agencies when preparing statutory documents such as the second generation Regional Policy Statement. As the document is non-binding on parties, it has effect to the extent that this is given by forum partners. To do so, they must go through their respective procedures.

These recommendations have been formulated and discussed in detail by a 24-member strategic advisory group of forum members. Since the launch of the strategy working document in November 2007, the advisory group has met regularly to develop action points for implementation. These actions now form the strategy's recommendations.

Vision statement

"Improving quality of life for people in the Waikato, and in New Zealand, through affordable and energy efficient lifestyles, a reliable and renewable energy supply, efficient infrastructure, informed decision making, and innovative solutions that enhance competitive advantage".

Purpose of the strategy

The overall purpose of the Waikato Regional Energy Strategy is to:

- **encourage and enable energy conservation and efficiency**
- **promote the Waikato region's role in maintaining security of energy supply**
- **facilitate the development and use of renewable energy sources and innovative energy technologies**
- **acknowledge and promote the crucial role of energy in the regional and national economy.**

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Waikato's electricity generating capacity</p> <p>Recommendation 1: The Regional Energy Strategy advocates for policies and actions that promote the generation of electricity from renewable sources and innovative energy technologies within the region, that recognise the importance of security of supply. This includes:</p> <ul style="list-style-type: none"> Recommendation 1a) Supporting the building of sufficient generation capacity to meet demand. 	<p>Generators and lines companies, Environment Waikato (second generation RPS)</p>	<ul style="list-style-type: none"> Develop a Regional Policy Statement that recognises the importance of building energy infrastructure, and provides for the development and use of renewable sources of energy 	<p>Across the region</p>	<p>Making sure this is on the agenda of the annual planning cycle</p>
<ul style="list-style-type: none"> Recommendation 1b) Promote planning for appropriate allocation of natural resources for the development of renewable electricity generation to assist nationwide security of supply (to cope with peak load times and future overall demand). 	<p>Generators, local Authorities Environment Waikato, EECA New Zealand Clean Energy Centre, Waikato Regional Energy Forum, Ministry of Economic Development and related agencies</p>	<ul style="list-style-type: none"> Encourage appropriate agencies in particular Environment Waikato, district and city councils to make provision in their policy and planning resource assessment. 	<p>In the identification of resources and in policy provision for development</p>	<p>Making sure this is on the agenda of the Regional Policy Statement, and the annual planning cycle</p>
<ul style="list-style-type: none"> Recommendation 1c) Enabling investment in transmission and distribution to connect generation to load. 	<p>Lines companies, Transpower, Environment Waikato and local authorities</p>	<ul style="list-style-type: none"> Commercial/operational decision for Transpower and lines companies 	<p>In policy planning and development planning</p>	<p>ASAP</p>
<ul style="list-style-type: none"> Recommendation 1d) Acknowledge the importance of developing distributed generation. 	<p>Environment Waikato, lines companies, distribution companies, Electricity Commission, Transpower, gentailers and alternative energy companies</p>	<ul style="list-style-type: none"> Ensure the Regional Policy Statement assists with removal of barriers to the development and distribution of distributed generation. Promote greater public awareness of micro generation alternatives Seek buy-in from the territorial local authorities. 	<p>Regional Policy Statement</p>	<p>ASAP</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Transmission of electricity</p> <p>Recommendation 2: The Regional Energy Strategy advocates for policies and actions that recognise transmission of electricity as an important part of maintaining security of supply.</p> <p>That the Waikato is an important conduit for meeting the transmission of electricity around New Zealand to meet national demand.</p> <p>Grid and network investment and maintenance is an important component in the development of renewable sources of electricity generation (due to its role in facilitating connection to the National Grid).</p>	<p>Transpower, Electricity Commission, lines companies, Environment Waikato, territorial authorities, Waikato Regional Energy Forum</p>	<ul style="list-style-type: none"> Acknowledge the importance of the Waikato region's role in transmission and distribution both for local and national business and community energy needs. Recognise the importance of all transmission and distribution, in national, regional and local policy documents Improve information and education available to local authorities and policy makers to support understanding of the importance of transmission and distribution and to recognise its critical role for wellbeing and economic growth. Advocate for policy to support and enable planned maintenance and upgrading of existing transmission lines. Support the development of new lines to meet local and national needs. 	<ul style="list-style-type: none"> Through advocacy and information work to strengthen the relationships between Transpower, regional councils, district councils, lines companies and communities. District plans should have criteria that support the intended generation. Inclusion in Regional Policy Statement. 	<p>Linked to Regional Policy Statement review for long term planning</p> <p>Ensure connections with Electricity Commission planning</p>
<p>Geothermal</p> <p>Recommendation 3: Regional Energy Strategy acknowledges the value of the extensive geothermal resources within the region and its importance, in addition to the contribution of clean renewable energy to regional and national energy needs.</p> <p>Regional Energy Strategy advocates for policies and actions that promote research and appropriate development and use of existing and potential geothermal heat sources, for heating and generation of electricity.</p> <p>Recommendation 3: Continues</p>	<p>New Zealand Clean Energy Centre</p> <p>EECA, Ministry of Economic Development, Electricity Commission for funding demonstration projects</p> <p>Industry for development of small and large scale geothermal projects</p> <p>Industry working for re-categorisation of specific</p>	<ul style="list-style-type: none"> Develop working examples which showcase the appropriate use of geothermal resources. Seek government and industry funding for demonstration projects to highlight innovative technologies for the utilisation of geothermal energy (including heat as well as power, on both a small and large scale). Develop an 'umbrella brand' to highlight the importance of geothermal energy to New Zealand, and the fact that 80 per cent of the resource is based in the Waikato region. 	<ul style="list-style-type: none"> throughout the Waikato region, but specifically within the geothermal zone around Taupo with potential funders for demonstration projects advocacy and support for geothermal development at the consenting stage in Regional Policy Statement and plan development process 	<p>ASAP</p>

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Recommendation 3: Continued Cogeneration</p> <p>Regional Energy Strategy supports the development of cogeneration projects.</p>	<p>areas</p> <p>Waikato Regional Energy Forum in advocacy role to support geothermal developments</p> <p>Waikato Regional Council</p> <p>Territorial local authorities</p> <p>Links companies</p> <p>Ministry of Social Development</p>	<ul style="list-style-type: none"> Encourage progress in the re-categorisation of specific geothermal zones for appropriate application. Encourage flexibility in the use of unassigned geothermal fields. Encourage the inclusion of appropriate policies in relevant planning documents and consenting processes. Promote and encourage the removal of regulatory barriers and investigation, research and uptake of cogeneration. 		
<p>Hydro generation</p> <p>Recommendation 4: The Regional Energy Strategy recognises the importance and value of existing and potential hydro generation infrastructure, within the Waikato region and its essential contribution to regional and national energy needs and security of supply.</p> <p>The strategy advocates for policies and actions that promote maintenance and appropriate development and use of this valuable natural resource.</p> <p>When new proposals for water allocation are being considered in the consenting process, the Regional Energy Strategy recommends that hydro generation should be considered a desirable renewable low-emission source of electricity essential to regional and national energy needs and for security of supply</p>	<p>Environment Waikato</p> <p>EECA</p> <p>New Zealand Clean Energy Centre</p> <p>Waikato Regional Energy Forum</p> <p>Ministry of Economic Development and related agencies</p> <p>Local authorities</p> <p>Generators</p>	<ul style="list-style-type: none"> Give appropriate recognition to the importance of existing generation assets to the national electricity infrastructure. Ensure recommendation is considered in the second generation Regional Policy Statement, including concerns regarding existing and future generation capacity being restricted or prevented by water allocation policy and decisions. Obtain support for existing hydro generation at consent and planning hearings by national agencies such as the Ministry of Economic Development. 	<ul style="list-style-type: none"> The Waikato Regional Energy Forum helps promote the development of renewable electricity generation to assist in nationwide security of supply. In particular with the development of policy, Regional Policy Statement and planning instruments 	<p>As determined by planning and policy processes</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Coal</p> <p>Recommendation 5: The Regional Energy Strategy acknowledges the importance of existing and potential coal resource and infrastructure within the Waikato region.</p> <p>It acknowledges that the use of coal is essential to meet regional and national energy needs and security of supply.</p> <p>The strategy also promotes the identification, research and appropriate development and use of this valuable natural resource. In particular, clean coal technologies and low emission extraction and use techniques.</p>	<p>Environment Waikato and local Authorities</p> <p>EECA</p> <p>New Zealand Clean Energy Centre</p> <p>Waikato Regional Energy Forum</p> <p>Ministry of Economic Development and related agencies</p> <p>Solid Energy and generators</p>	<ul style="list-style-type: none"> Ensure the Regional Policy Statement recognises the significance of coal resources within the Waikato region, and provides appropriate direction to territorial local authorities. Encourage regional and district councils to give special consideration to clean coal technologies and low emission extraction techniques, especially in regard to trial pilot plants. Encourage district councils to acknowledge the location and role of the coal resource (and its potential for utilisation) in their district plan and zoning processes to avoid impeding or preventing future development of known coal resources. 	<ul style="list-style-type: none"> Regional Policy Statement and district plans should acknowledge the potential for the development of clean coal technologies and low emission extraction techniques with the region Regional Policy Statement and planning instruments should provide recognition for the significance of coal resources In recognising the importance of coal in maintaining security of supply and promoting the development of clean coal technologies. 	<p>As determined by planning and policy processes and also the evolution of technology</p>
<p>Natural gas</p> <p>Recommendation 6: The Regional Energy Strategy acknowledges the importance of the existing and potential of natural gas resources and infrastructure within the Waikato region and supports the importance of this contribution to Regional and National energy needs.</p> <p>The strategy acknowledges the importance of distribution (including pipelines) for gas, and the key role that natural gas plays in industrial processes, electricity generation and domestic use within the region and nationally.</p> <p>The strategy advocates for policies and actions that promote research and appropriate development, distribution and use of this valuable natural resource.</p>	<p>Environment Waikato and district councils</p> <p>Gas network companies</p> <p>Solid Energy</p> <p>Gas Association of New Zealand</p>	<ul style="list-style-type: none"> Ensure that the development of the second generation Regional Policy Statement considers this recommendation 	<ul style="list-style-type: none"> The Waikato Regional Energy Forum help to promote the development of natural gas infrastructure to assist in nationwide security of supply 	<p>Within the appropriate planning timeframes</p>

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Wind energy</p> <p>Recommendation 7: The Regional Energy Strategy acknowledges the importance of existing and potential wind generation locations and infrastructure within the Waikato region and advocates for policies and actions that enable wind energy to contribute to regional and national energy needs and for security of supply.</p> <p>The strategy advocates for policies and actions that identify and develop wind generation at suitable locations, including transmission and/or distribution.</p>	<p>Environment Waikato, district councils</p> <p>Electricity generators, lines companies and Transpower</p> <p>NPS on electricity transmission/renewable generation</p> <p>Wind Energy Association</p> <p>EECA</p> <p>Waikato Regional Energy Forum</p>	<ul style="list-style-type: none"> Ensure that the Regional Policy Statement includes criteria where wind energy generation location should not occur. Ensure that the RPS makes provisions for wind energy generation in remaining areas. Ensure the Regional Policy Statement has provisions for transmission and connection to the national grid that offer greater certainty for investor decision making. Design criteria to assist policymakers and industry to achieve an appropriate balance between competing values Promote the importance of wind generation to meet New Zealand's renewable electricity generation needs. 	<ul style="list-style-type: none"> Regional and district policy and plans including the Regional Policy Statement The Waikato Regional Energy Forum promote the value of wind energy to assist in nationwide security of supply and obligation for renewable clean generation. 	<p>During the revision of the Regional Policy Statement</p>
<p>Marine energy</p> <p>Recommendation 8: That the Regional Energy Strategy advocates for an investigation into marine energy generation in the region.</p> <p>That the Regional Energy Strategy encourages the coordination of Waikato agencies to promote the establishment of a trial project to identify the effects and value of new marine technologies suitable to the region.</p>	<p>Generators and lines companies</p> <p>Waikato Regional Energy Forum</p> <p>Environment Waikato</p> <p>Research agencies (including Wintec and Waikato University)</p> <p>Generators and lines companies</p> <p>AWATEA (Aotearoa Wave and Tidal Energy Association)</p> <p>EECA</p>	<ul style="list-style-type: none"> Identify areas of the Waikato region and technologies that could be suitable for wave energy and other marine generation. Establish a project group for research and for trial projects 	<ul style="list-style-type: none"> The identification process should be included in provisions of the Regional Policy Statement Trial needs to overcome perceptions about the maturity of the technology. Costs of transmission from offshore sites need to be assessed 	<p>ASAP</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Biomass and biofuels</p> <p>Recommendation 9: The Regional Energy Strategy supports the work of agencies and developers such as Scion, EECA and New Zealand Clean Energy Centre involved in research and development and proposes working collaboratively with these agencies, developers plus policymakers to open opportunities for the continued research, trial and development of biomass and biofuels including appropriate amendments to local government policy and/or procedures.</p>	<p>Territorial authorities Environment Waikato New Zealand Clean Energy Centre Industry Distributors MAF BANZ</p>	<ul style="list-style-type: none"> Develop enabling policies to support biomass and biofuel initiatives. Find synergies with regional waste strategies to ensure best use of waste in regards to energy and useful by-products. Develop greater information about biomass potentials through demonstrations and education. Collaborations between industry groups. 	<ul style="list-style-type: none"> Providing information about biomass opportunities to wider audience Encouraging collaboration between agencies to support biomass and biofuels initiatives 	<p>In the LTCCP and Regional Policy Statement processes</p>
<p>Recommendation 10: The Regional Energy Strategy advocates the identification and removal of any unintended barriers to the production and uptake of biofuels within the region, provided externalities are successfully managed and production is undertaken in a sustainable way.</p>	<p>EECA Territorial authorities Environment Waikato New Zealand Clean Energy Centre BANZ</p>	<ul style="list-style-type: none"> Undertake analysis of the barriers to the uptake of biofuels in the region. Investigate mechanisms for stimulating the market such as parking incentives for cars or vehicles using biofuels. Encourage councils and public agencies to commit to the use of biofuels, where appropriate, in order to lead by example. Investigate the enabling of biofuels production through land-use planning processes. 	<ul style="list-style-type: none"> Need to overcome lack of public awareness about second generation biofuel options. 	<p>Within the timeframe of the Regional Policy Statement review</p>
<p>Recommendation 11: The Regional Energy Strategy supports the establishment of pilot projects to investigate the processing of animal by-products for bioenergy.</p>	<p>Research agencies, industry, farming sector, district and regional councils</p>	<ul style="list-style-type: none"> Establish pilot projects. Work with NIWA and other agencies specialising in biogas and animal waste products for bioenergy. 	<ul style="list-style-type: none"> Development of funding opportunities 	<p>ASAP</p>

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Biomass and biofuels</p> <p>Recommendation 12: The Regional Energy Strategy advocates the capture of landfill and waste gas and its use for electricity cogeneration, wherever appropriate, throughout the region.</p>	<p>Territorial authorities Environment Waikato Ministry for the Environment Electricity Commission Research agencies</p>	<ul style="list-style-type: none"> Promote demonstration projects, such as Hamilton's landfill gas site Advocate for government agencies and councils to provide leadership in the promotion of cogeneration options 	<ul style="list-style-type: none"> Need greater public and policy-making awareness of cogeneration potentials from waste. Legal issues may need resolution, as landfill sites are often contracted out, and may require a change of contract in order to incentivise greater energy efficiency 	<p>ASAP</p>
<p>Small scale electricity generation</p> <p>Recommendation 13: The Regional Energy Strategy advocates that local authorities consider providing clear rules for small scale and micro generation projects which reflect the size and scale of proposed electricity generation facilities.</p> <p>The Regional Energy Strategy encourages the consideration of 'feed in tariffs' for stimulating uptake of renewable generation.</p>	<p>Local authorities Ministry for the Environment Electricity Commission EECA</p>	<ul style="list-style-type: none"> Work with local authorities and government agencies such as EECA and Electricity Commission and generators to standardise district plan and regional plan rules for small scale generation. Government to consider 'feed in tariffs' and/or other incentives to encourage small scale and micro generation. 	<ul style="list-style-type: none"> Need to agree upon acceptable definitions of small scale and micro generation. In the first instance, adopt EECA definition of micro generation as domestic scale electricity generation up to 10Kw Need for flexibility between rural and urban areas e.g. tower height for micro turbines and noise levels. 	<p>ASAP</p>
<p>Recommendation 14: The Regional Energy Strategy recommends that investigation and trials of small scale electricity generation are undertaken in the Waikato.</p>	<p>Waikato Regional Energy Forum Wintec and Waikato University) Alternative energy companies EECA's NZEECS programme of action</p>	<ul style="list-style-type: none"> Coordination of trial project on small scale generation Promote feed in tariffs (FIT) to central government. Encourage consideration of FIT to stimulate the uptake of distributed generation 	<ul style="list-style-type: none"> finding of appropriate sites for trials of small scale generation technologies understanding the local authority rules for the specific location, and promoting standardisation where appropriate 	<p>ASAP</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Recommendation 15: The Regional Energy Strategy advocates that the regional council and territorial authorities consider modifications (where appropriate) to district and regional plan rules to ensure plans assist and facilitate micro generation and that consideration is given to allowing domestic-scale renewable energy production as a permitted activity.</p>	<p>District and city councils Environment Waikato EECA as advisory body</p>	<ul style="list-style-type: none"> Local authorities to develop model plan provisions. Advocate for micro generation, where appropriate. Reduce or remove where possible consenting fees for solar hot water systems. 	<ul style="list-style-type: none"> development of model plan provisions 	<p>Linked to LTCCP process to ensure funding</p>
<p>Recommendation 16: The Regional Energy Strategy advocates the promotion of energy education as part of all learning, promotes the development of centres of learning that include energy training, demonstrations and practical assistance, and supports the training of greater numbers of trades people capable of working on energy systems.</p>	<p>Ministry of Education/Tertiary Education Commission ETITO and ESITO School Board of Trustees Wintec/Waikato University Clean Energy Centre Industry</p>	<ul style="list-style-type: none"> Work with community groups and local authorities to make the regions community more 'energy aware'. Develop enhanced networks between education providers and industry. Strengthen links with ITOs involved in the energy sector. Work with Enviroschools to teach energy efficiency. 	<ul style="list-style-type: none"> development of framework and proposals for enhanced 'energy education' at tertiary level explore STAR and ITO funding options for teaching energy education develop 'School of Energy' concept development of training projects 	<p>ASAP</p>
<p style="text-align: center;">ENERGY DEMAND-SIDE EFFICIENCY RECOMMENDATIONS</p>				
<p>Energy efficiency and conservation</p>				
<p>Recommendation 17: That the Regional Energy Strategy strongly advocates energy efficiency and conservation.</p>	<p>Waikato Regional Energy Forum EECA Local authorities EMANZ</p>	<ul style="list-style-type: none"> Take a strong leadership role in promoting energy efficiency and conservation projects. Promote energy conservation by changing people's habits and purchasing routines. Product identification to promote energy efficient products. Identification of the best initiatives and promotion of these to the wider community. Promote energy efficiency and 	<p>Waikato Regional Energy Forum can help promote education programmes and workshops with other agencies.</p>	<p>ASAP</p>

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Business and industry energy efficiency</p> <p>Recommendation 18: That the Regional Energy Strategy advocates to Waikato business the importance of energy efficiency and conservation to reduce regional energy demand and to improve productivity and competitiveness by reducing business energy costs.</p>	<p>EECA Industry New Zealand Clean Energy Centre Waikato Regional Energy Forum Wintec/Waikato University</p>	<ul style="list-style-type: none"> Promote the provision of skilled staff in commerce and industry for energy efficiency programmes. Support local authorities in being more flexible in the planning processes for energy enhancement by industry, such as allowing small scale trials of energy efficiency within existing resource consents. Showcase best practice industrial sites highlighting advantages, such as heat recovery. Encourage the development of enhanced marketing for industrial energy efficiency and promotion of best practice 'green standards' and a 'green tick' in industry." Develop innovative energy saving projects, with local and government funding for specific local industries and tourism facilities. Establish a trial project for energy efficiency within existing resource consents, to show the suitability of 'limited variation' concept. Support the New Zealand Clean Energy Centre's proposals for 'combined heat and power' network clustering of industry to enhance energy efficiency. 	<ul style="list-style-type: none"> Establishing a pilot energy saving project with EECA Promotion of the 'green tick' concept for industrial energy efficiency <p>Note: A green tick to provide a better value proposition for the business owner than just energy savings. Offers branding opportunities for the business, which could incentivise an energy efficiency project to gain the green tick for sustainability reporting at corporate level, rather than just the energy savings involved – which tend to be long term</p>	<p>ASAP</p>
<p>Energy and communities</p> <p>Recommendation 19: That local, authorities within the Waikato, work together on a region-wide implementation of energy efficiency, conservation and increased use of renewables.</p>	<p>Local authorities Environment Waikato Waikato Regional Energy Forum EECA</p>	<ul style="list-style-type: none"> Local authorities to work together to align local action plans across the region 	<ul style="list-style-type: none"> Promotion of education programmes and workshops 	<p>ASAP</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Household energy efficiency for healthy homes</p> <p>Recommendation 20: The Regional Energy Strategy supports forum partners in their efforts to secure greater sources of funding for the Waikato region for household energy efficiency retrofit projects and to promote design and construction regulations and practices to ensure the regions homes are healthy and energy efficient.</p>	<p>Household energy efficiency groups EECA Local authorities Waikato Regional Energy Forum partners</p>	<ul style="list-style-type: none"> Educate potential funders about the benefits of household energy efficiency. Establish a conference to link opportunities with funding to develop case studies. Waikato Regional Energy Forum partners to consider supporting the Waikato rollout of the energy advice line (which is being proposed by the Energy Efficiency Community Network on a national basis). Support councils in establishing eco-design advisor positions. Promote skills development, innovation and implementation of retrofitting of homes to improve health and wellbeing of occupants. Secure greater sources of funding (such as government, corporate and independent not for profit) into the Waikato region for household energy efficiency projects. 	<ul style="list-style-type: none"> Facilitate networking to promote the importance of household energy efficiency to health and local government sectors, with personal case studies from individuals who have benefited from insulation. Development of a business plan to attract government funding for energy efficiency within the Waikato region. 	ASAP
<p>Smart metering group</p> <p>Recommendation 21: That the Regional Energy Strategy supports systems to help users monitor electricity usage to enable consumers to use energy more efficiently, and to reduce their peak time demand usage.</p>	<p>Gentailers and distributors EECA Waikato Regional Energy Forum Energy efficiency groups</p>	<ul style="list-style-type: none"> promotion and deployment of user electricity usage monitoring such as with smart metering greater community education about the value of demand-side reduction 	<ul style="list-style-type: none"> encouraging gentailers to speed up the rollout process liaison with EECA to learn from overseas examples develop mechanism for community participation and information regarding the benefits of smart metering 	ASAP

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Green urban planning group</p> <p>Recommendation 22: The Regional Energy Strategy advocates for local authorities to put in place international best practice for energy efficient planning and development.</p>	<p>Local authorities</p> <p>Waikato Regional Energy Forum</p> <p>Planners, builders and contractors</p> <p>EECA</p>	<ul style="list-style-type: none"> • Promote the HERS and Green Star energy rating schemes. • Show leadership through the development of workshops. • Establish demonstration projects to promote environmentally conscious urban planning. • Seek funding opportunities to provide workshops and demonstration projects. • Encourage Environment Waikato to adopt guidelines for best practice in its regional policy. 	<ul style="list-style-type: none"> • Work with local authorities and other agencies to set up demonstration projects and workshops on energy efficient planning, design and construction. 	<p>ASAP</p>
<p>DAIRYING RECOMMENDATIONS</p> <p>Energy innovation projects</p>				
<p>Recommendation 23: That the Regional Energy Strategy acknowledges the ongoing energy innovation projects in the agricultural sector, and supports the trialling of new energy-saving projects within the Waikato.</p>	<p>Waikato Regional Energy Forum</p> <p>EECA</p> <p>Dairy sector</p> <p>Fonterra</p> <p>NIWA</p> <p>AgResearch</p> <p>Dairy NZ</p> <p>CRIs</p>	<ul style="list-style-type: none"> • Engage with the dairy industry to find the appropriate trials for energy efficiency and micro generation projects 	<ul style="list-style-type: none"> • Consider developing contract provisions which enable the farm owner to share in the benefits of energy efficiency – and therefore become incentivised to promote cost-effective electricity solutions • Establish a Farm Energy Rating Scheme (similar to the Home Energy Rating Scheme) which would provide an incentive to attract top sharemilkers to a farm. • Promote the importance of energy security of supply to the farm owner to encourage greater interest in energy issues. 	<p>As soon as pilot project has been developed</p>

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Recommendation 24: The Regional Energy Strategy advocates that Waikato Regional Energy Forum partners work with EECA and other agencies to provide education and resources on improving energy efficiency on individual farms.</p>	<p>Waikato Regional Energy Forum EECA Dairy sector lines companies Alternative energy suppliers Farm advisers</p>	<ul style="list-style-type: none"> Work with EECA and dairy sector to develop communication strategies. Promote embodied energy efficiency e.g. fertilizer and transport fuels. Develop a pilot project for farms going off grid, or with alternative energy backup. Work with the lines companies interested in promoting distributed generation under the new Section 62 requirements. Provide greater education on energy efficiency and energy security of supply options to farm advisers. 	<ul style="list-style-type: none"> Develop a targeted campaign aimed at promoting energy efficiency within the dairy sector at the individual farm level. Ensure information is easily digestible, attractively presented and preferably visual and practical. (Note: <i>Given the busy nature of a sharemilker's working day, it can be difficult to get them to read information sent through the post on energy efficiency</i>). Provide greater information to farm advisers, and possibly train them on how to undertake energy audits and/or advise on potentials for biogas, or micro generation. 	<p>As soon as pilot project has been developed</p>
<p>TRANSPORT RECOMMENDATIONS</p>				
<p>Encouraging and advocating alternative forms of fuel</p>				
<p>Recommendation 25: That the Regional Energy Strategy advocates renewable energy forms of fuel, including:</p> <ul style="list-style-type: none"> advocating the uptake of renewable energy sources for public transport investigate and encourage pilot programme of bioenergy including second generation biofuels promote use of forestry residues. 	<p>Environment Waikato and Hamilton City Council Regional Transport Committee New Zealand Railways Corporation Major freight users like Fonterra Waikato Regional Energy Forum</p>	<ul style="list-style-type: none"> Liaise with Regional Transport Committee about the importance of low emission fuels (renewable energy). Make links with other planning documents and passenger transport plans such as via the Regional Policy Statement review. Talk with Ministry of Transport regarding uptake of renewable energy sources for transport including 'blending' options with the view of participating to a pilot project or programme. 	<ul style="list-style-type: none"> Liaise with agencies and industry to establish pilot project for alternative fuels Urge consideration that any 'green fuel' should be exempt from any future regional fuel tax. That financial incentives be considered to promote use, such as lower tax. 	<p>ASAP</p>

Waikato Regional Energy Strategy

Recommendations	Who is involved	What action is required	Where should actions be focused	Timeframe
<p>Electrification of rail</p> <p>Recommendation 26: The Regional Energy Strategy advocates that the forum support greater use of rail and the NZEECS proposal to investigate electrification of the rail link between Hamilton and Auckland, and other possible routes</p>	<p>New Zealand Railways Corporation</p> <p>Ministry of Transport</p> <p>Freight users</p> <p>Waikato Regional Energy Forum</p>	<ul style="list-style-type: none"> Liaise with Ministry of Transport, EECA and regional transport committee officials about the investigation process Encourage the development of rail facilities, such as the inland port concept in the Waikato region. Promote study on electric vehicle technology and energy generation needs and provision of charge points for electric vehicles. 	<ul style="list-style-type: none"> Make sure that investment in rolling stock and locomotives is consistent with future environments Make provision for both passenger and freight 	<p>Begin working with MOT and other agencies ASAP</p>
<p>Transport energy efficiency</p> <p>Recommendation 27: Promote reduced transport energy consumption and encourage energy and transport efficiency such as for moving of freight and encouraging mode choices including public transport, walking and cycling.</p>	<p>Environment Waikato and local councils</p> <p>Town planners</p> <p>Architects</p> <p>Developers</p> <p>Ministry of Transport</p> <p>Waikato University and Wintec</p> <p>Waikato Regional Energy Forum as advocate</p>	<ul style="list-style-type: none"> Promote sustainable energy efficient design and development. Promote the development of electric vehicles such as the Waikato University work on electric car technology. 	<ul style="list-style-type: none"> promotion of education events and workshops that encourage energy efficient travel promotion of sustainable urban design and growth strategies that encourage 'green' travel options and reduce the need for travel 	<p>Within the next 12 months</p>

Appendices

1. Transpower's list of New Zealand's operating capacities for electricity generation
2. Large version of Sankey diagram showing energy flows within the Waikato

Appendix 1

Transpower's list of grid connected generation

Existing Grid-Connected Generation

(From Transpower's 2008 Annual Planning Report – Page 60)

Generation Plant	Region	Fuel	Installed Capacity MW	Operating Capacity MW	Grid Injection Point
Glenbrook	Auckland	Cogen	74	74	Glenbrook
Otahuhu B	Auckland	Gas	404	380	Otahuhu
Southdown	Auckland	Cogen	170	170	Southdown
Kinleith	Bay of Plenty	Cogen	40	40	Kinleith
Matahina	Bay of Plenty	Hydro	72	72	Matahina
Wheo	Bay of Plenty	Hydro	24	24	Rotorua
Aratiatia	Central North Island	Hydro	84	78	Aratiatia
Mangahao	Central North Island	Hydro	42	28	Mangahao
Ohaaki ¹	Central North Island	Geothermal	116	40	Ohaaki
Poihipi ¹	Central North Island	Geothermal	55	37	Poihipi
Rangipo	Central North Island	Hydro	120	120	Rangipo
Tararua III ²	Central North Island	Wind	93	93	Woodville
Te Apiti	Central North Island	Wind	90	90	Woodville
Tokaanu	Central North Island	Hydro	240	240	Tokaanu
Wairakei	Central North Island	Geothermal	167	161	Wairakei
Kaitawa	Hawkes Bay	Hydro	36	36	Tuai
Piripaua	Hawkes Bay	Hydro	42	42	Tuai
Tuai	Hawkes Bay	Hydro	60	60	Tuai
Whirinaki	Hawkes Bay	Diesel	155	155	Whirinaki
Kapuni	Taranaki	Cogen	25	25	Kapuni
Kiwi Dairy	Taranaki	Cogen	70	70	Hawera
New Oil ¹⁷⁹	Plymouth Taranaki	Oil	300	0	New Plymouth
Patea	Taranaki	Hydro	31	31	Hawera
Taranaki	Taranaki	CCGT	377	367	Stratford

¹⁷⁹ Contact has advised that the New Plymouth power station has been mothballed

Generation Plant	Region	Fuel	Installed Capacity MW	Operating Capacity MW	Grid Injection Point
Combined Cycle					
Arapuni	Waikato	Hydro	197	197	Arapuni
Atiamuri	Waikato	Hydro	84	84	Atiamuri
Huntly	Waikato	Coal	1000	1000	Hi
	Waikato	Gas	385	385	Hi
Huntly F4U	Waikato	Gas	50	50	Huntly
Karapiro	Waikato	Hydro	90	90	Karapiro
Maraetai	Waikato	Hydro	360	360	Maraetai
Mokai	Waikato	Geothermal	112	112	Whakamaru
Ohakuri	Waikato	Hydro	112	112	Ohakuri
Waipapa	Waikato	Hydro	51	51	Maraetai
Whakamaru	Waikato	Hydro	100	100	Whakamaru
Argyle	Nelson/Marlborough	Hydro	4	4	Argyle
Cobb	Nelson/Marlborough	Hydro	32	32	Cobb
Coleridge	Canterbury	Hydro	45	45	Coleridge
Aviemore	South Canterbury	Hydro	220	220	Aviemore
Benmore	South Canterbury	Hydro	540	540	Benmore
Ohau A	South Canterbury	Hydro	264	264	Ohau A
Ohau B	South Canterbury	Hydro	212	212	Ohau B
Ohau C	South Canterbury	Hydro	212	212	Ohau C
Tekapo A	South Canterbury	Hydro	25	25	Tekapo A
Tekapo B	South Canterbury	Hydro	160	160	Tekapo B
Waitaki	South Canterbury	Hydro	105	105	Waitaki
Clyde	Otago/Southland	Hydro	432	432	Clyde
Manapouri ³	Otago/Southland	Hydro	850	710	Manapouri
Roxburgh	Otago/Southland	Hydro	320	320	Roxburgh
Waipori	Otago/Southland	Hydro	84	84	Halfway Bush
White Hill	Otago/Southland	Wind	58	58	North Makarewa

Note: The Transpower figures used in the calculation of Waikato's percentage of generation capacity are based on 'operating capacities' (rather than the 'installed' capacity figures). Transpower uses the operating capacity as this is seen as the capacity which the generators can realistically generate up to. These Transpower figures are used to calculate the percentages of generation available in each region – on the assumption that the operating capacity provides a consistent measure across the nation.

Appendix 2

Waikato regional energy balance

