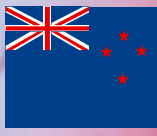
INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries



NEW ZEALAND

2006 Review

OECD

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-six of the OECD's thirty member countries. The basic aims of the IEA are:

- to maintain and improve systems for coping with oil supply disruptions;
- to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- to operate a permanent information system on the international oil market;
- to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- to assist in the integration of environmental and energy policies.

The IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission takes part in the work of the IEA.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of thirty democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission takes part in the work of the OECD.

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REVIEW TEAM

The IEA 2006 in-depth review of the energy policies of New Zealand was undertaken by a team of energy policy specialists drawn from IEA member countries. The IEA review team visited Wellington from 10 to 14 October 2005 for discussions with energy administration officials, energy industry groups and non-governmental organisations. The team greatly appreciates the candour and co-operation shown by everyone it met.

The members of the team were:

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Jolanka Fisher managed the review and wrote the report. Monica Petit prepared the figures and Bertrand Sadin prepared the maps. Marilyn Ferris and Viviane Consoli provided editorial assistance.

ORGANISATIONS VISITED

The team held discussions with various energy and environment stakeholders.

Government entities:

- Energy Efficiency and Conservation Authority

- Foundation for Research, Science and Technology
- Ministry of Economic Development, Resources and Networks Branch
- Ministry of Economic Development, Business Services Branch, Crown Minerals
- Ministry for the Environment
- Ministry of Transport
- Ministry of Research, Science and Technology
- Treasury

Regulators:
- Commerce Commission
- Electricity Commission
- Gas Industry Company

Oil, gas and coal industry:
- BP
- Caltex
- Gull
- Mobil
- New Zealand Refining Company
- Shell
- Solid Energy
- Todd Energy

Electricity generator/retailers:
- Contact Energy
- Genesis Power
- Meridian Energy
- Mighty River Power
- TrustPower

Electricity and gas network industry:
- M-Co, the Marketplace Company (provides electricity market services)
- NGC (now part of Vector; owns and manages gas and electricity distribution infrastructure and gas transmission infrastructure)
- Transpower (electricity system operator; owns the electricity transmission infrastructure)
- Vector (owns and manages gas and electricity distribution infrastructure and gas transmission infrastructure)

Public and industry interest groups:

- Coal Association of New Zealand
- Consumers' Institute
- Electricity Networks Association
- Gas Association of New Zealand
- Greenhouse Policy Coalition
- Major Electricity Users' Group
- Petroleum Exploration and Production Association of New Zealand
- Sustainable Energy Forum

REVIEW CRITERIA

The IEA *Shared Goals*, which were adopted by IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The *Shared Goals* are set out in Annex B.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Over the last two decades, New Zealand's energy policy has been marked by a commitment to light-handed regulation, to ongoing government monitoring and review and to liberalisation. Relative to many IEA member countries, New Zealand has a small population, low population density and is isolated from the rest of the world. Given this, its success with energy market liberalisation is remarkable. In fact, New Zealand was a pioneer in electricity market liberalisation, whereas many countries are just starting down the path of liberalisation. Furthermore, the country's strong commitment to undistorted and transparent liberalised markets is evidenced by a general lack of direct energy subsidies to specific customers or producers. Its commitment to ongoing review of its energy markets to ensure efficient and competitive outcomes is shown by the government's recent creation of two new regulatory bodies, the Electricity Commission (EC) and the Gas Industry Company (GIC). In short, New Zealand should be proud of its high-quality energy policies.

Nevertheless, the government's commitment to ongoing policy improvement and its new and very difficult energy challenges require continued policy evolution and government action. To that end, the government of New Zealand should strengthen its policy documents to reduce regulatory uncertainty, particularly in the face of recent energy policy and institutional changes. The energy strategy announced at the end of 2005 is a promising development and should be completed as quickly as possible.

The establishment of the EC and the GIC provides much needed regulatory oversight to industries that had previously been left to self-regulation. Furthermore, the new regulatory threshold regime for network energy businesses may improve transparency and efficiency in these industries by reducing the regulatory burden and increasing business flexibility. There are likely to be long-term benefits to customers from these new institutions and regimes, but in the medium term the changes create uncertainty, which could inhibit appropriate investment. While the establishment of the Electricity Commission puts in place an institution better equipped to make necessary regulatory reforms, its lack of complete independence from the government, including the government's discretion on the removal of commissioners, is a cause for concern. The government should modify the governance structure of the Electricity Commission so that it operates independently. With respect to the GIC, a very new co-regulatory body owned by gas industry participants, some concerns have been raised as to whether it is a viable long-term institution. The government and the GIC should work to establish a stable regulatory regime as quickly as possible to minimise the negative effects of the current transition period. While New Zealand's threshold regulatory mechanism for network businesses is an

innovative regulatory approach, the mechanism may increase regulatory uncertainty as it is applied on an *ex post* basis. In certain situations it might be prudent to allow companies to apply for *ex ante* approval of particular projects to ensure that sufficient infrastructure is built and supply security is not threatened.

Appropriate investment is underpinned not only by regulatory stability, but also by accurate and easily available market information. For this reason, the government's continuous modelling of medium- and long-term scenarios and the free dissemination of the scenario findings greatly benefit the market. The government should continue this work, and ensure that worst-case scenarios (*e.g.* no new significant gas fields are discovered) remain included in the analysis.

As in many countries, responsibilities for New Zealand's energy and environmental policy and regulation are spread across different parts of the government. While it is impossible to put all responsibilities in a single institution, New Zealand's structure could be streamlined.

New Zealand's energy market also suffers from increased regulatory risk due to two factors related to the appeals process – limited appeals remedies and the lack of strict time limits. Both of these factors increase uncertainty for companies operating in the energy industry, and could therefore inhibit investment. The government should consider expanding the scope of regulatory appeals and instituting strict time limits.

Meeting New Zealand's Kyoto greenhouse gas (GHG) emissions target is very difficult because energy-sector emissions are relatively small and half of the GHG emissions come from the agricultural sector, where there are no practicable emissions-reducing technologies in the short term. Current government estimates project that emissions could be 21%, or 64 $MtCO_2$-eq, above the Kyoto target during the first commitment period (2008-2012). The government has not yet outlined how it will cover the remaining shortfall, but it is likely to include international mechanisms such as joint implementation, the clean development mechanism and international emissions trading. Given that these mechanisms often need significant lead time and that prices are likely to rise closer to the first commitment period, the government should outline and undertake its international efforts as quickly as possible. It is positive that the government has quantified its financial liability to account for emissions credits it will probably have to purchase, but it should ensure that this liability is sufficient to cover the shortfall and should detail as quickly as possible how it will spend the money. The government should also detail what part of its shortfall will be met through domestic action and implement the appropriate policies as quickly as possible.

It is disappointing that the government has decided not to proceed with its planned carbon tax for some sectors of the economy, as incorporating a carbon price signal into the market is a cost-effective means of reducing GHG

emissions. Following on this decision, the government is considering other options, including in the short term a more narrow carbon tax and in the longer term other measures. The government should also consider policy options beyond a revised carbon tax, including an emissions trading scheme linked to international markets. Regardless of the mechanisms implemented, and given that the government has abruptly changed its policy direction, it should finalise all climate change policies and measures as quickly as possible. Given the large number of small and medium-sized enterprises, the government should explore the possibility of expanding the coverage of voluntary agreements to them.

Owing to historically low energy prices, energy efficiency in New Zealand has generally not been strong. As energy prices, security of supply concerns and environmental problems have grown, so has the government's focus on energy efficiency. In 2001, New Zealand set an ambitious target to improve energy efficiency by 20% by 2012; government estimates show that only a 1.1% improvement has occurred between 2001 and 2003. While energy efficiency policies do not generally have immediate effects, the results do highlight the need for continued and vigilant monitoring of efficiency measures. Meeting the long-term efficiency targets will require accurate data collection and sector-level monitoring, not just economy-wide monitoring. It is positive that the government is considering specific sectoral efficiency targets. Such targets should be measurable, cost-effective and practicable.

Energy consumption in the transport sector makes up the largest share of total consumption and is growing faster than in any other sector. Efficiency in the transport sector is relatively low, in part because New Zealand has a large share of used vehicles and because petrol and diesel taxes are relatively low. Stronger policies that give incentives for substantially improved energy efficiency in the transport sector are necessary. The government should consider fiscal and tax incentives, as well as fuel economy standards for new cars. The country is considering developing a fuel economy labelling scheme for all vehicles at the point of sale, which is a positive step. Labelling should be made mandatory and implemented as quickly as possible. As a large share of the population lives in urban centres, reduced reliance on single-passenger vehicles and greater reliance on public transit and alternative modes of transport would have a large effect on transport-sector energy efficiency. The government should strengthen incentives to reduce single-passenger vehicle transport through policies such as tolls on highways and for entering congested city areas, car-pool lanes, corporate discounts or tax incentives for employees to use public transport or alternative transport modes and taxes and fees on central district parking. The government is investigating some of these options, but it should expand the scope of possible options and implement a set of policies as soon as possible.

The residential sector also provides good opportunities to improve energy efficiency. In light of the poor thermal insulation found in many older New Zealand homes, the government has developed a comprehensive strategy to improve thermal insulation in these buildings, which is a very positive step. The government is currently reviewing its building code for new and upgraded buildings and considering implementing enhanced energy efficiency requirements. A strengthened building code should be established and put into force as quickly as possible. As New Zealand moves to a regime that includes more energy efficiency elements in its building code, the government should ensure that building code compliance mechanisms and enforcement training evolve with it. The joint New Zealand-Australia programme on minimum energy performance standards for appliances should continue to expand, adding cost-effective standards for more product classes as quickly as possible. New Zealand's efforts to introduce appliance labelling, including endorsement labelling, should continue to be expanded and made mandatory for more product classes. The government should also more aggressively market its energy efficiency public awareness information.

There is much to praise in New Zealand's approach to renewables policy, particularly in the electricity sector. Unlike many IEA countries, the government has not taken mandatory measures thanks to favourable and competitive renewable energy sources, particularly for wind. This light-handed approach to renewables promotion is consistent with New Zealand's overall approach to energy policy and is very commendable. Despite the growth of renewables to date, New Zealand is aware that growth of fossil fuels consumption is outpacing growth in renewable energy supply and the government is working to remove barriers to the growth of renewable energy supply, including through recent revisions to the Resource Management Act. New Zealand should continue these efforts, taking care to ensure that regional residents remain active and informed stakeholders in the process. Integration of large amounts of wind into the electricity grid poses some unique challenges for New Zealand. Nevertheless, such risks do not preclude wind from growing into a larger and more significant source of New Zealand's electricity supply, but they do require that the system operator and all stakeholders work together to develop and implement the best medium- and long-term systems and market rules to mitigate any negative effects as quickly as possible. Such measures should use incentives rather than requirements whenever possible and ensure that the full costs of all energy resources – wind and other – are made transparent and allocated accordingly.

While New Zealand appears to be on track to meet its overall renewables target of increasing by 30 petajoules (or 0.7 Mtoe) annually the amount of energy produced from renewables by 2012, it is unlikely to meet its indicative biofuels target of 2 PJ (0.05 Mtoe) by 2012 if further efforts are not made. The government has announced that it is developing and intends to introduce a mandatory biofuels sales obligation on suppliers. Care should be taken to

ensure that this target is set at a level that is cost-effective compared with other options of reducing oil dependence. It is positive that the government is considering a mandatory sales obligation for suppliers, as this can be a flexible manner of increasing biofuels uptake.

The depletion of the Maui gas field by the end of the decade is a major challenge facing New Zealand. The government has proactively enhanced incentives for exploration and increased exploration levels indicate that this strategy is working. Nevertheless, the government should monitor the effectiveness of the incentives and evaluate the need for further measures. Whether or not New Zealand should import natural gas is a hot topic in the country. The government is leaving the possibility of importing natural gas open and the decision on the construction of a liquefied natural gas import terminal to the private sector, reflecting the government's reluctance to interfere in the market. The government should also continue to ensure that there are no undue regulatory barriers for market participants to construct natural gas import infrastructure. The government might also consider regulatory incentives for such infrastructure, taking care that any incentives are not at the undue expense of competition from other supply options

The government's successful implementation of an open access regime on the Maui pipeline will help encourage hydrocarbon exploration by providing greater access to the downstream market. The open access regime on its two gas transportation pipelines may also encourage the development of gas import infrastructure, as it will give confidence to resource owners that they can get access to the downstream market.

New Zealand has not been in compliance with its IEA oil stockholding requirement for several years. Its stocks fell to 61 days of net imports as of 1 January 2006, well below the 90-day obligation. This is the lowest reported level of stocks by an IEA member country in over a decade. Over the last year and a half, the government has been working on a plan for coming into compliance through tendering additional stocks, possibly to be held abroad in other IEA member countries. The plan is already behind its original timetable to bring New Zealand into compliance by mid-2006. To remedy this unacceptable situation, the New Zealand government should speed up implementation of its tendering plan or, as alternatives to tendering or options for the future, require that industry hold mandatory stocks or create a special industry stockholding agency for this purpose.

It is critical to note that in improving its electricity market, New Zealand faces a number of country-specific challenges that stem from its unique characteristics, including its lack of interconnections with other countries, its reliance on large amounts of hydro, its radial network geography and its small size. In particular, given the small size of the country it is not surprising that there are only five generators. Nonetheless, the small number of market

participants – exacerbated by the vertical integration between generators and retailers – is a cause for concern and market power abuse is a real threat. The Commerce Commission's inquiry of wholesale and retail electricity markets is, therefore, a positive step that will keep pressure on market participants to behave competitively.

The lack of liquid and transparent financial markets to hedge electricity price risk and locational basis risk is a significant barrier to entry that exacerbates market power concerns. A market that allowed companies to hedge locational basis risk, in particular, would help improve transparency, reduce commercial incentives for retail-generation vertical integration, reduce barriers to entry and increase competition. It would also build on New Zealand's already impressive level of transparency in the physical market.

The country's growing electricity demand means that new capacity must be built to ensure sufficient supply, particularly in drought years. For this reason it is positive that New Zealand does not cap its electricity prices, as this does not suppress the high peak price signals that encourage new generation investment. In addition, the country's locational marginal pricing system creates appropriate incentives for investors to build new capacity when and where it is needed. Unfortunately, the government's 155 MW reserve power plant, Whirinaki, operates in a way that acts as a soft electricity price cap, which can suppress prices and incentives for generation investments. It is understandable that the government has commissioned its own power plant given the country's unique risks stemming from the heavy reliance on hydro and a lack of interconnections. Nevertheless, the Electricity Commission and the government should revise the operation policy for Whirinaki such that it includes only 1-in-60-year hydro level triggers, not price triggers. As the Electricity Commission is responsible for contracting for future reserve capacity, it has the opportunity to do so in a way that is less distorting to the market. It should consider tendering for financial products that are not tied to specific facilities, reducing the market-distorting effects of government intervention.

Consistent with its limited financial resources, New Zealand's energy-related R&D portfolio is quite small. The government generally focuses research money on projects where smaller grants can directly benefit New Zealand's supply security and economic efficiency. Furthermore, New Zealand seeks to gain the benefits of other countries' larger research efforts by being a fast technology taker. Such a strategy takes the greatest advantage not only of the country's small R&D funding portfolio, but also of its flexible market economy and energy sector. The country should continue this sound strategy, and not be tempted to overspend on basic science research. It is positive that the country has started to develop explicit R&D priorities that match its new energy and environmental challenges. The government should also work to make the development of public-private partnerships a priority. New Zealand rapidly increased government funding of energy R&D

between 2000 and 2004 by an average annual rate of 17%, which also increased the share of energy R&D budget per unit of GDP. The government should strive to continue this growth, particularly as New Zealand's energy R&D spending per unit of GDP remains relatively low compared with that of other IEA member countries.

RECOMMENDATIONS

The government of New Zealand should:

General Energy Policy

- *Seek to allay stakeholder concerns about certainty and predictability of regulatory policies, institutions and regimes in order to underpin appropriate energy market investments.*
- *Complete the planned energy strategy and review of the climate change policy package as quickly as possible.*
- *Continue to articulate scenarios, including worst-case scenarios, for medium-term gas supply possibilities so as to stimulate discussion and analysis to bring greater and more timely certainty about gas supplies.*
- *Ensure security of electricity supply through appropriate regulatory policies that do not inhibit infrastructure investment in either transmission or generation, in light of the country's medium-term supply constraints.*
- *Ensure regulatory independence of the Electricity Commission from the government.*
- *Ensure that the roles and relationships of different government entities are clearly and optimally defined, particularly where these entities have overlapping responsibilities.*
- *Consider establishing a streamlined merit-based appeals mechanism for energy-sector decisions from the Commerce and Electricity Commissions; consider implementing or strengthening time limits for energy-related hearings and decisions from the Electricity Commission, the Commerce Commission and the Environment Court.*
- *Intensify efforts to increase energy efficiency and, where appropriate, renewables, particularly in the transport sector.*
- *Continue to support a level playing field for both state-owned and independent energy companies.*

- *Periodically reconsider the policy of not selling any state-owned enterprises in the energy sector, especially when a policy change may result in more efficient and competitive outcomes.*

Energy and the Environment

- *Outline a budget and plan for international actions to meet New Zealand's projected Kyoto Protocol shortfall, and implement the plan as quickly as possible.*
- *Finalise and implement all climate change policies and measures as quickly as possible, particularly in light of the government's recent decision not to proceed with the planned carbon tax.*
- *Consider implementing a carbon tax or emissions trading – or a combination of the two – as quickly as possible.*
- *Consider revised incentives for enterprises to participate in negotiated greenhouse agreements, and ensure effective reporting and monitoring; consider expanding the coverage of voluntary agreements to small and medium-sized enterprises.*
- *Address CO_2 emissions from the transport sector through appropriate fiscal and regulatory measures.*
- *Continue research efforts on methane emissions from the agriculture sector, noting the difficulty of reducing such emissions.*
- *Continue to implement policies and measures that address New Zealand's local air quality problems in a cost-effective manner.*

Energy Efficiency

- *Continue to improve data collection and data accuracy in order to better evaluate the cost-effectiveness of energy efficiency measures.*
- *Complete the* National Energy Efficiency and Conservation Strategy *(NEECS) review in a timely manner and ensure that the revised NEECS establishes sectoral targets that are measurable, cost-effective and practicable.*
- *Ensure that responsibilities for energy efficiency promotion are clearly defined and efficiently organised; ensure effective co-ordination between the relevant authorities.*
- *Introduce policies and measures – such as revised transport fuel tax rates and arrangements, tax incentives or fleet-wide fuel economy standards on new cars – designed to improve the fuel efficiency of New Zealand's vehicle fleet.*

- *Implement fuel efficiency labelling of both new and used vehicles.*
- *Introduce policies and measures that encourage a shift away from single-occupancy cars in order to reduce the energy intensity of transport.*
- *Ensure that revisions to the building code implement cost-effective energy efficiency measures in new and existing buildings as quickly as possible.*
- *Ensure that the revised building code is flexible so that it can incorporate new cost-effective energy efficiency measures for buildings on an ongoing basis.*
- *Ensure compliance with energy efficiency requirements in the existing and revised building code.*
- *Intensify efforts to broaden the scope of and improve minimum energy performance standards and labelling for electrical appliances, consumer electronics and office equipment to the extent that they are cost-effective.*
- *Put sustained emphasis on education and raising public awareness regarding energy efficiency.*

New and Emerging Renewables

- *Continue to investigate the system effects of greater wind power penetration, such as on grid reliability and stability, and implement appropriate short-term and long-term mitigation measures as quickly as possible.*
- *Design and implement flexible policy measures to achieve appropriate biofuels targets in the transport sector.*
- *Raise public awareness of biofuels.*

Fossil Fuels

- *Monitor the effects of the measures taken to stimulate exploration activity and evaluate the need for further actions to accelerate and bring forward exploration and development of oil and gas reserves in an increasingly competitive world market for hydrocarbon investments.*
- *Ensure that the newly instituted open access regime for the Maui gas pipeline supports competition and contributes to the development of the market, as well as provides incentives for new hydrocarbon exploration and production.*
- *Ensure that there are no undue regulatory barriers for market participants to invest in natural gas import infrastructure.*
- *Maintain a stable mandate for and closely monitor the work of the Gas Industry Company in order to provide more regulatory certainty and predictability and ensure efficient and competitive functioning of the gas market.*

- *Complete urgently the necessary legal and administrative arrangements to bring New Zealand into compliance with the 90-day IEA stockholding obligation as quickly as possible.*
- *Consider requiring industry to hold mandatory stocks or to create an industry stockholding agency for this purpose.*
- *Consider evaluating the potential of South Island lignite resources to be competitive with other energy sources given emerging energy technologies for lignite use in electricity generation and conversion to transport fuels, and disseminate this information to the market.*

Electricity

- *Remove any inefficient barriers to entry for new market participants.*
- *Implement a financial mechanism that allows market participants to manage locational basis risk, and implement the appropriate mechanism without delay.*
- *Revise the triggering mechanism for the Whirinaki power plant so that it is triggered only by hydro levels; ensure that the Electricity Commission's ongoing tendering for capacity minimises any distortion of the competitive market.*
- *Ensure that the Commerce Commission's threshold mechanism provides appropriate incentives for network investment and that regulatory reviews are completed in a timely manner.*
- *Consider providing for* ex ante *approval of investment projects on request in order to increase regulatory certainty.*
- *Ensure that the Commerce Commission's quality thresholds take into account local, not just regional, electricity quality so that pockets do not experience undue risk of outages or unreliability.*
- *Further develop the ability of the demand side of the market – including residential and industrial customers – to respond to price signals, including through the development of financial instruments.*

Research and Development

- *Ensure that the R&D roadmap for the energy and environmental sectors well reflects New Zealand's new energy challenges, in part by enhanced co-operation between the different ministries involved in energy policy and R&D.*
- *Stimulate co-operation and communication between public and private sectors in energy R&D.*

COUNTRY OVERVIEW

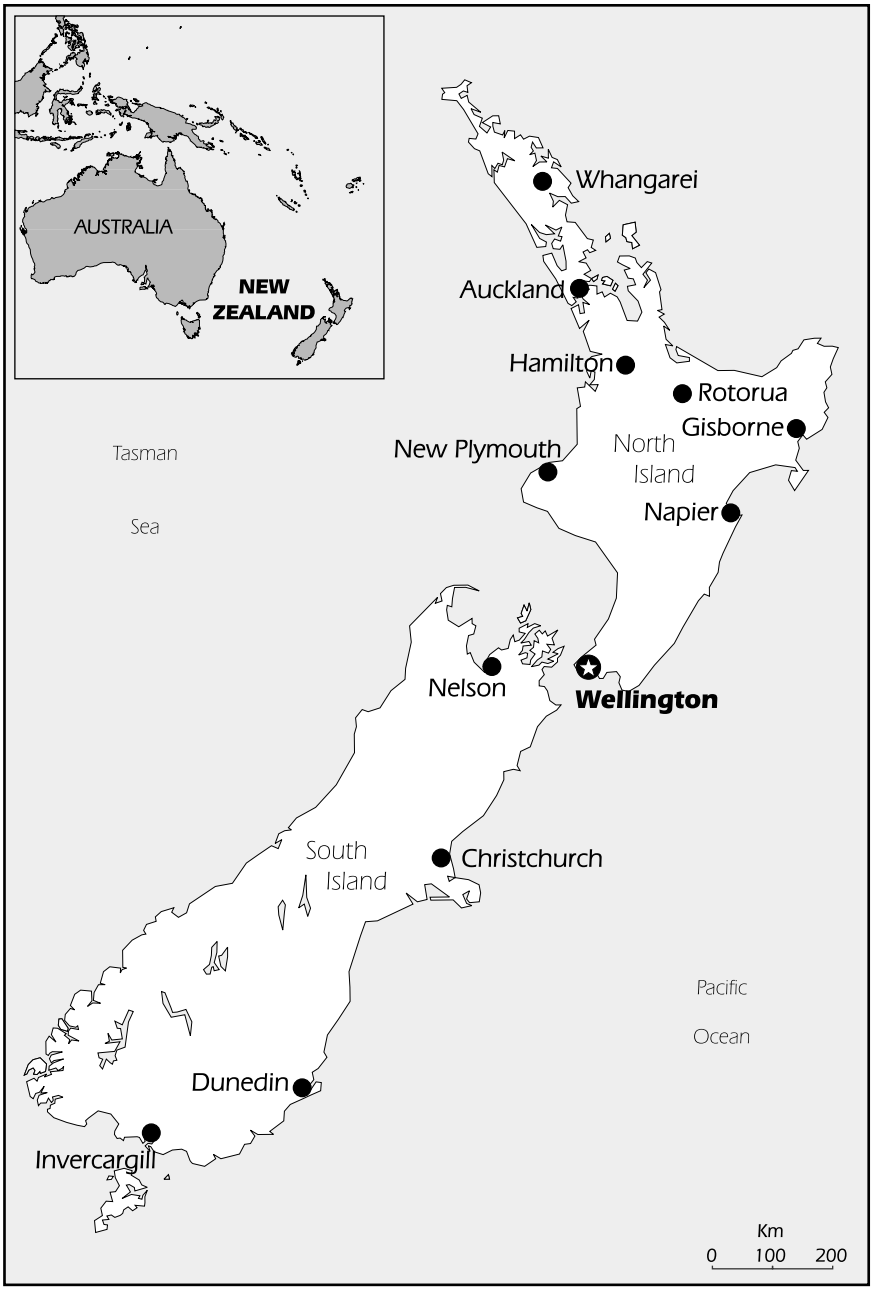
New Zealand is a small country in the south-west Pacific Ocean, located about 1 600 kilometres south-east of Australia. Most of its landmass is made up of two islands – the North Island and the South Island – but there are also a number of smaller islands (see Figure 1). The land area is about 270 000 square kilometres in total, about the size of the United Kingdom or the state of Colorado in the United States. With a total population of just over 4 million people, New Zealand has a very low population density (see Table 1). It is lower than all European Union countries and more than 16 times lower than the population density of the United Kingdom. About 80% of the population lives in cities, particularly in the North Island cities of Auckland and Wellington, the capital. English and Māori are the official languages. Nearly 70% of New Zealanders are of European descent; about 8% are of Māori descent. The Māori are the original settlers of New Zealand since approximately A.D. 800.

Compared to many IEA countries, New Zealand has relatively abundant natural energy resources of coal, natural gas, hydro and oil, though current natural gas fields are rapidly declining. The country has predominantly mountainous geography, with some large coastal plains. While the climate is generally temperate, there can be distinct regional differences. This is particularly true in the South Island where a mountain range divides the island climatically. In addition, the South Island's climate can drop to near arctic conditions in the winter. In general, high rainfall characterises the country – the west coast of the South Island has one of the highest annual rainfalls in the world.

New Zealand is a democratic parliamentary monarchy. The constitution is largely unwritten and is a mixture of statutes and constitutional convention, complemented by a Bill of Rights. Members of the 120-seat House of Representatives are elected by universal suffrage for a three-year term, using the mixed member proportional system, with seven seats reserved for indigenous Māori. Queen Elizabeth II is represented by the governor-general, Dame Silvia Cartwright. New Zealand gained Dominion status with Great Britain in 1907; total independence from Great Britain was later gained by the Statute of Westminster Adoption Act of 1947. New Zealand remains a member of the British Commonwealth, but is an independent nation. Despite being the constitutional head of state, the British monarchy does not play an active role in New Zealand's government.

Figure 1

Map of New Zealand



Source: Country submission.

Following the July 2002 election, Labour was returned to power, led by the Prime Minister, Helen Clark. As it failed to win an overall majority, the party formed a minority coalition government with the small, left-wing Progressive Coalition Party and entered into a formal "confidence and supply" agreement with United Future, a minor moderate centre-right party. In the very close September 2005 election, Labour was elected for its third straight term, but again without an overall majority. It once more formed a coalition government with the Progressive Coalition Party, but this time entered into a confidence and supply agreement with two parties – United Future again and New Zealand First, a minor centrist party. This review was conducted immediately following the 2005 election.

Table 1

New Zealand and its Islands in 2005

	New Zealand	*North Island*	*South Island*	*Other islands*
Land area (km^2)	268 021	113 729	150 437	3 855
Population	4 098 300	3 116 100	981 400	760
Population density (inhabitants/km^2)	15.3	27.4	6.5	0.2
GDP (million NZD)	147 542			

Source: Statistics New Zealand, stats.govt.nz, retrieved 8 November 2005.

The New Zealand economy has expanded quickly in recent years. Its economy grew by 4.5% in 2004; the average growth rate since the early 1990s has been 3.75%. Real GDP is now 40% higher than it was a decade ago. On a per person basis, real GDP growth has outpaced the OECD 10-year moving average; the country is on track to be in the top half of the OECD in this measure, a government goal. In 2005, GDP per capita was about NZD[1] 36 000 (about USD 22 200 or EUR 18 300). The country's GDP per capita currently ranks 20th out of all 26 IEA countries and 21st out of all 30 OECD countries. Unemployment in the country is under 4%, and wage and inflation rates have begun to rise.

ENERGY POLICY OBJECTIVES

The New Zealand government's energy policy objectives are outlined in policy statements on natural gas and electricity and in the government's *National Energy Efficiency and Conservation Strategy* (NEECS). Additional energy policy objectives are outlined in other government documents.

1. On average in 2005, NZD 1 = USD 0.70. At current exchange rates, 1 NZD = 0.62 USD = 0.51 EUR.

On 8 November 2005, the prime minister announced plans to develop a formal, comprehensive energy strategy. The strategy, which is being prepared by the Ministry of Economic Development, is expected to be released in its final form during the first quarter of 2007. A draft will be released before the end of 2006.

ELECTRICITY

In October 2004, the government outlined its objectives for the electricity sector in its *Government Policy Statement on Electricity Governance*. To support general growth and sustainability objectives, the government's policy objectives for electricity are to ensure that electricity is produced and delivered for all customer classes in an efficient, fair, reliable and environmentally sustainable manner, and to promote and facilitate the efficient use of electricity. Consistent with these goals, the government also seeks some more specific outcomes:

- Energy and other resources should be used efficiently.
- Risks (including price risks) relating to security of supply should be properly and efficiently managed.
- Barriers to competition in electricity should be minimised for the long-term benefit of end-users.
- Incentives for investment in generation, transmission, lines, energy efficiency and demand-side management should be maintained or enhanced and should not discriminate between public and private investment.
- The full costs of producing and transporting each additional unit of electricity should be signalled.
- Delivered electricity costs and prices should be subject to sustained downward pressure.
- The electricity sector should contribute to achieving the government's climate change objectives by minimising unnecessary hydro spill, efficiently managing transmission and distribution losses and constraints, promoting demand-side management and energy efficiency and removing barriers to investment in new generation technologies, renewables and distributed generation.

NATURAL GAS

In October 2004, the government also outlined its natural gas sector objectives in the *Government Policy Statement on Gas Governance*. The overall policy objective is to ensure that gas is delivered to existing and new customers in a

safe, efficient, fair, reliable and environmentally sustainable manner. To that end, the government has developed more specific desired outcomes:

- Ongoing supply to meet New Zealand's energy needs should be facilitated and promoted by providing access to essential infrastructure and competitive market arrangements.
- Energy and other resources should be used efficiently.
- Barriers to competition in the gas industry should be minimised for the long-term benefit of end-users.
- Incentives for investment in gas processing facilities, transmission and distribution, energy efficiency and demand-side management should be maintained or enhanced.
- The full costs of producing and transporting gas should be signalled to consumers.
- Delivered gas costs and prices should be subject to sustained downward pressure.
- The quality of gas services and, in particular, trade-offs between quality and price should reflect customers' preferences as far as possible.
- Risks relating to security of supply, including transport arrangements, should be properly and efficiently managed by all parties.
- Consistency with the government's gas safety regime should be maintained.
- The gas sector should contribute to achieving the government's climate change objectives by minimising gas losses and promoting demand-side management and energy efficiency.

ENERGY EFFICIENCY, TRANSPORT AND CLIMATE CHANGE

New Zealand's energy policy is heavily influenced by the Energy Efficiency and Conservation Act of 2000, and the subsequent NEECS, which was released in 2001. The strategy's purpose is "to give effect to the government's policy on the promotion in New Zealand of energy efficiency, energy conservation and the use of renewable sources of energy". The strategy's two main non-binding targets are a 20% energy efficiency improvement and an increase of 30 PJ (0.7 Mtoe) per year of renewable energy, both by 2012. Five action plans on energy supply, buildings and appliances, central and local government, industry and transport are under development to achieve the government's objectives.

The government is currently reviewing NEECS, including its associated action plans. It is expected to be released in early 2006. A ministerial decision on whether to replace the current NEECS is legally required to be issued by 27 March 2006.

Transport-sector policy, in addition to being influenced by NEECS, is also guided by the *New Zealand Transport Strategy* of 2002, the first comprehensive attempt to recognise all modes and users of transport and to take a sustainable development approach to transport policy. It shifted New Zealand's transport policy towards sustainable transport, whereas it had previously focused on safety and efficiency at a reasonable cost. The transport strategy has five integrated objectives: to assist economic development, to assist safety and personal security, to improve access and mobility, to protect and promote public health and to ensure environmental sustainability. The subsequent enactment of the Land Transport Management Act of 2003 provides for long-term planning of transport networks, integrated transport infrastructure, a multi-modal approach to the sector and new mechanisms for funding roads.

New Zealand is a party to the Kyoto Protocol on GHG. The government announced its policy package on climate change in October 2002. The Climate Change Response Act, which enables New Zealand to meet its Kyoto GHG reduction obligations, was passed by Parliament in 2002. Its three key policies were: the implementation of a price on carbon dioxide emissions (first applied through an emissions tax), negotiated GHG reduction with industry and the provision of incentives for projects that will deliver defined emissions reductions. In December 2005, however, government officials released a review of the policy package and decided not to proceed with the carbon tax, which was to take effect in 2007. The full policy package is currently under review.

Other government strategies and legislation that significantly affect energy efficiency and renewable energy outcomes include the Sustainable Development New Zealand Programme of Action, the Growth and Innovation Framework, the Government Policy Statement on Electricity Governance and the Resource Management Amendment Act of 2004.

LIGHT-HANDED REGULATION

New Zealand has historically relied on a "light-handed" approach to regulation. Under this policy, the government relies on existing general competition and economic regulation instead of developing industry-specific regulations or regulators. As a result, energy market regulation has generally been left to each industry, with the stipulation that the government would step in if industry could not come to an agreement, or if the agreement was at the expense of customers. While in recent years the government has moved away from this approach somewhat through the development of industry-specific regulations and regulators, government policy remains committed to regulation that has as light a touch as possible, consistent with advancement of its policy objectives.

GOVERNMENT AND REGULATORY INSTITUTIONS

GOVERNMENT INSTITUTIONS

Most government institutions that handle energy and environment issues are housed in three ministries: the Ministry of Economic Development, the Ministry for the Environment and the Ministry of Transport. In addition, the Ministry of Research, Science and Technology (MoRST), manages R&D policies for energy and environmental issues. Furthermore, because many energy entities in New Zealand are state-owned enterprises (SOEs) or Crown assets, there is some interaction with the Treasury, which is responsible for monitoring significant Crown assets (see box).

Most energy issues are the responsibility of the Resources and Networks branch of the Ministry of Economic Development. This branch has three energy policy groups: electricity, fuels and Crown resources, and energy and the environment. Another body that handles energy issues is the Crown Minerals group, which is housed in the Business Services branch of the Ministry for Economic Development. This group manages New Zealand's petroleum, natural gas and mineral estates, all of which are owned by the Crown, and its activities include attracting investors to New Zealand, efficiently allocating prospecting, exploration and mining rights and ensuring a fair return to the Crown.

The New Zealand Climate Change Office, which was established in 2003, handles climate change programmes and policy development. It is a branch of the Ministry for the Environment, but reports to the minister responsible for climate change issues, who is currently also the Minister of Energy and the Minister of Transport.

Another important government institution related to energy is the Energy Efficiency and Conservation Authority (EECA). EECA is an independent Crown entity whose eight-member board is appointed by, and directly accountable to, the Minister of Energy and whose performance is monitored on the minister's behalf by the Ministry for the Environment. EECA was established under the Energy Efficiency and Conservation Act of 2000. EECA programmes and measures must reflect government policy and must comply with any directions given by the Minister of Energy.

REGULATORY INSTITUTIONS

The Commerce Commission (CC) is a Crown entity that handles general economic and competition regulation, including the regulation of mergers and acquisitions and anti-competitive practices. It also has regulatory control of natural gas pipelines and electricity distribution and transmission businesses, among other responsibilities. The Governor-General, New Zealand's independent

State-owned enterprises and Crown entities

New Zealand has a number of government-owned assets. They can generally be divided into two groups: state-owned enterprises (SOEs) and Crown entities.

• SOEs are government-owned companies that operate as close as possible to private-sector companies. They were established under the State-owned Enterprises Act of 1986, which was passed to improve the efficiency and accountability of government enterprises.

The boards of SOEs have complete autonomy on operational matters and board members are drawn from the private sector. The shareholders of SOEs are represented by a set of government ministers. The shareholding ministers elect the SOE boards. SOEs are expected to meet performance targets and pay dividends to the Treasury on a basis comparable to their private-sector competitors. These dividends can be determined by the shareholding ministers.

SOEs borrow capital in their own names and on their own credit and, in most cases, without credit support from the government. SOEs must disclose the absence of government credit support on all loan documentation. In one case, Terralink New Zealand Limited, an SOE, was allowed to go into receivership. The government did not step in to support the company or prevent it from going into receivership, where its assets were liquidated.

The government currently has no plans to divest any of its remaining energy industry SOEs. Nevertheless, retaining state ownership of remaining SOEs is a policy decision; it is not codified in any regulation or statute.

• Crown entities include all government-owned assets and government institutions that are not SOEs or official government departments. Crown entities are a broad category of institutions and assets. In addition to including entities that manage some Crown-owned assets such as petroleum and minerals, Crown entities include Crown research institutions and the Commerce and Electricity Commissions. Crown entities must present their annual financial statements in Parliament and are subject to various levels of government involvement.

head of state, appoints commissioners on the recommendation of the government. Commissioners may be removed only under specific circumstances (*e.g.* dereliction of duty, misconduct). As an independent Crown entity, the CC is not subject to direction from the government in carrying out its enforcement and regulatory control activities. Its regulatory powers over competition derive directly from the Commerce Act.

In August 2001, new legislation established an industry-specific regulatory regime for electricity lines businesses (distribution and transmission companies). The CC also has a special group dedicated specifically to electricity regulation, which generally implements the industry-specific regulation. This new legislation implemented a threshold regulatory mechanism for lines businesses. Under this mechanism, lines businesses are assessed annually using price path and quality thresholds. If these thresholds are breached, these businesses are subject to further investigation and, if required, control by the CC.

The CC has an adjudicative role in some cases; it adjudicates merger and acquisition cases itself and can authorise restrictive trade practices. These decisions can be appealed to the High Court. In its role of regulating gas and electricity network businesses where it can impose regulatory control of prices and revenues, the CC's findings can only be appealed on points of law. Outside areas where it can adjudicate cases itself, it can choose to pursue cases through the court system. These cases can be appealed, both on points of law and on the merits. The CC is subject to statutory time constraints when considering mergers or restrictive trade practices. When making "control" determinations, or other decisions relating to business competition, there are no statutory time constraints.

Regulation of the electricity industry is shared between the CC and the Electricity Commission (EC), a Crown agent. Apart from regulation by the CC, previously the electricity industry was not regulated by government but through industry self-regulation. In 2003, however, the government determined that self regulation had failed to establish a fully integrated governance regime, and so the government established the EC, which began operation in 2003. While it currently shares responsibilities for electricity market oversight with the CC, the government is considering consolidating electricity oversight responsibilities within the CC, but will not do so in the near future. Broadly speaking, the EC can currently be considered more of a technical regulator.

By design, the EC is less independent than the CC (see Table 2). Its five-to-nine commissioners (the EC currently has five commissioners) are appointed by the Minister of Energy for three-year terms, but the Minister of Energy can remove commissioners at any time. In addition, the government has a large amount of influence over the EC's activities. In contrast to the CC, the activities of the EC must not only have regard for its primary legislation (the Electricity Act), but must also give effect to the legislation. The EC's governance of electricity markets is generally administered through rules made by the Minister of Energy on the Commission's recommendation. These rules must adhere to the Electricity Act. The Minister of Energy may accept the recommendations of the EC without major modification, or reject the recommendations outright[2].

2. In future, should some CC functions be transferred to the EC, the government's influence in the transferred areas would be limited as they were with the CC.

Table 2

Structure and Governance of the Electricity and Commerce Commissions

	Commerce Commission	*Electricity Commission*
Appointments	By the Governor-General on the recommendation of the Minister of Commerce	By the Governor-General on the recommendation of the Minister of Energy
Conditions for removal	Only on specific grounds (*e.g.* neglect of duty, failure to disclose financial interests, misconduct)	At any time at the discretion of the Minister of Energy
Funding mechanism	Funded as a Crown entity; it is initially funded by the Crown, but then the Crown is reimbursed for some funds through levies on industry (costs for the electricity and gas regulatory regimes are reimbursed to the Crown)	Funded as a Crown entity; it is initially funded by the Crown, but then the Crown in reimbursed from the industry through function-specific levies
Source of policy guidance	The Commerce Act; the Commerce Commission must have regard for Section 26 of the Commerce Act	The Electricity Act; the Electricity Commission must have regard for and give effect to the Electricity Act; final rules are made by the Minister of Energy based on Electricity Commission recommendations
Government's ability to overrule decisions	None; appeals go through the judicial system	None; appeals against EC adjudicatory decisions go through the judicial system
Ministry-commission interaction	No prescribed interaction	Electricity Commission makes recommendations to the Minister of Energy, who must either accept the recommendations, decide not to act on them or refer them back to the Electricity Commission for consideration

Source: Country submission.

The EC does not have an explicit adjudicatory role; cases dealing with breaches of EC rules are adjudicated by the Rulings Panel, which is appointed by the EC. Rulings Panel decisions and EC policies and findings are not subject to merit-based appeals; decisions may be appealed to the High Court on points of law. Some EC findings are subject to time constraints, as are Rulings Panel decisions. The Rulings Panel must make reasonable endeavours to make its final decision within 40 working days of the date at which it received all submissions on the matter. The EC operates under strict timelines when dealing with electricity governance rules.

The government has considered broadening the appeals process to allow for merit-based appeals for CC decisions, but determined that the cost of expanding the process and adding an appeals layer outweighed the benefits from greater appeal opportunities.

When the EC was established, the government considered giving it responsibility for the natural gas industry as well. Ultimately, it was decided that the natural gas industry should instead establish a co-regulatory structure with industry and government, in part because the natural gas industry in New Zealand is quite small. As a result, under the Gas Act of 2004 the government established the Gas Industry Company (GIC) to develop recommendations for gas sector arrangements in the areas of processing, wholesaling, transmission and retailing. The GIC, which became fully operational towards the end of 2005, has a board comprised of four independent members and three additional members from industry. All board members are appointed by the GIC itself. The GIC makes recommendations to the Minister of Energy, which can be accepted without modification or rejected. All recommendations must comply with the *Government Policy Statement on Gas Governance*. Despite the ability to make regulatory recommendations to the government, the GIC has a preference for promoting industry-based co-operative arrangements and market-based contractual solutions where possible.

Regulatory review under the Resource Management Act

Energy infrastructure projects must obtain regulatory approval (known as "resource consents") as defined by the Resource Management Act (RMA). Though the RMA is a national act monitored by the Ministry for the Environment, decision-making is largely devolved to regional and local councils. Among other things, each council is required to have resource management plans ("district plans") in place that dictate which resource consents an energy project must obtain. The RMA provides for regional councils to consider the adverse effects and benefits to the community of energy projects when deciding on resource consents. In special cases, projects can be "called in" and decided by a special commission established by the national government. The RMA was recently amended by Parliament and most of the changes came into force in August 2005. Many of these amendments are aimed at speeding up the resource consent process, empowering local consenting authorities, in part through providing better resources and more national policy guidance.

Council RMA decisions can be appealed to New Zealand's Environment Court, part of the Ministry of Justice. Environment Court decisions can be appealed to the High Court, but only on points of law, not on the merits. There is no time limit under which cases must be heard or decided by the Environment Court. Given that over 1 000 cases are appealed to the Environment Court annually, there have historically been lengthy delays between appeals applications and hearing dates. To reduce the delay, the Ministry of Justice and the Ministry for

the Environment have worked to improve the process, in part by increasing funding and personnel levels, as well as by implementing differentiated case tracking. The court tries to ensure that standard-track cases receive a hearing date within six months of the proceedings having been filed. Recent RMA amendments have also helped speed the appeals process, as some cases can now be heard and decided by a single judge. A recent Environment Court review shows that outstanding cases fell by more than 65% between 2001 and 2005.

MARKET STRUCTURE, REGULATION AND PARTICIPANTS

OIL

The oil industry was liberalised in the 1980s, removing price controls, government involvement in refining, licensing requirements for wholesalers and retailers, and restrictions on imports of refined products. The industry is subject to general competition regulations through the CC.

In New Zealand, oil and condensate are produced from nine oilfields. Upstream oil production is dominated by Shell, through Shell Todd Oil Services. Todd Energy and OMV are also significant upstream players. Other minor upstream players include Greymouth Petroleum, Origin Energy and Austral Pacific. As most oil produced in New Zealand is light, sweet crude, and New Zealand's refinery is geared towards sour crude, most oil produced from New Zealand is exported. All oil from New Zealand fields is transported to market via tanker.

There are five players in oil wholesaling and retailing: BP, Caltex, Mobil, Shell and Gull Petroleum. Collectively BP, Caltex, Mobil and Shell are the majority shareholders in New Zealand's only oil refinery, which processes crude oil and condensate for these four companies only. A refinery-owned pipeline transports about half of the refinery's production to bulk storage facilities that supply the Auckland area, New Zealand's major petroleum market. The remaining petroleum products are transported to port depots by coastal tanker; the coastal tanker operation is also owned collectively by these four companies. From storage facilities and port depots, road tankers service most of the country. Unlike the refinery, the refinery pipeline and the coastal tankers, road tankers are independently owned or contracted by each oil company. Gull, the independent oil company, has its own oil terminal, to which it imports its own product from Singapore and South-East Asia. It also has its own fleet of delivery vehicles.

Oil is distributed in three ways. Independent retailers can purchase product from the oil majors at wholesale prices and then sell it through their own network of service stations. Independent retailers can be employed by the oil majors to sell fuel as part of the oil major's branded network of service stations. Oil majors can

also retail through their own sites. Consolidation in the industry has led the number of service stations to fall from a high of more than 4 000 in 1976 to around 1 500 in 2001.

NATURAL GAS

The natural gas market was liberalised along with the oil market in the 1980s. The government sold its remaining interest in the market in 1988, although the government once again has a small interest in the upstream market through Genesis Energy, a state-owned enterprise. General competition regulation is imposed on the industry by the CC, which has powers to regulate pipelines subject to government decisions. The industry is also now under industry-government co-regulation through the GIC.

As with oil production, upstream natural gas production is dominated by Shell, which operates the Maui field. Other operators in the upstream market include Todd Energy, Swift Energy and Genesis Power. Natural gas from the country's nine producing fields is primarily transported by two high-pressure, privately owned pipelines, the Maui pipeline and the NGC pipeline. There are also several intermediate, medium- and low-pressure gas networks. The NGC pipeline is subject to open access[3]. The Maui pipeline became subject to open access on 1 October 2005. It had been reserved exclusively for transporting gas from the Maui field. The open access regime will allow gas to be transported to market from fields that are currently under development. There is no gas storage in New Zealand.

There had been five gas distributors – NGC Infrastructure, Nova Gas, Wanganui Gas, Vector and Powerco – but in mid-2005 Vector purchased NGC. Recently, the CC imposed price controls on the gas pipeline businesses of Vector and Powerco, because of the market power positions of these companies in their markets. Vector and Powerco were found to be earning excess profits on their pipeline businesses.

There are eight gas retailers: NGC (now a Vector subsidiary), Nova Gas, Wanganui Gas, Contact Energy, Genesis Power, Mercury Energy, Bay of Plenty Electricity and E Gas. NGC retails only to larger commercial and industrial customers and Contact Energy is a gas wholesaler/retailer.

There are four gas processors in New Zealand: NGC, Shell Todd Oil Services Ltd, Maui Development Ltd (MDL) and Swift Energy. NGC and Shell Todd both have gas treatment plants at Kapuni, Shell Todd is building another at Pohokura, MDL has a plant at Oaonui and Swift has production at Hawera from its Kauri/Rimu permits and at Waihapa from its TAWN licences.

3. In Europe and some other markets, "open access" is typically referred to as "third-party access" (TPA). This regime gives all market participants non-discriminatory and transparent access to transportation regardless of pipeline (or transmission line) ownership or operation.

The three major groups of gas users in New Zealand are petrochemicals, electricity generation and direct reticulated users. Petrochemicals, the bulk of which were produced by the Methanex plants, accounted for about 33% of total consumption, but in late 2004 and late 2005 Methanex mothballed its two New Zealand methanol plants when its 20-year gas contract ended. Recently, however, the plant mothballed in late 2005 started again because Methanex has been able to secure additional reserves of gas on a short-term contract for at least one year. In 2004, about 38% of New Zealand's natural gas production was used for electricity generation (including co-generation). Direct residential consumption accounted for 4.5% of total consumption in 2004, and industrial consumption accounted for 44%. Natural gas is only reticulated in the North Island, through the high-pressure NGC and MDL pipelines and local gas utilities' networks. Gas companies are under no obligation to service any particular customer.

COAL

Solid Energy New Zealand was established as a state-owned enterprise in 1987 to replace the loss-making State Coal Mines that had existed as a government-controlled organisation since 1901. Solid Energy mines about 80% of the 5 Mt of coal that is produced in New Zealand annually. The remainder is produced by a number of smaller, private-sector coal companies. The country is largely self-sufficient in coal (some imports of specific types of coal are made) and exported more than 40% of its production in 2003. New Zealand also has very large, but relatively unexploited, reserves of lignite in the southern part of the country. Recently the country has begun to rely on imports to cover some needs related to increased coal-fired generation at the Huntly power plant owing to reduced gas availability.

There are no government restrictions on the import or export of coal and the government does not provide explicit coal production subsidies. As an SOE, the government does not control the operations of Solid Energy, nor direct its business decisions. It is subject to the same rules, regulations and taxes as privately owned coal companies in New Zealand.

Major domestic coal customers are Pacific Steel, New Zealand Steel and Genesis Power, owner of the 1 000 MW Huntly plant – New Zealand's only coal-fired power station (it can also run on natural gas). Other coal users are the dairy and cement industries, meat and timber processors, other industrial processing, including brewing, and a declining number of residential consumers.

ELECTRICITY

New Zealand liberalised its electricity market relatively early. In 1987, the Electricity Corporation of New Zealand (ECNZ) was established as a state-

owned enterprise, and given responsibility for owning and operating the government's generation and transmission assets, and in 1996 it began operation of a wholesale market. In 2003, following the failure of the electricity industry to establish a fully integrated self-governance regime, the government decided to take responsibility for industry regulation and established the Electricity Commission (EC), which took over responsibility for governing the electricity market on 1 March 2004. The electricity market is also subject to general competition regulation by the Commerce Commission. In particular, the CC regulates electricity transmission and distribution networks through a threshold regime.

The 1998 Electricity Industry Reform Act required the full ownership unbundling of distribution and generation. This requirement was unique; no other country required such strict unbundling. Since the introduction of the law, however, amendments have allowed distribution companies to own some generation and to sell the output to the market. The CC enforces compliance with all rules and regulations dealing with ownership issues, and may grant exemptions to the cross-ownership restrictions.

There are five main generation companies: Meridian Energy, Contact Energy, Genesis Energy, Mighty River Power and TrustPower. These five companies have a combined 92% market share. Meridian, Genesis and Mighty River are SOEs. Recently, the government partially underwrote the gas supply for a new gas-fired power plant built by Genesis.

Transpower, an SOE, owns and operates the high-voltage transmission network. It is the system operator for the electricity market. In December 2005, the CC announced its intention to declare control of Transpower's transmission services. The move followed an inquiry after the company breached regulatory thresholds. Transpower argues that the thresholds were breached because the company has to make substantial transmission infrastructure investments. Furthermore, it argues that the investments are being fully scrutinised by the EC and that the company will not proceed with the investments unless they are approved. On 31 March 2006, it was announced that Transpower was seeking to negotiate an administrative settlement with the CC that, if approved, would avoid a declaration of control by the CC.

There are 28 distribution companies that own the local distribution networks throughout New Zealand. The ownership of distribution companies is a mix of public listings, shareholder co-operatives, community trusts and local body ownership, with most companies being owned by trusts. The largest company is Vector, which makes up one-third of the sector (based on number of connections); the four largest companies supply 66% of all connections. The CC is considering actions against Hawke's Bay Unison, a distribution company, which could lead to the commission taking control of its distribution activities. Unison is under investigation after a breach of regulatory thresholds. Unison

is currently preparing an administrative settlement offer for the Commerce Commission that, if approved, would avoid a declaration of control by the CC.

There is a high degree of vertical integration between generation and retail activities. The five main generation companies supply 98% of the retail market. The retail market is completely contestable, and almost all end-use customers purchase electricity through a retailer, though customers can choose to purchase directly from the wholesale market.

A nodal market with locational marginal pricing (LMP) has been in operation since 1996. Through a contract with the EC, M-co, a private company, operates this market. It clears and settles bids and offers, handles market communications and conducts surveillance and compliance. It also advises the EC on market issues. M-co's services are periodically subject to contestable tender. Recently, a subsidiary of Transpower sought clearance from the CC for approval to purchase M-co. The application was declined in December 2005.

SUPPLY AND DEMAND BALANCE

ENERGY SUPPLY

New Zealand's total primary energy mix is relatively diversified (see Figure 2), but is dominated by oil and natural gas. Together these two fuels provide nearly 60% of total energy supply. Hydro, geothermal and coal each provide about 10% of supply. New Zealand's share of geothermal energy is the highest in the IEA; it is second only to Iceland among OECD countries. Given New Zealand's abundant native coal resources, its 10% share of coal as a proportion of total primary energy supply (TPES) is relatively low. It is significantly lower than the 43% share that coal has in Australia, which also has large native reserves.

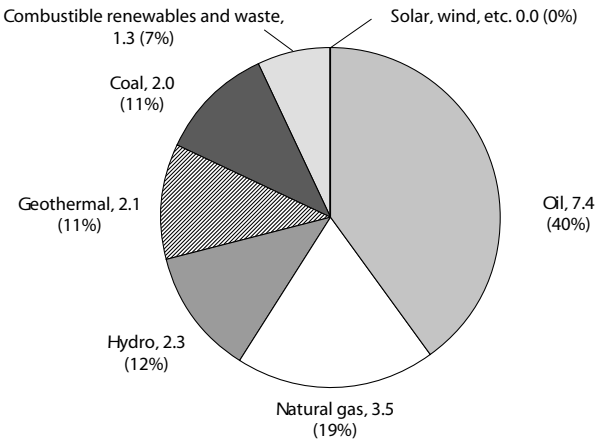
Total primary energy supply (TPES) was 18.6 million tonnes of oil equivalent (Mtoe) in 2004. This is a rise of nearly 75% since 1984 – equivalent to an average annual growth rate of 2.8% (see Figure 3). After falling by 2.6% between 2002 and 2003 due to lower natural gas supply, TPES grew by 7.5% between 2003 and 2004, driven by growth in coal, oil and combustible renewables. As energy supply has grown over the last two decades, supply from oil, natural gas and geothermal sources has grown dramatically. Coal supply has also increased significantly, beginning in the early 1990s.

ELECTRICITY GENERATION

Looking at the country's supply mix, generation is dominated by hydro (see Figure 4). In 2004, 63% of electricity was generated from hydro; an additional 6% was generated from geothermal sources. Natural gas fuelled

Figure 2

Total Primary Energy Supply, 2004*



Total = 18.6 Mtoe

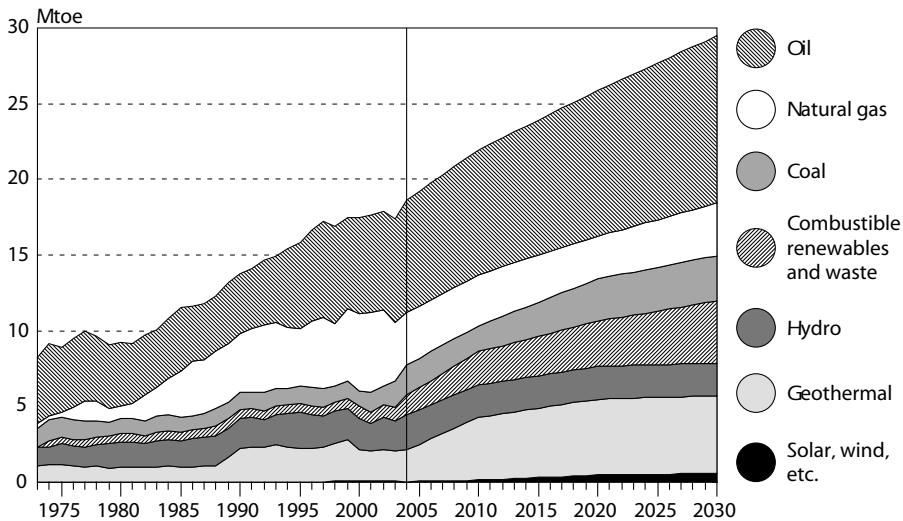
* provisional data.

Note: The primary energy equivalent of geothermal reflects primary energy losses, which vary depending on the technology used. If the primary energy equivalent were calculated without taking this into account, the percentage of renewable energy in TPES would be lower.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

Figure 3

Total Primary Energy Supply by Source, 1973 to 2030

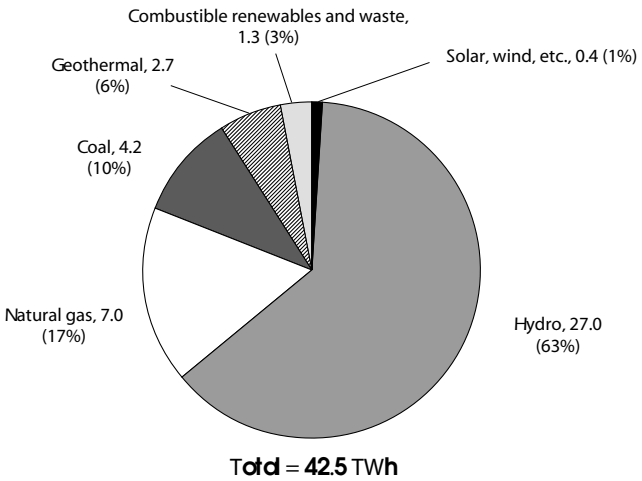


Note: The primary energy equivalent of geothermal reflects primary energy losses, which vary depending on the technology used. If the primary energy equivalent were calculated without taking this into account, the percentage of renewable energy in TPES would be lower.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

Figure 4

Total Electricity Generation by Source, 2004*



* provisional data.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

about 17% of total production and coal about 10%. Of IEA countries, New Zealand's share of hydro generation is the third-highest, after Norway and Austria. At about 6%, New Zealand's geothermal electricity generation share is the highest of all IEA countries and over three times greater than that of the country with the next largest share.

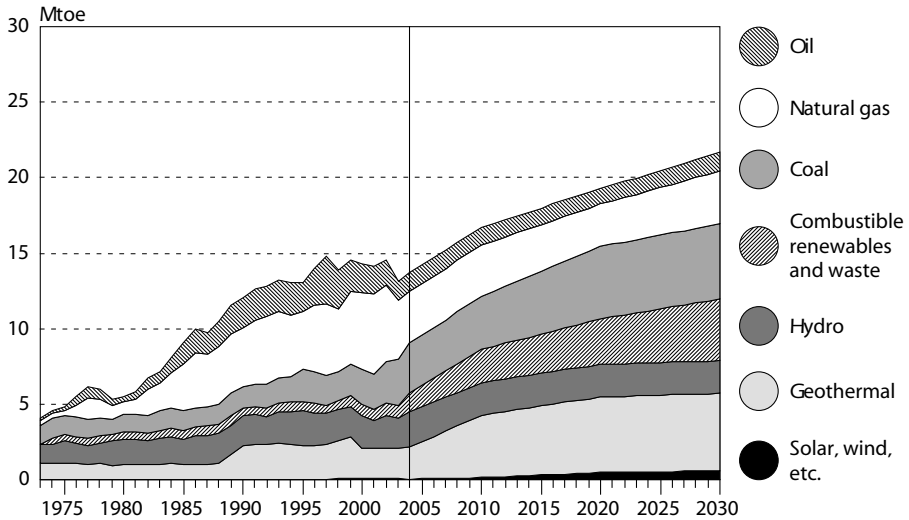
ENERGY PRODUCTION

Unlike most IEA countries, New Zealand has relatively large indigenous energy resources, including coal, oil, natural gas, hydro and geothermal. In 2004, the country produced about 13.7 Mtoe, which covered nearly 75% of the country's total supply (see Figure 5). The country has large coal resources and exported about 40% of its production in 2004. New Zealand imports most of its oil – domestic production covered 17% of total supply in 2004. The country relies exclusively on domestic sources of natural gas; currently it does not have any import or export capability for natural gas, either through pipelines or liquefied natural gas (LNG) facilities.

Energy production has declined in the last few years, owing to declining natural gas and oil production. Since its peak in 1997 of nearly 3.2 Mtoe, oil production has declined by over 60%, an average annual decline of

Figure 5

Energy Production by Source, 1973 to 2030



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

13%. Natural gas production has declined even more rapidly. From its peak production of 5.3 Mtoe in 2001, production declined to 3.5 Mtoe in 2004, dropping by 35% in three years.

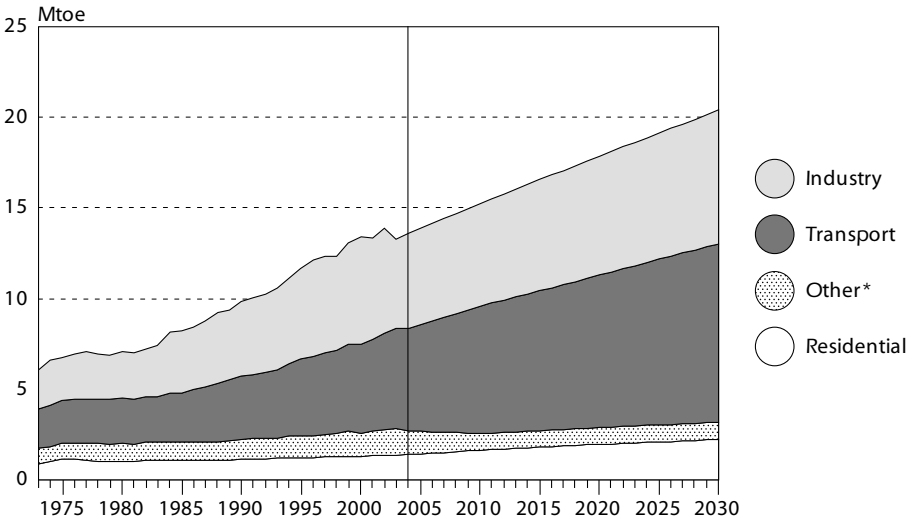
CONSUMPTION AND EFFICIENCY

In 2004, New Zealand's total final consumption (TFC) was 13.6 Mtoe, a rise of 2.5 Mtoe and 22% from 1994 (see Figure 6). The greatest rise was in consumption from the transport sector, which grew by 40% over the decade – rising from 36% to 41% of total consumption to become the largest consuming sector. Industrial-sector consumption rose by 15% over the period, at the same time falling from 39% of total consumption to 37%.

Two measures of energy efficiency – supply and consumption in terms of GDP and population, shown in Table 3 – reveal that improvements have been made over the last 15 years. While this is in line with the experience of most IEA countries, New Zealand's energy efficiency remains below both the IEA and IEA-Pacific averages. Efficiency is also not improving as quickly as these averages. Nonetheless, New Zealand has been improving its energy intensity (energy use per unit of GDP) since 2000 more quickly than it did in the 1990s.

Figure 6

Total Final Consumption by Sector, 1973 to 2030



* includes commercial, public service and agricultural sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

Table 3

Energy Intensity and Energy Use Per Capita, 1990 to 2003

					Average annual change	
	1990	*1995*	*2000*	*2003*	*1990-2000*	*2000-2003*
TPES/GDP	0.23	0.23	0.22	0.20	–0.4%	–3.8%
IEA average	*0.20*	*0.20*	*0.18*	*0.18*	*–1.1%*	*–0.6%*
IEA-Pacific average	*0.21*	*0.21*	*0.21*	*0.19*	*0.0%*	*–2.6%*
TFC/GDP	0.16	0.17	0.17	0.15	0.3%	–4.1%
IEA average	*0.15*	*0.15*	*0.13*	*0.13*	*–1.1%*	*–0.6%*
IEA-Pacific average	*0.14*	*0.15*	*0.15*	*0.14*	*0.1%*	*–2.4%*
TPES/person	4.04	4.27	4.50	4.30	1.1%	–1.5%
IEA average	*4.15*	*4.26*	*4.50*	*4.62*	*0.8%*	*0.9%*
IEA-Pacific average	*3.72*	*4.18*	*4.60*	*4.57*	*2.1%*	*–0.3%*
TFC/person	2.88	3.15	3.47	3.29	1.9%	–1.7%
IEA average	*3.06*	*3.13*	*3.36*	*3.44*	*0.9%*	*0.9%*
IEA-Pacific average	*2.53*	*2.91*	*3.17*	*3.15*	*2.3%*	*–0.2%*

Note: GDP data use purchasing power parities.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; *National Accounts of OECD Countries*, OECD Paris, 2005; and country submissions.

ENERGY SECURITY

OIL

Domestically, New Zealand produces about one-fifth of its oil needs. This represents a significant decline over the past decade – domestic production accounted for more than half of all consumption in 1997 and has been declining ever since. As a result, New Zealand's reliance on imported oil has grown dramatically. Recent oil finds in the Taranaki basin will soon enter production, which will mean increased domestic oil supply likely to result in an overall decrease in net oil imports.

As New Zealand's net imports have grown, so have the oil stocks it is required to hold under the IEA's International Energy Program (IEP). New Zealand is currently nearly 30 days below the 90-day IEP obligation. To meet its IEA stockholding obligation now and in future, New Zealand has decided to lease additional stocks, possibly to be held in other IEA countries. Therefore, the government has started the process of tendering for oil stocks and expects to come back into compliance with its IEP obligation in late 2006, behind its original mid-2006 target. (For more information, please see Chapter 7 on fossil fuels.)

NATURAL GAS

New Zealand's domestic natural gas production is depleting even more rapidly than its oil production. The country's main natural gas field, Maui, which has traditionally provided up to two-thirds of the country's natural gas supply, is quickly depleting, and will likely be fully depleted around 2010. Other gas fields – notably Ngatoro, Tariki/Ahuroa, Kamiro, Waihapa, Ngaere, Mangahewa, and Kapuni – are also in decline. There have been some new discoveries by Swift Energy offshore from Hawera, by Origin Energy in Kupe and by Shell Todd offshore from Waitara at Pohokura that are now producing, but they alone will not be sufficient to make up the post-Maui shortfall. The government has already instituted incentives to encourage new exploration by reducing royalty rates for new discoveries and by making large amounts of geological data and other information freely available. The country has seen encouraging signs that exploration activity is increasing.

Nevertheless, if significant new natural gas fields are not discovered in the next few years, natural gas supply cannot be easily replaced with imports. The country could build an LNG regasification terminal, a NZD 600 million investment. Imports of compressed natural gas (CNG) are also possible. CNG shows some promise for economically delivering relatively small amounts of natural gas over short distances via tanker, but this technology has not yet been proven commercially viable. In March 2006, Vector, an energy network company, announced plans to import CNG from Papua New Guinea. Genesis Power and Contact Energy, two large generators in New Zealand that operate gas-fired power plants, are currently investigating two

locations, Taranaki and Marsden Point, for a proposed LNG terminal. The New Zealand government sees the uncertainty about natural gas supplies in the medium term, but remains reluctant to interfere in the market. LNG and CNG investment decisions, if they are made, will be made by industry.

ELECTRICITY

Another unique aspect of New Zealand's energy situation is that, as a remote island, it cannot rely on any electricity imports. In addition, given New Zealand's heavy reliance on hydropower, the country's electricity supplies are at risk during drought periods. These two conditions make electricity particularly prone to security of supply risks. Events in 2001 and 2003 highlighted the country's at-risk electricity supply and, as a result, some new generation has been built and significant gas, wind and geothermal generation projects have been proposed (see box). An alternative to new generation can, in some cases, be upgraded transmission. For this reason, and in response to demand growth in the region, Transpower, the government-owned grid operator, has recently proposed a 400-kV upgrade from the central North Island to Auckland, to be completed in 2010. Nevertheless, some critics contend that the 2010 completion date is too late to prevent energy shortages in Auckland predicted by some to arrive in 2007. The EC is currently investigating alternatives to the proposed project.

Electricity shortages and blackouts in New Zealand

Since 1998, New Zealand has been hit by a blackout and two drought-induced shortages.

In 1998, four cables that serviced Auckland's central business district failed, leaving the area without grid-supplied power for five weeks and forcing most of the 60-70 000 workers and 6 000 tenants to relocate temporarily.

In 2001, a prolonged drought combined with an early cold snap resulted in an electricity shortage that triggered a 10-week government-sponsored conservation campaign to reduce consumption by 10% in the private sector and 15% in the government sector. No blackouts resulted from the shortage.

In 2003, a drought and high electricity demand – this time combined with low coal reserves to power backup thermal plants – triggered an industry-sponsored conservation campaign. Again, no blackouts resulted from the shortage.

The EC is tasked with managing supply to ensure that electricity demand is met in a 1-in-60 dry year without national emergency conservation campaigns. To this end the government commissioned a 155 MW power plant at Whirinaki. Its operation is triggered by prices or hydro levels. In addition, the EC may contract for additional reserve energy in future. The country's heavy reliance on hydro means that power shortages are typically the result of energy constraints, not capacity constraints. For this reason the country cannot rely on a capacity reserves market, as other countries can.

An additional potential threat to the security of electricity supply is lack of transmission and distribution investment. The government's relatively new threshold regime for lines businesses could provide disincentives for investment in needed upgrades, as companies may not want to make investments that are out of line with historical investment levels and could trigger regulatory review and price control.

ENERGY AND CO_2 FORECASTS

TOTAL PRIMARY ENERGY SUPPLY

In 2003, New Zealand issued its long-term energy forecasts to 2025. Through various scenarios – a reference scenario and a set of alternative scenarios – the government has projected energy supply, demand, electricity generation, energy prices and CO_2 emissions[4]. Broadly speaking, the reference scenario includes price and policy assumptions that are reasonably likely. Some alternative scenarios were also included: high GDP growth, no new gas discoveries, high and low oil prices, high growth in forestry processing, no additional energy efficiency uptake, continued industrial methanol production and baseline, which excluded energy efficiency and climate change policies.

As shown in Table 4, TPES is projected to rise to nearly 30 Mtoe by 2030, an increase of nearly 60% from 2004, based on the reference scenario. Overall, the largest percentage increases are from various renewables: supply from solar and wind combined is projected to grow to nearly 20 times its current supply, energy from combustible renewables and waste is projected to more than double and a rise of 160% is projected from geothermal sources. In absolute terms, however, the largest increase will come from oil, which is projected to rise by 3.6 Mtoe or nearly 50% under the reference scenario.

4. New Zealand Ministry of Economic Development, *New Zealand Energy Outlook to 2025*, October 2003. IEA forecast data are based on the reference scenario, but use IEA methodology and carry the forecasts out to 2030.

Table 4

Total Primary Energy Supply, 1990 to 2030

Units: Mtoe						*Average annual growth rate*	
	1990	*2000*	*2010*	*2020*	*2030*	*1990-2000*	*2000-2030*
Oil	4.0	6.3	8.2	9.6	11.1	4.8%	1.9%
Share of total	*29%*	*36%*	*38%*	*37%*	*37%*		
Natural gas	3.9	5.1	3.4	2.8	3.5	2.6%	–1.2%
Share of total	*28%*	*29%*	*15%*	*11%*	*12%*		
Hydro	2.0	2.1	2.1	2.2	2.2	0.4%	0.1%
Share of total	*15%*	*12%*	*10%*	*8%*	*7%*		
Geothermal	2.2	2.1	4.1	5.0	5.1	–0.7%	3.1%
Share of total	*16%*	*12%*	*19%*	*19%*	*17%*		
Coal	1.1	1.0	1.7	2.8	3.0	–0.8%	3.6%
Share of total	*8%*	*6%*	*8%*	*11%*	*10%*		
Combustible renewables and waste	0.5	0.8	2.2	3.0	4.1	3.6%	5.7%
Share of total	*4%*	*4%*	*10%*	*12%*	*14%*		
Solar, wind, etc.	0.0	0.1	0.1	0.5	0.6	19.4%	7.5%
Share of total	*0%*	*0%*	*1%*	*2%*	*2%*		
Total	13.8	17.4	22.0	25.9	29.5	2.4%	1.8%

Notes: Based on New Zealand's "reference scenario", but modified according to IEA data methodology. The primary energy equivalent of geothermal reflects primary energy losses, which vary depending on the technology used. If the primary energy equivalent were calculated without taking this into account, the percentage of renewable energy in TPES would be lower.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

CO_2 EMISSIONS

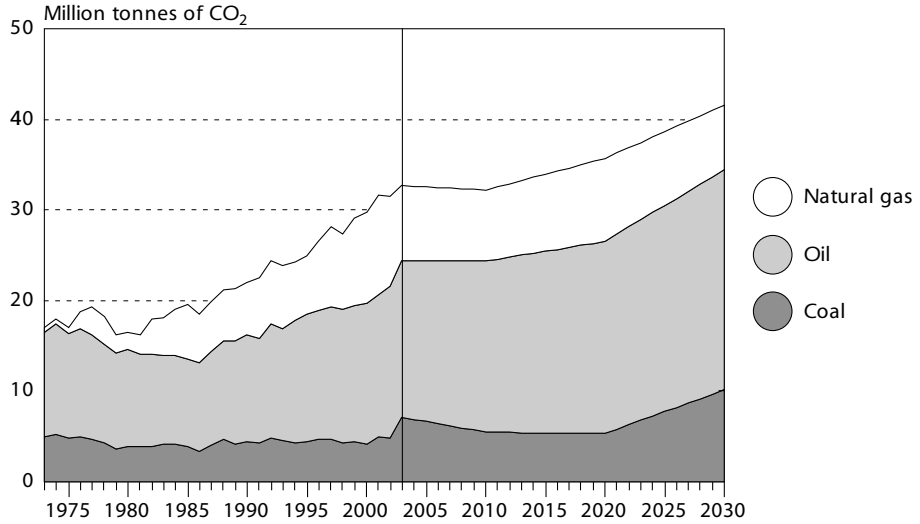
As shown in Figure 7, CO_2 emissions have grown steadily since the 1980s, growing at an average annual rate of 3.1% between 1990 and 2000, primarily from the large rise in CO_2 emissions from natural gas. In contrast, the reference scenario projects that CO_2 emissions will increase between 2000 and 2030 at nearly a third of that rate, 1.1% annually (see Table 5). As natural gas supply is expected to decline under the reference scenario, so are natural gas-related CO_2 emissions.

STATISTICS AND MODELLING

Following a general review of the Ministry of Economic Development, a new group, the Energy Information and Modelling Group, was established in June 2005. Among other things, the group is responsible for providing quality and timely energy statistics and projections, ensuring that modelling and statistics work is effectively integrated with policy development and strengthening relationships with key stakeholders and suppliers of statistical data. As part of this effort, energy data are now available free on line.

Figure 7

Forecast CO_2 Emissions by Fuel*, 1973 to 2030



* estimated using the IPCC Sectoral Approach.

Sources: CO_2 *Emissions from Fuel Combustion*, IEA/OECD Paris, 2005 and country submission.

Table 5

Forecast CO_2 Emissions, 1990 to 2030

Units: Mtoe						*Average annual growth rate*	
	1990	*2000*	*2010*	*2020*	*2030*	*1990-2000*	*2000-2030*
Oil	11.8	15.6	18.9	21.2	24.3	2.8%	1.5%
Share of total	*54%*	*52%*	*59%*	*59%*	*58%*		
Natural gas	5.7	10.0	7.9	9.2	7.1	5.9%	-1.1%
Share of total	*26%*	*34%*	*24%*	*26%*	*17%*		
Coal	4.5	4.1	5.5	5.4	10.1	-0.8%	3.1%
Share of total	*20%*	*14%*	*17%*	*15%*	*24%*		
Total	22.0	29.8	32.2	35.7	**41.6**	3.1%	1.1%

Note: Based on New Zealand's "reference scenario", but modified according to IEA data methodology.

Sources: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2005 and country submission.

TAXES AND SUBSIDIES

In New Zealand, taxes on motor fuels are primarily used to raise revenue for road construction and maintenance, and to pay for the costs of road accidents, as opposed to being used to achieve energy policy objectives. Table 6 shows taxes imposed on motor fuels as of 1 July 2005. (For further information on motor fuel taxes, see Chapter 7.)

Table 6

Volume-based Duties, Taxes and Direct Levies on Motor Fuels on 1 July 2005

Units: NZc/litre	*Unleaded (91 RON)*	*Unleaded (96 RON)*	*Automotive diesel*	*Methanol*	*Liquefied petroleum gas*	*Compressed natural gas*
Crown Bank Account	18.708	18.708	0	30.2	0	0
National Land Transport Management Fund	22.492	22.492	0	0	10.4	10.5
Total excise	*41.2*	*41.2*	*0*	*30.2*	*10.4*	*10.5*
Accident Compensation Corporation Levy	5.78	5.78	0	0	0	0
Petroleum Fuels Monitoring Levy	0.025	0.025	0.025	0	0	0
Local Authorities Petroleum Tax	0.66	0.66	0.33	0.66	0	0
Total of volume-based duties and taxes	**47.665**	**47.665**	0.355	**30.86**	**10.4**	10.5

Source: Country submission.

Most taxes and levies on diesel use come in the form of road-user charges, which are designed to reflect road maintenance costs stemming from commercial vehicles. They are imposed on all diesel vehicles, on all vehicles heavier than 3.5 tonnes (loaded) and on all vehicles lighter than 3.5 tonnes (loaded) that are powered by fuel other than petrol, compressed natural gas or liquefied petroleum gas. The charges range from NZD 31.41/1 000 km to NZD 40.28/1 000 km. In addition, there are transaction fees for acquiring the licence and supplementary licences for heavier-than-normal loads carried a short distance.

In addition, an Energy Resources Levy is applied to natural gas produced from fields discovered before 1986 and on some opencast coal. The tax rate for this natural gas is NZD 0.45/GJ. Coal is taxed at a rate of NZD 2.00/tonne, except South Island lignite, which is taxed at NZD 1.50/tonne.

Levies on reticulated natural gas and electricity fund safety-related regulatory activities. Piped natural gas is taxed at a rate of NZD 0.02/GJ. Electricity is taxed at a rate of NZD 1.05 for every 100 kWh, paid by any person or entity that generates electricity for sale.

Unlike many IEA member countries, New Zealand does not provide any direct subsidies for domestic energy consumption, including subsidies for low-income consumers.

CRITIQUE

Over the last two decades, New Zealand's energy policy has been marked by a commitment to light-handed regulation, to ongoing government monitoring and review, and to liberalisation. Relative to most IEA member countries, New Zealand has a small population, low population density and is isolated from the rest of the world. Given this, its success with energy market liberalisation is remarkable. The country cannot rely on large economies of scale to improve efficiency or high liquidity to improve competition, and yet its electricity market, for example, is relatively well functioning. In fact, New Zealand was a pioneer in electricity market liberalisation; a nodal-priced market and the necessary institutional structures are now in place and functioning well, whereas many countries are just starting down the path of liberalisation. Furthermore, the country's commitment to undistorted and transparent liberalised markets is evidenced by its general lack of direct energy subsidies to specific customers or producers. Its commitment to ongoing and necessary review of its energy market ensures efficient and competitive outcomes and is shown by the government's recent creation of two new regulatory bodies, the EC and the GIC.

Alongside this commitment to liberalised markets, the government has continued to improve its energy policy, through revised royalty regimes to encourage exploration for natural gas and oil, through tax incentives and through the establishment of energy efficiency, renewables and sustainable transport strategies and high-level efficiency and renewables targets. Despite this progress, and in part because of its continuous market evolution, the country faces some specific challenges. Addressing these challenges will improve New Zealand's overall energy outcomes, and help ensure that the country's energy markets remain successful and bring benefits to New Zealand customers.

The New Zealand government has released a number of policy statements and strategies for different energy sectors and themes, including natural gas, electricity, transportation, energy efficiency and climate change. These documents are helpful in that they outline the government perspective and provide a degree of regulatory certainty. Governments are generally more reluctant to change course from policies that have been expressed in public documents. To that end, the government of New Zealand should strengthen its policy documents to reduce regulatory uncertainty, particularly in the face of the recent energy policy and institutional changes the government has undertaken. The energy strategy that was announced at the end of 2005 is a promising development and should be completed as quickly as possible.

The establishment of the EC and the GIC provides much needed regulatory oversight to industries that had previously been left to self-regulation, a somewhat unsuccessful regime that in many cases paralysed necessary

reforms. Furthermore, the new threshold regime for transmission and distribution businesses may improve transparency and efficiency in these industries by reducing the regulatory burden and increasing business flexibility. These are examples where there are likely to be long-term benefits to customers from these new institutions and regimes, but where in the medium term the changes create uncertainty. For example, some market participants have raised concerns about whether the GIC is a viable long-term institution, or if it will quickly be replaced by an institution similar to the EC. In addition, the threshold regulatory regime may add to regulatory uncertainty because reviews are conducted on an *ex post* basis. In the case of the EC and GIC, the government should continue to signal its support for these new institutions – should they continue to perform acceptably – to allay concern about their permanence. As discussed more fully in Chapter 8, the government should consider adding an *ex ante* component or option to the threshold regulatory regime. In so doing the government could help reduce market concerns about regulatory certainty and help underpin appropriate infrastructure investment.

The government's decision not to proceed with the carbon tax and its current review of all climate change policies have also created significant uncertainty, particularly in the electricity sector where important infrastructure decisions need to be taken to avoid shortages that some predict could be felt in Auckland as early as 2007. While the market is responding – new gas-fired generation is about to come on line, major transmission upgrades are being planned and significant gas, coal, wind, hydro and geothermal generation projects have been proposed – regulatory uncertainty may be delaying new investment. The current review of the government's climate change policies should be completed and a revised policy package should be announced and implemented as quickly as possible in order to reduce uncertainty and aid appropriate infrastructure investment.

The depletion of the Maui gas field by the end of the decade is a major challenge facing New Zealand. The government is well aware of this challenge and ensuring a successful transition to a post-Maui natural gas market is a priority. The government proactively increased incentives for exploration, both by reducing royalty rates for new discoveries, by introducing tax incentives and by reducing the costs and risks of potential exploration by making large amounts of geological data and other important information easily available. Early signs indicate that this strategy has been successful. In the event no new major gas fields are found, the government leaves open the possibility for imported LNG and the construction of an LNG terminal, but is reluctant to interfere in the market – LNG and CNG investment decisions are to be made by industry. Since New Zealand's energy mix is already relatively well diversified, it may be an option to let the share of natural gas in the market decline along with the Maui field and be replaced by a combination of other fuels, renewables and increased efficiency. The market will determine whether the

significant investment – approximately USD 400 million – necessary to build an LNG regasification terminal is appropriate for New Zealand, a country with 4 million inhabitants and a GDP of USD 90 billion (in current dollars). To that end, the government should ensure that there are no undue regulatory barriers for market participants to construct natural gas import infrastructure. As discussed more fully Chapter 7 on fossil fuels, the government might also consider regulatory incentives for new infrastructure.

Appropriate investment is also underpinned by accurate and easily available market information. In the case of the decline of the Maui gas field, such information is even more critical given the government's commitment to a free market determination of New Zealand's long-term dependence on natural gas. For this reason, the Ministry of Economic Development's Energy Information and Modelling Group, the group's continuous modelling of medium- and long-term scenarios – including scenarios that assume no new gas supplies – and the free dissemination of the scenario findings greatly benefit the market as it shifts from one that can rely on Maui field gas to one that cannot. The government should continue this modelling work, and ensure that worst-case scenarios remain included in the analysis. Easily available, understandable and accurate data and scenarios will stimulate public discussion and analysis, which will help New Zealand's energy market better adapt to new natural gas supply conditions and make appropriate investment decisions in a timely manner. The government should also look to the experience of the UK for guidance, where its North Sea gas fields declined at a faster rate than expected, shortening the investment window and disrupting the market.

The establishment of the EC will help ensure that appropriate infrastructure investments are made. While New Zealand's experience with self-regulation was not an outright failure, over the long term the blackout in 1998 and shortages in 2001 and 2003 highlighted the need for more regulatory oversight. The industry's inability to come to agreement and correct the conditions that led to these events shows the acute challenges and risks of the self-regulation model. Thus the government's establishment of the EC is commendable as it puts in place an institution better equipped to make necessary regulatory reforms that reduce the risk of supply shortages. However, the commission's lack of complete independence from the government is a cause for concern. Commissioners can be removed at the discretion of the Minister of Energy. Furthermore, the Minister of Energy and the government's energy administration can direct commission policy. The government should modify the governance structure of the EC so that it operates independently from the government. This will increase the transparency and predictability of the commission, leading to increased investor confidence and better functioning of the electricity market.

Like many governments, the responsibilities for energy and environmental policy and regulation are spread across a number of ministries, departments,

agencies and commissions. In New Zealand, these entities often report to various departments and ministers. For example, EECA's performance is monitored by the Ministry for the Environment but the conservation authority does not report to the Minister for the Environment. In an example of shared responsibility, electricity market regulation is split between the Electricity and Commerce Commissions. While it is impossible to put all responsibilities in a single institution – energy and environment issues affect a very wide range of policy areas – New Zealand's institutional structure could be streamlined. Ensuring an optimal allocation of responsibilities, better clarifying specific responsibilities and formalising co-operation between the various government bodies would help ensure that resources are not wasted and policies are consistent.

New Zealand's energy market also suffers from increased regulatory risk due to two factors related to the appeals process. First, appeals of many regulatory decisions by the CC and all decisions from the EC can only be made on points of law; merit-based appeals are not allowed. This reduces the perception of fairness and equity, and may diminish long-term stability. Second, there are no time limits for decisions made by the CC relating to business competition, or for many decisions made by the EC, though it does operate under strict timelines when dealing with electricity governance rules. While there are time-limit guidelines for decisions from the Rulings Panel of the Environment Court under the Resource Management Act, these time limits are not mandatory. This introduces uncertainty as to when a hearing will be scheduled or a decision rendered. Both of these factors increase uncertainty for companies operating in the energy industry in New Zealand, and could therefore inhibit investment. With due consideration to the costs and benefits of such changes, the government should consider expanding the scope of regulatory appeals, as well as instituting strict time limits. To that end, the government's successful efforts to improve the appeals process at the Environment Court are commendable and should continue.

Improvements in energy efficiency are critical for New Zealand to meet its Kyoto GHG reduction commitments, particularly given the relatively small share of emissions from the electricity sector and large share of emissions from the agricultural sector. In light of this, the government's energy efficiency targets and policies, part of NEECS, are commendable. Nevertheless, to ensure that the country takes greatest cost-effective advantage of domestic measures to meet its Kyoto target, New Zealand should intensify its efforts to improve its energy efficiency, particularly in the transport sector. The government should develop a set of integrated measures that address all aspects of the transport system, including technology, fuels, modal shifts and urban transportation issues. To the extent that they are cost-effective, increased deployment of smaller-scale renewables like wind and solar can also help improve the country's overall energy efficiency.

Despite New Zealand's commitment to liberalised markets, there is a high degree of government ownership of energy assets. New Zealand has taken great care in structuring these state-owned enterprises (SOEs) as independent entities, modelling private companies without government intervention. Indeed, there is no evidence that SOEs are systematically favoured by the government or that there is government intervention in their operations. However, the existence of SOEs could create governance issues in the future, given the degree of mutual interest in the financial health of these companies. The government should continue to support a level playing field such that SOEs and independent companies compete on equal terms. Furthermore, the government should periodically evaluate the policy of maintaining SOEs, ensuring that this policy does not inhibit more competitive or efficient outcomes.

RECOMMENDATIONS

The government of New Zealand should:

- *Seek to allay stakeholder concerns about certainty and predictability of regulatory policies, institutions and regimes in order to underpin appropriate energy market investments.*
- *Complete the planned energy strategy and review of the climate change policy package as quickly as possible.*
- *Continue to articulate scenarios, including worst-case scenarios, for medium-term gas supply possibilities so as to stimulate discussion and analysis to bring greater and more timely certainty about gas supplies.*
- *Ensure security of electricity supply through appropriate regulatory policies that do not inhibit infrastructure investment in either transmission or generation, in light of the country's medium-term supply constraints.*
- *Ensure regulatory independence of the Electricity Commission from the government.*
- *Ensure that the roles and relationships of different government entities are clearly and optimally defined, particularly where these entities have overlapping responsibilities.*
- *Consider establishing a streamlined merit-based appeals mechanism for energy-sector decisions from the Commerce and Electricity Commissions; consider implementing or strengthening time limits for energy-related hearings and decisions from the Electricity Commission, the Commerce Commission and the Environment Court.*

- *Intensify efforts to increase energy efficiency and, where appropriate, renewables, particularly in the transport sector.*
- *Continue to support a level playing field for both state-owned and independent energy companies.*
- *Periodically reconsider the policy of not selling any state-owned enterprises in the energy sector, especially when a policy change may result in more efficient and competitive outcomes.*

Like most IEA countries, New Zealand is facing a significant challenge in reducing its GHG emissions and meeting its climate change targets. GHG emissions are currently 23% above the country's Kyoto Protocol target and estimates show that emissions could be 21%, or 64 $MtCO_2$-eq, over the Kyoto target during the first commitment period (2008-2012). This projection takes into account the domestic policies and measures the country has planned or implemented that aim to reduce its GHG emissions. As policies to reduce GHG emissions span many sectors and areas, climate change issues are addressed not only in this chapter, but also in the chapters on energy efficiency and renewables, and, to a lesser extent, in the chapter on electricity. The other critical environmental challenge the country is facing is improving its air quality. Most regional air quality issues are addressed in this chapter, but some issues relating to transport are also found in the energy efficiency chapter. Some energy efficiency efforts related to industry are discussed in this chapter; in general, transport and residential sector efficiency policies are discussed in the chapter on energy efficiency.

CLIMATE CHANGE

New Zealand is a party to the Kyoto Protocol, and has agreed to return its GHG emissions to their net 1990 levels over the 2008-2012 commitment period through domestic actions (reducing emissions or increasing uptake by land use and forestry), or by purchasing emission units on the international market.

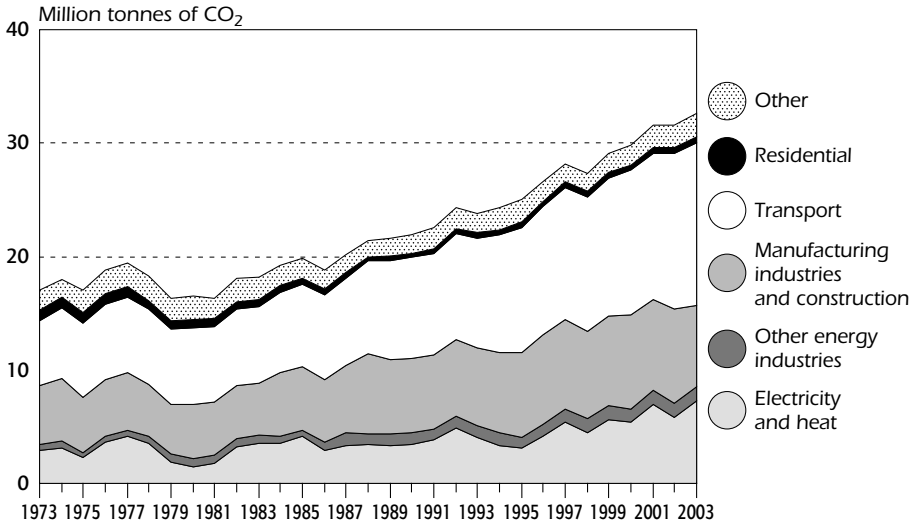
TRENDS IN CO_2 EMISSIONS

As shown in Figure 8 and Table 7, GHG emissions from fuel combustion in 2003 were 32.7 $MtCO_2$, nearly 50% above 1990 emissions. They have been rising at an average annual rate of 3.1% since 1990. The smallest percentage growth has been in manufacturing industries and construction, where emissions from industry have risen by 10% since 1990. The overall rise would have been much larger, but between 2002 and 2003 manufacturing industry and construction emissions dropped by over 1 $MtCO_2$ in large part owing to the mothballing of Methanex's methanol plants, representing over 60% of the total increase between 1990 and 2002.

In absolute terms, however, the largest growth has been in the transport sector – nearly half of all CO_2 increases since 1990 are from this sector. The second-largest absolute increase in CO_2 emissions is in the electricity sector, which grew by more than 4 $MtCO_2$, making up over one-third of the total increase since 1990.

Figure 8

CO_2 Emissions by Sector*, 1973 to 2003



* estimated using the IPCC Sectoral Approach.

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2005.

Table 7

CO_2 Emissions by Sector*, 1970 to 2003

						1990-2003		
Units: $MtCO_2$	*1970*	*1980*	*1990*	*2000*	*2003*	*Absolute increase*	*Percentage increase*	*Average annual increase*
Transport	4 858	6 714	8 963	12 767	14 291	5 328	59%	4%
Share of total	*35%*	*41%*	*41%*	*43%*	*44%*			
Electricity & heat	1 885	2 186	4 442	6 585	8 501	4 058	91%	5%
Share of total	*13%*	*13%*	*20%*	*22%*	*26%*			
Manuf. ind. & constr.	4 434	4 798	6 541	8 237	7 193	652	10%	1%
Share of total	*32%*	*29%*	*30%*	*28%*	*22%*			
Other	1 776	2 065	1 674	1 696	2 112	438	26%	2%
Share of total	*13%*	*13%*	*8%*	*6%*	*6%*			
Residential	1 121	728	348	487	571	223	64%	4%
Share of total	*8%*	*4%*	*2%*	*2%*	*2%*			
Total	**14 075**	**16 491**	**21 968**	**29 772**	**32 667**	**10 699**	**49%**	**3%**

* estimated using the IPCC Sectoral Approach.

Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2005.

GHG emissions in New Zealand do not match the profile of most IEA countries. GHG emissions from fuel combustion represent only half of the country's total emissions; the other half comes from the agricultural sector. These are primarily emissions of methane (CH_4) and, to a lesser extent, nitrous oxide (NO_2) from livestock and agricultural soils. Total GHG emissions from all sectors are shown in Table 8. Non-CO_2 emissions have been converted to CO_2 equivalents based on the global warming potential of each gas. As the Kyoto Protocol looks at net emissions – total emissions less certain absorption from land use and forestry sinks – land use change and forestry removals are also included.

Table 8

Greenhouse Gas Emissions and Removals in CO_2 Equivalent, 1990 to 2003

Units: $MtCO_2$-eq						*Percentage change*		
	1990	*2000*	*2001*	*2002*	*2003*	*1990-2003*	*2000-2003*	*2002-2003*
Agriculture	32.19	35.51	36.35	36.76	37.20	15.6%	4.8%	1.2%
Share of subtotal	*52%*	*51%*	*50%*	*50%*	*49%*			
Energy	23.59	28.91	30.83	30.87	32.32	37.0%	11.8%	4.7%
Share of subtotal	*38%*	*41%*	*42%*	*42%*	*43%*			
Industrial processes	3.21	3.51	3.67	3.82	4.01	25.0%	14.3%	5.0%
Share of subtotal	*5%*	*5%*	*5%*	*5%*	*5%*			
Waste	2.48	1.72	1.72	1.73	1.75	-29.3%	2.2%	1.5%
Share of subtotal	*4%*	*2%*	*2%*	*2%*	*2%*			
Solvent and other product use	0.042	0.047	0.047	0.048	0.048	16.4%	2.6%	0.0%
Share of subtotal	*0%*	*0%*	*0%*	*0%*	*0%*			
Subtotal	**61.52**	**69.69**	**72.62**	**73.23**	**75.34**	**22.5%**	**8.1%**	**2.9%**
Land use change and forestry	-21.37	-22.82	-23.19	-23.327	-22.86	7.0%	0.2%	-2.0%
Total	**40.16**	**46.87**	**49.43**	**49.90**	**52.48**	**30.7%**	**12.0%**	**5.2%**

Note: The "energy" category in this table and the "total" in Table 7 contain different subgroups; they are not directly comparable.

Source: *New Zealand Energy Greenhouse Gas Emissions, 1990-2004*, New Zealand Ministry of Economic Development, June 2005, Table 9.1.1.

Total GHG emissions have increased significantly less since 1990 than fuel combustion emissions alone. Gross emissions have increased by 23% since 1990 whereas energy-sector emissions have increased by 37%. This is due in part to relatively lower increases in agricultural emissions, and somewhat lower increases in industrial process emissions. Assuming straight-line reductions from 2003 to the start of Kyoto's first commitment period in 2008, total GHG emissions in New Zealand would need to fall by 2.9% annually to meet the entire Kyoto target through domestic action.

New Zealand's current GHG balance with regard to its Kyoto target is higher than was expected when the Kyoto Protocol was signed. This is due to a number of factors. Substitution of coal for natural gas is one contributing factor. In addition, the 2.9% increase from 2002 to 2003 is due to the relatively dry winter and lower gas availability and, therefore, higher reliance on coal. Another factor is stronger-than-expected growth in both the economy and, by extension, transportation. In addition, an accounting change under the Kyoto Protocol effectively increases New Zealand's emissions by heavily devaluing its forestry sinks.

PROJECTED GHG EMISSIONS

Based on the most recent government estimates[5], New Zealand's GHG emissions during the first Kyoto commitment period are projected to be 21%, or 64 $MtCO_2$-eq, above its target. This estimate takes into account the recent decision not to proceed with the carbon tax, as well as the government's programme liabilities[6] and the effects of forestry sinks. The government is expected to release more detailed projections, including alternative scenarios, in late May 2006.

POLICIES AND MEASURES TO REDUCE EMISSIONS

In October 2002, the government issued its policy package on climate change after cost-benefit analysis of various means to reduce emissions. The policy package included many policies and measures, but the three cornerstone components were a carbon tax, negotiated GHG agreements (NGAs) and the *Projects to Reduce Emissions* programme. These policies and measures were administered by the New Zealand Climate Change Office (which has since become part of the Ministry for the Environment), in co-ordination with other offices. Given the country's GHG emissions profile and that there are currently no practicable means of reducing agricultural emissions, the government sees the reduction of transport emissions as a high priority. Transport-sector climate change activities will be discussed in Chapter 5 on energy efficiency. Until at least 2012, the agricultural sector will be exempt from any broad-based price measures on the CH_4 and NO_2 emissions it produces; the government will cover the full cost of these emissions. Research on ways to reduce these emissions is discussed in Chapter 9 on R&D.

In December 2005, the government announced that it would not introduce the previously announced carbon tax model or any other broad-based economic instrument before the end of the Kyoto Protocol's first commitment period. NGAs

5. New Zealand Treasury, *Financial Statements of the Government of New Zealand: For the Six Months Ended 31 December 2005*, 17 February 2006, available from www.treasury.govt.nz/financialstatements/month/dec05/cfs6dec05.pdf.
6. For further information on programme liabilities, see the section on the *Projects to Reduce Emissions* programme later in this chapter.

and the *Projects to Reduce Emissions* programme are both under review. The government is in the process of developing a work plan on alternative measures to the cancelled carbon tax, including consideration of emissions trading and new, possibly voluntary, arrangements to replace negotiated greenhouse agreements. This decision was taken after the government received a report by a cross-departmental team that reviewed climate change policies.

In recognition of the expected shortfall in meeting its Kyoto target – net emissions are expected to be above the target by 64 $MtCO_2$-eq during the first commitment period's five years – the government Treasury has listed an equivalent liability of NZD 562 million in its financial statements. This is based on a carbon price of USD 6/tonne. The liability of NZD 562 million takes into account the full cost of procuring New Zealand's projected Kyoto target shortfall on international markets. Emissions reductions stemming from current policies and measures are taken into account in this estimated liability. However, the government is currently reviewing its climate change policy package and if existing policies and measures are strengthened, this could reduce New Zealand's overall liability. While the government's projected liability estimates the cost of procuring 100% of New Zealand's shortfall from international markets, the government could ultimately choose to make up some of this shortfall through additional domestic actions.

Carbon tax

As part of the policy package, the government originally intended to price carbon through a carbon tax, which was to be introduced on fossil fuels from 1 April 2007 and set at a level that approximated the international price of carbon, but capped at NZD 25/tCO_2-eq. The carbon tax was to have been applied by levying the tax as close to the source as possible. For coal and natural gas produced in New Zealand, the levy was to be imposed at point of first sale, for imported coal this would be when it crossed the border and for liquid fossil fuels this would be when they left the oil refinery or crossed the border. However, following the release of a government review of its climate change policy[7], in December 2005 the government decided to cancel implementation of the carbon tax.

In part, the carbon tax was cancelled because of opposition from business and consumer groups, and also because it lacked the support of the Labour Party's coalition partners, the New Zealand First and United Future parties, who argued that the tax would place an unfair and costly burden on New Zealand businesses and households. In addition, the climate change policy review found that the tax was set too low to have a significant impact on GHG emissions. Estimates showed that the tax would have added about

7. New Zealand Ministry for the Environment, *Review of Climate Change Policies*, 2 November 2005 (released 21 December 2005), available from www.climatechange.govt.nz/resources/reports/policy-review-05/policy-review-05.pdf.

3.5 cents/litre to the cost of petrol, which is currently around NZD 1.50/litre. For a typical New Zealand household, the government estimated the cost to total about NZD 4 per week for electricity, petrol and other fuels.

As a result of the policy review, the government is assessing options for a more narrowly based tax or trading scheme and/or voluntary agreements to replace negotiated GHG agreements. An initial set of draft policy options was completed in April 2006 and the final decision on which policy options to adopt is expected in October 2006. The government has left open the possibility of implementing a broad-based carbon tax or other economic instrument after 2012.

Negotiated greenhouse gas agreements

When the carbon tax was still part of the government's policy package, the government recognised that it would significantly increase costs for energy-intensive industries and put them at a competitive disadvantage compared to companies in countries without carbon charges or with lower charges. For this reason, the government developed negotiated GHG agreements (NGAs), which would have provided companies that entered into the agreements full or partial exemption from the carbon charges. In exchange for the exemptions, these companies were required to move to world's best practice in GHG emissions management or to meet the financial consequences. However, the NGA programme is now under review and may not be continued.

The *Projects to Reduce Emissions* programme

Through the *Projects to Reduce Emissions* (PRE) programme, the government provided incentives to initiatives that would reduce GHG emissions prior to and during the Kyoto Protocol's first commitment period. This programme is currently under review as part of the overall climate policy package review and may not be continued.

In order to qualify, projects had to be uneconomic without the incentive, *i.e.* the emissions reduction would not be achieved under normal business-as-usual conditions. For example, some wind energy projects did not qualify, or even apply, for these incentives as wind energy is often already economic in New Zealand. The programme took advantage of the Kyoto Protocol's joint implementation (JI) mechanism, encouraging the development of projects by providing a share of New Zealand's Kyoto emission units, which can be traded on international markets. The benefit to New Zealand in terms of emissions reductions comes from the difference between the amount of credits the government provided to the project and the reductions the project actually delivers.

The benefit was not the full amount of the project's reductions because any emission units provided to a project were counted as an equivalent liability against New Zealand's Kyoto commitment, fully offsetting the reduction's

benefit. For example, one tonne of CO_2 reduction units provided to a project by the government increased New Zealand's Kyoto commitment by one tonne. To account for this equivalent liability, only projects where the number of Kyoto Protocol emission units requested by the project were less than or equal to the tonnes of CO_2-equivalent emissions expected to be reduced by the project were considered. In the second round of the programme, taking into account the assessed risk that a project would not deliver its promised reductions, projects offering the greatest reduction in emissions in exchange for the smallest number of emission units were ranked highest until all emission units allocated to the programme were exhausted. This modification to the allocation scheme in the second round differentiated New Zealand's JI mechanism from that of other countries – most countries provide emissions reduction units using a one-to-one ratio with projected emissions reductions.

Projects were selected through annual tender rounds. After a selected project has delivered verified emissions reductions, it receives emissions reduction units in the form of assigned amount units (AAUs) from the New Zealand government. AAUs are tradable emission units under the Kyoto Protocol's emissions trading mechanism that can be used during the first commitment period, between 2008 and 2012. Each AAU allows the emission of one tonne of CO_2 equivalent. In addition, projects could choose to receive emissions reduction units (ERUs), provided that the projects met the requirements for joint implementation (JI) under the Kyoto Protocol[8]. AAUs and ERUs are functionally equivalent – they each represent one tonne of CO_2-eq emissions – but operate under different rules and regulations. Some companies may prefer ERUs because they are considered traceable, verified reductions, and thus may have a higher value on the market. The mechanism was open to participation and investment from outside New Zealand if the project activity resulted in emissions reductions in New Zealand. AAUs and ERUs were not immediate financial incentives. Instead they provided longer-term incentives, as companies can sell the credits on Kyoto emission credit markets in 2008 and beyond.

Two tender rounds have been completed and 41 projects have received contracts for the provision of a share of 10.6 million Kyoto emission units (see Table 9). In total, 11.0 $MtCO_2$ in reductions are expected from the projects over the first commitment period, resulting in a net benefit to the country of 1.2 $MtCO_2$ over Kyoto's five-year first commitment period. This corresponds to about 2% of the total emissions reductions necessary for New Zealand to meet its Kyoto commitment – assuming that New Zealand's emissions are 64 $MtCO_2$-eq above its Kyoto target during the first commitment period without the projects.

8. If companies choose to receive ERUs, they must pay any costs associated with obtaining ERUs.

Table 9

Emissions Reduction Credits Awarded to New Zealand Companies, 2003 and 2004

	Number of projects awarded units	*Units allocated (millions; equal to $MtCO_2$-eq)*	*Expected reduction ($MtCO_2$-eq)*
Early projects	2	0.8	0.9
Tender round 1 (2003)	13	3.7	3.7
Tender round 2 (2004)	26	6.1	7.3
Total	**41**	**10.6**	**11.9**
Total during first commitment period	**39**	**9.8**	**11.0**

Source: Country submission.

Between the first and second tender rounds, changes were made to the programme. Priority for electricity generation projects was removed and a risk assessment component was added, together with a cost-effectiveness criterion. In the second round, projects were ranked and selected on the basis of the ratio between the tonnes of CO_2-equivalent emissions expected to be reduced and the number of emission units requested, and only projects with a ratio above one were considered. In the previous round, all projects needed to meet the one-to-one minimum ratio, but projects were not ranked on the basis of this ratio.

One benefit of New Zealand's JI programme is that it lowers transaction costs for New Zealand projects. As these projects are typically small – and New Zealand is very far from most countries with Kyoto commitments – it is unlikely that these projects would be initiated by interest from other countries seeking JI projects. Instead, this mechanism provides New Zealand firms with Kyoto units that they can take directly to the market. Companies that have received emissions reduction units in both rounds, as well as the owners of two early projects authorised prior to the first tender round, have engaged in negotiations over the sale of allocated emission units to government procurement programmes, particularly in the Netherlands and Austria. The New Zealand government has entered into a bilateral co-operation arrangement with the Netherlands and Austria to facilitate the carryin-out of JI projects.

Assistance for energy-intensive SMEs

Emissions from small and medium-sized enterprises are estimated to account for around 15% (5 $MtCO_2$-eq) of New Zealand's 34 $MtCO_2$-eq annual emissions. The Energy Efficiency and Conservation Authority (EECA) estimates that most firms are capable of achieving energy efficiency gains of 5-7% through relatively simple measures. The government estimates that further improvements, often up to 20%, can be made using information from energy audits.

To that end, government assistance for energy-intensive small and medium-sized businesses aims to achieve overall efficiency gains of 5% for fossil fuel use (coal, gas, liquid fuels) and 7% for electricity use, with up to 20% in some firms in target industries. This would translate into emissions reductions of at least 300 000 tCO_2-eq per year (about 3% of emissions from industrial and commercial sources). Nine industries have been identified as being energy-intensive: wood processing, food processing, basic metals, non-metallic industries, paper and paper products, tourism transport, glasshouse crops, fishing and irrigated dairying and arable crops.

In March 2005, the government approved specific policies for energy-intensive businesses to help them reduce GHG emissions through improved energy efficiency. The assistance will be implemented through four measures. First, financial grants will be available to assist capital investment in technologies to improve energy efficiency. Demonstrations of energy-efficient technologies to provide support for innovation and technology uptake will also be conducted. The government will also sponsor training for company directors to influence a conservation culture in corporate governance. Finally, education for company managers and staff about energy efficiency will be provided.

On 1 July 2005, EECA established a pilot programme to test the effectiveness of the grant scheme and demonstration projects, and to provide information that could support establishment of a fully fledged scheme. Training and education programmes will begin in 2006. The pilot demonstration and grant scheme will cost NZD 1.1 million to implement in 2005/06 and NZD 1.35 million annually in 2006/07 and 2007/08, excluding private-sector capital investment. The costs of the full scheme have not yet been fully determined. The pilot scheme is a combined grant and demonstration programme. Cash grants are available for projects that demonstrate the application of technologies that are proven to increase energy efficiency.

This assistance targets energy-intensive SMEs in New Zealand (about 3% of all businesses) that are too small to bear the costs of a negotiated GHG agreement. Companies that signed NGAs were not eligible for this assistance. EECA also administers other policies and measures aimed at all SMEs. These are primarily focused on energy efficiency and include subsidised energy audits, self-diagnostic methods to assess energy use, and advice and guidelines about energy-saving methods and suppliers of energy-saving equipment. However, most of the policies targeting SMEs focus on energy-intensive SMEs. (For more information on these programmes, see Chapter 5 on energy efficiency.)

Communities for Climate Protection

Seventeen regional councils have joined the Ministry for the Environment's *Communities for Climate Protection* programme, covering about 45% of New Zealand's population. The programme is fully funded by the Ministry for the

Environment and managed by the International Council for Local Environmental Initiatives, a not-for-profit local government association. Councils that join the programme commit to achieving milestones through passage of a council resolution. The programme works with regional councils to help them develop emissions inventories, set targets for emissions reductions, develop and approve action plans for achieving these targets and monitor progress towards targets on an on-going basis. The programme has helped regional councils reduce emissions by implementing programmes to increase sustainable transportation, to improve energy efficiency and conservation, to enhance urban design and to reduce landfill emissions.

A programme run by EECA that complements the *Communities for Climate Protection* programme is the *EnergyWise Councils Partnership*, which aims to have energy efficiency and conservation acknowledged as a core responsibility of local government. Under the programme, councils and EECA work together towards shared energy efficiency goals. Twenty-four local authorities are involved. The programme takes a long-term approach to achieving energy savings. Councils are encouraged to promote energy efficiency and conservation in-house and throughout their communities.

Public awareness

New Zealand is also focusing on public awareness to drive emissions reductions. Through the *Four Million Careful Owners* programme, New Zealand has launched two public awareness campaigns. Phase one of the campaign, which started in December 2003, consisted of strong media coverage of energy efficiency and general environmental measures in all key news media including television news, radio interviews and print stories. Radio, print and on-line advertising messages continued over a six-week period.

Phase two of the *Four Million Careful Owners Public Awareness and Education Campaign* was undertaken from August 2004 to February 2005. The campaign aimed to build awareness of the effects of climate change and what New Zealanders can practically do to reduce GHG emissions. It was built on the success of Phase 1 of the campaign and expanded the media and advertising component to include stakeholder and event management to raise public awareness, and the formation of an industry reference group to represent private, public and local government-sector interests and to encourage leadership in climate change action.

Research following the first campaign showed that the number of New Zealanders who attributed climate change to the effects of pollution from human activities grew from 63% before the campaign to 74% after the campaign. In addition to raising awareness of climate change, the programme also provides information to communities and residential customers on how to reduce home and transport emissions.

AIR QUALITY

Air quality throughout New Zealand is generally quite good, owing in large part to the country's low population density and proximity to the sea. However, in a few regions – namely in the urban centres of Auckland and Christchurch – air quality suffers from air pollution, particularly during low wind conditions and in areas where home heating is mainly by open fires or wood burners. Particulate air pollution is of most acute concern. The primary source of fine particulate pollution is home heating using wood and coal, though in the Auckland area vehicles are a major contributor.

AMBIENT AIR QUALITY STANDARDS

National environmental standards for regional air quality were established in September 2004. Fourteen standards were adopted, including five ambient air quality standards and a design standard for new wood burners installed in urban areas. The air quality standards are shown in Table 10. Comparative standards in other regions, plus the World Health Organization (WHO) standard, are also provided.

Regional councils were required to be compliant with these ambient air quality targets by September 2005, except for the particulate matter (PM_{10}) standard, which must be achieved by 2013. There are currently 30 air sheds likely to be out of compliance with the ambient air quality standards. For these regions, an air quality pathway will be established so that each region achieves the standards by 2013. If air sheds breach ambient air quality standards for any contaminant, they must alert the public to the breach monthly until they are back in compliance. Currently, estimates of the population living in air sheds likely to be non-compliant with the air quality standards are not available, in part because air shed definitions are set by regional councils and differ across regions. Nonetheless, these areas cover all of New Zealand's large cities and towns and the majority of New Zealand's population.

In order to aid the implementation of these national environmental standards, in particular the fine particulate standard, the Ministry for the Environment is leading a *Warm Homes* project. This project focuses on the use of solid fuel for domestic heating and promotes an approach that enables the clean and sustainable heating of New Zealand homes. A national subsidy scheme and an awareness-raising campaign are currently being investigated. Additionally, EECA operates a grant scheme to install insulation in older housing stock – a key step in ensuring fine particle emissions from domestic heating are reduced. For more information on this programme, see Chapter 5 on energy efficiency.

Table 10

Ambient Air Quality Standards

				Comparative standards				
	Averaging period	*New Zealand standard*	*Permissible excess*	*Australia*	*EU*	*WHO*	*California*	*US*
PM_{10}	24 hours	50 μg/m³	One 24-hour period in a 12-month period	50 μg/m³	50 μg/m³	No safe level	50 μg/m³	150 μg/m³
NO_2	1 hour	200 μg/m³	9 hours in a 12-month period	256 μg/m³	200 μg/m³	200 μg/m³	470 μg/m³	–
Ozone	1 hour	150 μg/m³	Not to be exceeded at any time	210 μg/m³	170 μg/m³	–	180 μg/m³	–
CO	8 hours	10 mg/m³	One 8-hour period in a 12-month period	–	–	10 mg/m³	10 mg/m³	10 mg/m³
SO_2	1 hour	350 μg/m³	9 hours in a 12-month period	570 μg/m³	350 μg/m³	–	655 μg/m³	–
	1 hour	570 μg/m³	Not to be exceeded at any time					

Note: mg/m³ = milligram per cubic metre; μg/m³ = microgram per cubic metre. A μg is one-one thousandth of a milligram. Comparative values do not include all applicable standards. Many governments and organisations have additional standards for different averaging periods.

Sources: *Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004*, Governor-General, 6 September 2004, available from http:// gpacts.knowledge-basket.co.nz/regs/regs/text/2004/2004309.txt; *Ambient Air Quality Standards*, California Air Resources Board, available from www.arb.ca.gov/aqs/aaqs2.pdf; *The Proposed Air Quality Standards*, New Zealand Ministry for the Environment, available from www.mfe.govt.nz/publications/air/nes-air-standards-analysis/html/page5.html.

VEHICLE EMISSIONS

Vehicle particulate emissions standards were introduced from 2003 under the 2003 Vehicle Exhaust Emissions Rule. It puts in place a vehicle exhaust emission standards regime for motor vehicles entering the fleet that were manufactured after 1990, and aims to ensure that all such motor vehicles have been manufactured to the applicable exhaust emissions standards specified in the rule. The rule was fully implemented on 1 January 2006. More stringent requirements are being phased in between 2004 and 2008 as fuel specifications in New Zealand become more stringent.

The phase-in of more stringent rule requirements will allow time for vehicles, particularly heavy vehicles, to adapt. The more stringent rules will result in progressive exclusion from New Zealand of vehicles manufactured after 1990 that do not meet the emission standards. Additional measures to tackle vehicle pollution include:

- Revised fuel specifications, including the progressive reduction of the maximum sulphur content in diesel fuels to 50 parts per million (ppm) by 2006, bringing them in line with current European standards. They will be further reduced to 10 ppm by 2009.
- Introduction of the Frontal Impact Standard on 1 April 2002, which acted as a *de facto* emission standard by limiting the age of vehicles coming into the country.
- Amending the 1976 traffic regulations to make it an offence to emit excessive smoke for more than ten seconds.

Work is ongoing to implement additional programmes:

- Uptake of cleaner fuels through further changes to fuel specification standards.
- Introduction of a visual smoke test by the end of 2006.
- Development of strategies to ensure that vehicles built with the emissions control technologies required by the 2003 Vehicle Exhaust Emissions Rule remain compliant with the rule throughout their useful life.
- Increased collaboration between central government agencies and local government to encourage more sustainable forms of urban development.
- Increased funding for walking and cycling infrastructure.
- A new patronage funding system for public transport.
- Increased collaboration across central and local government, trade and industry, as well as consumers, interest groups and other stakeholders to educate, involve and engage at all levels in transport emissions policy development.
- The continuing development of models that better assess the impact of transport policies and project vehicle emissions.

CRITIQUE

Like many IEA countries, New Zealand is facing a considerable challenge in meeting its Kyoto climate change commitments by reducing its GHG emissions. Current GHG emissions are 23% above the target and government estimates project that emissions could be 21%, or 64 $MtCO_2$-eq, over the Kyoto target during the first commitment period. Unlike most IEA countries, meeting New Zealand's target is made very difficult because energy-sector emissions are relatively small – New Zealand's GHG emissions are much lower per capita than other IEA member countries in large part because of its heavy reliance on hydro – and because it is difficult or impossible to extract significant reductions from its largest GHG-emitting sector. Half of GHG emissions are from the agricultural sector, where there are very few practicable emissions reduction technologies in the short term. While some reductions could come from the small number of GHG-emitting power plants, more focus is likely to be placed on the other sectors, including the transportation and industrial sectors.

While the government has provided significant data and estimates on existing climate change policy, it has not yet outlined how it will cover the remaining 64 $MtCO_2$-eq shortfall. Covering this shortfall will likely come from international mechanisms such as joint implementation, the clean development mechanism and international emissions trading. Given that project-based mechanisms like joint implementation and the clean development mechanism need significant lead time to implement and that emission credit prices are likely to rise closer to the first commitment period, the government should outline and undertake its international efforts as quickly as possible. The government should also ensure that international measures are allocated between the various options – joint implementation, the clean development mechanism and international emissions trading – in a cost-effective manner, noting that clean development mechanism projects may be the least costly. It is positive that the government has listed a liability of NZD 562 million in its financial statements to account for the likely purchase of emission credits (assuming the entire shortfall is met through purchasing), but the government should ensure that this is a sufficient amount to cover its shortfall and should detail as quickly as possible how it will spend the money. The government should also detail what part of its shortfall will be met through domestic action and implement the appropriate policies as quickly as possible.

It is disappointing that the government has decided not to proceed with its planned carbon tax, as incorporating a carbon price signal into the market is a cost-effective means of reducing GHG emissions and help New Zealand to meet its Kyoto commitment. It also matched New Zealand's general approach of relying on prices – and not programmes – to achieve policy goals most efficiently. Though the tax was to be set at a relatively low level and with

incomplete coverage and might not originally have sent a sufficiently strong price signal to the market to stimulate significant reductions, it was a good starting point for a long-term and efficient means of reducing emissions.

Following its decision not to proceed with the broad carbon tax, the government intends to assess options for a more narrow carbon tax levied on major energy users – including the electricity sector – and emitters who do not meet world best practices. The government should also consider policy options beyond a revised carbon tax. As the Kyoto Protocol provides international flexibility to achieve countries' commitments, an emissions trading scheme linked to international markets could be another cost-effective solution. Emissions trading would allow the country to assign specific volumes of emissions reductions to the sectors covered, contributing defined reductions to help New Zealand meet its Kyoto commitment. If New Zealand considers an emissions trading scheme, the country should look to the experience of Europe with the EU Emissions Trading Scheme (EU-ETS), particularly to the distribution effects of the scheme on various activities. Establishing a domestic emissions trading system does not preclude the use of a carbon tax. Such a tax could apply to those sectors not likely to be covered by a trading system (*e.g.* transport, residential, small businesses). Regardless of the mechanisms implemented, and given that the government has abruptly changed its policy direction, it should finalise all climate change policies and measures – including domestic measures and international purchases – as quickly as possible to minimise the negative effects of these decisions on the market.

Negotiated greenhouse agreements (NGAs) were another major component of New Zealand's policy package. Full or partial exemption from carbon taxes had been a strong incentive for companies to sign on to these agreements. However, this will not be the case owing to the government's decision not to implement the planned carbon tax and its current review of the NGA programme. As the government considers introduction of other mechanisms as discussed above, it should also consider how to link such mechanisms with NGAs if they are continued. For example, if a narrow carbon tax is applied to large emitters, full or partial exemption could be an incentive, as previously planned. In this case, intensive reporting and monitoring will be essential to avoid any "free riding" by companies that receive the benefits but fail to deliver the promised reductions. Given the large number of small and medium-sized enterprises, the government should explore the possibility of expanding the coverage of voluntary agreements to them, particularly as the country has decided not to proceed with the carbon tax. Noting that they may find it difficult to follow international best practice, some different arrangement, such as requiring participating companies to make energy efficiency investment with certain payback periods, may be necessary. For example, New Zealand might look to the Netherlands, which developed long-term agreements (LTA2) aimed at small and medium-sized businesses that cannot join its benchmark covenants for large industries. Small companies can

participate collectively in LTA2 if their total energy consumption surpasses certain thresholds. Each participating company has to draw up an energy conservation plan, which sets an energy efficiency target, proposes specific measures and establishes a schedule for their implementation. The participants agree to make energy efficiency investments with payback times of up to five years or with a positive net present value calculated using a 15% internal rate of return. Novem, an entity equivalent to EECA in New Zealand, monitors the progress of LTA2 and receives annual progress reports from the participants. Through a combination of benchmarking covenants for large industries and LTA2 for small and medium-sized enterprises, the voluntary agreements cover 95% of the total industrial energy consumption. New Zealand could learn from such experiences.

New Zealand has put significant focus on the industrial sector – through negotiated GHG agreements and assistance for energy-intensive industries – but has placed more limited focus on the transport sector, a particularly important emissions-producing sector in New Zealand, as discussed more fully in the following chapter. The government should ensure that all cost-effective measures are in place in the transport sector, noting the difficulty of creating appropriate incentives or standards in a market where most cars are imported as used vehicles. For more information, please see Chapter 5 on energy efficiency.

As there are currently no practicable methods for reducing emissions in the agricultural sector, the government's measures are focused on research. This is a reasonable approach, given the reality of existing technologies in the agricultural sector as well as the importance of the sector on total GHG emissions.

Unlike most IEA countries, New Zealand is only now implementing ambient air quality standards. This is necessary, as the standards will improve the health of those living in areas with poor air quality. New Zealand should continue to monitor air quality and compliance with the new ambient air quality standards, and ensure on an ongoing basis that standards are set at levels that protect public health in a cost-effective manner.

RECOMMENDATIONS

The government of New Zealand should:

- *Outline a budget and plan for international actions to meet New Zealand's projected Kyoto Protocol shortfall, and implement the plan as quickly as possible.*
- *Finalise and implement all climate change policies and measures as quickly as possible, particularly in light of the government's recent decision not to proceed with the planned carbon tax.*

- *Consider implementing a carbon tax or emissions trading – or a combination of the two – as quickly as possible.*
- *Consider revised incentives for enterprises to participate in negotiated greenhouse agreements, and ensure effective reporting and monitoring; consider expanding the coverage of voluntary agreements to small and medium-sized enterprises.*
- *Address CO_2 emissions from the transport sector through appropriate fiscal and regulatory measures.*
- *Continue research efforts on methane emissions from the agriculture sector, noting the difficulty of reducing such emissions.*
- *Continue to implement policies and measures that address New Zealand's local air quality problems in a cost-effective manner.*

Improved energy efficiency is often a cost-effective means of ensuring energy security and reducing the negative environmental impacts of energy consumption. As such, energy efficiency policy spans many sectors and areas. Energy efficiency polices related to the transport and residential sectors are largely discussed in this chapter, whereas industrial efficiency efforts are discussed both here and in Chapter 4, reflecting New Zealand's heavy reliance on industrial-sector policies to meet its climate change commitments.

In the past, energy efficiency awareness has not been high in New Zealand, in part because energy prices have been low for New Zealand customers. Government focus on energy efficiency has grown substantially in recent years, and it is now a key component of energy policy.

ENERGY INTENSITY MEASURES

New Zealand's energy intensity, as measured by energy consumption per unit of GDP, peaked in 1992 (see Figure 9). It has been falling steadily since 1997 at an average annual rate of 2.7%, nearly double the IEA average over the same period. While New Zealand's energy intensity remains 1.6% above the IEA average, in 2003 it dropped below that of Australia.

GOALS AND STRATEGIES

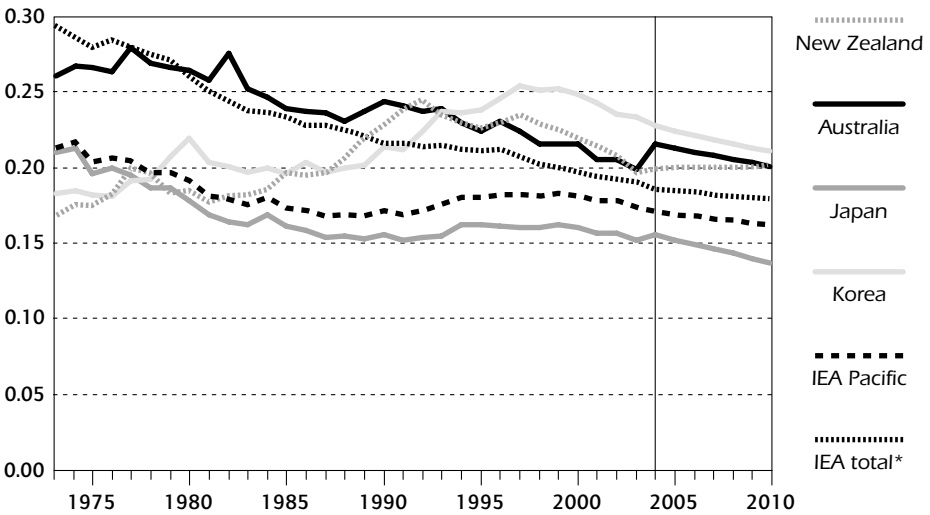
NATIONAL ENERGY EFFICIENCY AND CONSERVATION STRATEGY

In 2001, New Zealand released its first *National Energy Efficiency and Conservation Strategy* (NEECS), prepared as a requirement of the Energy Efficiency and Conservation Act of 2000. Its purpose is to promote energy efficiency, energy conservation and renewable energy, and to move New Zealand towards a sustainable energy future. To meet the objectives of the strategy, five action plans were developed for government, energy supply, industry, buildings and appliances, and transport. The strategy is to be reviewed every five years. Its two main targets for 2012 are a 20% improvement in the country's energy efficiency and a 30 petajoules (0.7 Mtoe) increase in annual renewable energy production, equivalent to a 22% increase. In October 2002, an indicative target for the transport sector was set; 2 PJ (0.05 Mtoe) of the renewable energy target should be met with biofuels in the transport sector, also by 2012. Progress and policies related to the renewables target are presented and discussed in Chapter 6.

Figure 9

Energy Intensity in New Zealand and in Other Selected IEA Countries, 1973 to 2010

(toe per thousand USD of GDP at 2000 prices and purchasing power parities)



* excluding Luxembourg and Norway throughout the series, as forecast data are not available for these countries.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; *National Accounts of OECD Countries*, OECD Paris, 2005; and country submissions.

The NEECS is a whole-of-government strategy. Key agencies involved in its implementation include the Energy Efficiency and Conservation Authority (EECA), the Ministry for the Environment, the Ministry of Economic Development, the Electricity Commission (EC), the Ministry of Transport and the Department of Building and Housing. NEECS was prepared by EECA in conjunction with the Ministry for the Environment. EECA reports to the Minister for Energy and has a memorandum of understanding with the EC regarding electricity efficiency.

EECA's *Year Three Report*, which reviews the progress on the NEECS goals through 31 March 2003, shows that there has been a 1.1% improvement in efficiency over the first two years of the strategy. This improvement does not put New Zealand on target to meet its 20% target in 2012 if efficiency gains are assumed to proceed linearly. However, it is more likely that efficiency improvements will be concentrated in later years, after policies have been implemented and have had time to penetrate. Thus it is too early to judge whether New Zealand is on track to meet its target. The NEECS is currently undergoing its regular five-year review as required by legislation, so this picture may change with new data.

NEW ZEALAND TRANSPORT STRATEGY

In December 2002, the government released the *New Zealand Transport Strategy* (NZTS), the overall goal of which is to have an affordable, integrated, safe, responsive and sustainable transport system by 2010. It has five objectives: assisting economic development, assisting safety and personal security, improving access and mobility, protecting and promoting public health, ensuring environmental sustainability. NZTS is the government's first effort to address transport policy in a comprehensive way that includes environmental and energy concerns, not just construction and safety. Efficiency-related priorities of the strategy include encouraging a modal shift towards transportation that has a lower impact on the environment and ensuring the appropriate use of renewables, as well as investigating road pricing options, ways of internalising environmental externalities into the transport system, encouraging the use of more fuel-efficient vehicles and introducing biofuels. Renewables, including biofuels, are discussed in the following chapter.

Like NEECS, NZTS is implemented by a number of government entities. The Ministry of Transport is the lead agency, but the strategy requires co-ordination with EECA, the Ministry of Economic Development, the Ministry for the Environment and Land Transport New Zealand, a Crown entity with responsibility for land transport funding and the promotion of land transport safety and sustainability.

Under the Land Transport Act of 1998, each regional council in New Zealand is required to develop a regional land transport strategy (RLTS). To aid with consistency, Land Transport NZ has published internal RLTS guidelines to assist their staff working in this area, and has also distributed these guidelines to many regional transport officers around the country. The Land Transport Management Act of 2003 later amended the requirements for what must be covered by an RLTS and what must be considered when formulating one. It also widened the scope of activities that can be funded by Land Transport NZ. Under the 2003 act, the government's new funding allocation framework saw a growing proportion of funding allocated to non-road projects.

POLICIES AND MEASURES

INDUSTRIAL AND COMMERCIAL SECTORS

Energy efficiency gains from voluntary agreements with industry and an assistance programme for energy-intensive small and medium-sized enterprises (SMEs) had been two key components of New Zealand's strategy to meet its Kyoto Protocol commitments. While the assistance programme for energy-intensive SMEs remains active, the voluntary agreements with industry

are currently under review. The government is now reviewing its climate change policies and it is likely that industrial-sector energy efficiency will remain a key focus of government policy, but these policies have not yet been determined or developed. The government's previous policies are discussed in Chapter 4 on the environment. Some industrial-sector pilot programmes are discussed in the electricity generation section below.

RESIDENTIAL SECTOR

Energy use in the residential sector accounts for about 12% of the country's total delivered energy use. NZD 1.1 billion is spent annually by households for space and water heating, and to run appliances. New Zealand's efforts to improve the energy efficiency of the residential sector focus on more stringent building code standards, promotion of improved insulation in existing homes and improved appliance efficiency.

New Zealand has one of the world's most advanced residential building energy monitoring programmes, the *Household Energy End-use Project* (HEEP). HEEP, which was partially funded by the New Zealand government, is a long-term study that uses extensive data collected between 1995 and 2005 on monitored physical building and appliance characteristics, in particular the achieved indoor air temperature, and the energy use of all household components. It allows New Zealand to understand for what end uses energy is used and the opportunities to reduce it.

Energy performance of buildings

In general, the building stock in New Zealand has an overall low thermal performance. National mandatory insulation requirements for new houses were first implemented on 1 April 1978, so buildings built before then generally have a low thermal performance. The current building code regulates the overall energy performance of buildings, but not specific components, such as windows or insulation. The Building Act of 2004 requires that the code promote buildings that are designed, constructed and used in ways that contribute to sustainable development, and that they facilitate the efficient use of energy and energy conservation. It also requires the building code to promote the use of renewable sources of energy in buildings. To implement the act, the government is undertaking the first major review of New Zealand's building code since 1991. A new code is scheduled for 30 November 2007.

While the revised building code will improve the energy performance of new buildings, a major effort is focused on retrofitting existing buildings, particularly those built prior to 1978 before insulation became mandatory. The government estimates that about 900 000 homes across New Zealand fall into this category, and about one-third of these have inadequate insulation. To improve the energy performance of these houses, EECA provides

financial assistance to service providers under its *EnergyWise* home grants programme to carry out a range of energy efficiency household retrofits – including ceiling and underfloor insulation, draught-stopping of doors and windows, hot water cylinder wraps and low-flow shower heads – for low-income families. Service providers are required to gain funding from sources other than EECA, including energy consumer trusts and councils. The average ratio of EECA funding to third-party funding is 1:1.5. In addition, service providers may charge low-income householders up to NZD 500 of the cost of an energy efficiency retrofit.

By 30 June 2005, 17 000 homes were insulated through the programme costing the government NZD 19 million. The *EnergyWise* home grants programme has a target to improve the energy performance of approximately 100 000 pre-1978 houses by 2016, representing one-third of pre-1978 houses believed to have inadequate insulation. In addition to the home grants programme, which targets low-income residents, the current NEECS has a 2016 target to have all pre-1978 houses (not just those houses targeted through the *EnergyWise* home grants programme) retrofitted with a set of cost-effective energy efficiency measures.

When evaluating the benefits of the *EnergyWise* home grants programme, EECA assumes a 30% rebound factor, *i.e.* the maximum possible energy savings are reduced by 30% to allow for households increasing rather than maintaining the temperature of heated rooms following retrofitting of insulation.

As the rate of household retrofits has increased over the last few years, EECA has perceived that there is some risk that the industry capacity to absorb additional funding may be limited. Options to support growth in the industry are currently being considered by EECA. Since 1995, EECA has directly funded service providers that facilitate domestic energy efficiency improvements, including commercial retrofit installers or non-profit community groups, through its *EnergyWise* programme. In some locations, service providers are experiencing difficulties obtaining third-party funding to meet the 1:1.5 ratio. Therefore, to build capacity in these locations, EECA is considering lowering the current limits on the ratio of EECA funding to third-party funding.

Appliance standards and labelling

New Zealand uses minimum energy performance standards (MEPS) and labelling to improve the efficiency of appliances. MEPS are set and implemented in common with Australia. By 2008, the two countries will have 14 product classes covered by MEPS or labelling requirements, and a further 19 product classes will be investigated for future measures. The seven classes of products currently covered by MEPS, as well as products covered by mandatory or voluntary labelling programmes, are listed in Table 11. New Zealand, along with the US and Australia, has recently moved to the most advanced energy efficiency standard for refrigeration in the world.

Table 11

Products Currently Covered by MEPS or Labelling Programmes

Labelling	*MEPS*
Requiring a label:	Air-conditioners
Domestic refrigerators	Domestic refrigerators
Freezers	Electric water heaters
Dishwashers	Refrigerated display cabinets
Clothes dryers	Distribution transformers
Clothes washers	Fluorescent lamps and ballasts
Single-phase air-conditioners	Three-phase motors
Voluntarily labelled by industry:	
Three-phase air-conditioners	
Three-phase electric (induction) motors	
Ballasts for fluorescent lamps	

Source: EECA.

In July 2005, New Zealand launched *Energy Star*, an international labelling programme that awards endorsement labels to products that achieve significant energy savings. The first phase of the programme, from July 2005 until June 2006, covers home electronics, domestic refrigeration appliances and office equipment. The government has allocated a budget of NZD 3.1 million over the next four years for the programme, which will be administered by EECA.

Public awareness and education

EECA promotes residential-sector energy efficiency improvements through its *EnergyWise* website. The website provides information on actions residents can take that vary in budget: free (primarily behavioural changes), simple and inexpensive (actions that cost less than NZD 50 like low-flow shower heads and simple insulation improvements); worthwhile investments (investments that pay for themselves in one to five years like installing window shades); and serious investments (that pay for themselves in 3 to 15 years like heavy-duty insulation upgrades). The website also provides efficiency information by area, including appliances, hot water, heating, insulation and household moisture.

The Ministry for the Environment also runs energy-related public awareness programmes, mostly under the climate change umbrella. A good example of this is the *Four Million Careful Owners* public awareness and education campaign, which is detailed in Chapter 4.

TRANSPORT SECTOR

The transport sector uses the largest share of total energy, consuming 42% of New Zealand's total energy use. It is also the fastest growing sector in terms of energy use, with increases often outstripping GDP growth. Land transport,

including road and rail, represents around 90% of total transport-sector energy use. Private motor vehicles account for almost 90% of total passenger transport energy use. Nearly 20% of passenger vehicles in New Zealand are part of corporate fleets[9]. Public transportation – including long-distance rail and shorter-distance bus and ferry commuting – is not heavily used compared with other IEA member countries.

New Zealand does not have a domestic vehicle manufacturer. The transport fleet in New Zealand is relatively old – the average age is 12 years. Two-thirds of all cars are imported second-hand from Japan, which is relatively close to New Zealand, where car ownership turnover is relatively high and where cars also drive on the left-hand side of the road. There is a high level of personal car ownership in New Zealand, and private-vehicle transport is the predominant mode. Private vehicle ownership increased significantly following the removal of tariffs in the mid-to-late 1980s, which enabled greater access to lower-priced vehicles. In addition, fuel costs have historically been low in New Zealand compared to other IEA nations.

In part, New Zealand's heavy reliance on single-passenger vehicles also stems from the long, stringy geography of the country, which makes public forms of transportation like rail more costly because they cannot make use of a network model. In addition, the country has a very low population density. While most of the country's population is located in a few urban areas, the rest of the country is sparsely populated and private road transport is the only means of mobility. The government is particularly concerned about maintaining mobility for rural residents, who are generally poorer and depend on cars.

Efforts aimed at reducing energy consumption from transport are discussed below. Biofuels, which would lower transport-sector oil consumption, are discussed in Chapter 6.

Fuel economy

There are currently vehicle exhaust emissions standards in New Zealand, but no fuel economy standards. In Europe, the US and Japan, large quantities of new cars are sold by domestic manufacturers or importers. Fleet-wide fuel economy standards are imposed on the average of all cars sold by these suppliers. In New Zealand, most cars are imported as used vehicles from Japan by small companies. Furthermore, the overall car market is relatively small. This market structure makes it difficult to impose fleet-wide average fuel economy standards.

9. Most of these cars are not "company cars" in the sense that they are owned in large fleets by businesses. Where a vehicle is made available for an employee to use privately, the employer must pay fringe-benefit tax (FBT), regardless of whether the employee actually uses the vehicle privately. Work-related vehicles are exempt from FBT but must meet certain criteria, *e.g.* a minimum weight requirement.

In 1999, Japan introduced its Top Runner programme, which aims at an increase in the fuel economy of diesel passenger vehicles by 15% between 1995 and 2005 and gasoline passenger vehicles by 23% between 1995 and 2010. Future Top Runner targets will continue to increase efficiency. Over time, fuel economy gains from this programme will flow to New Zealand as used cars originally sold under the Top Runner targets make their way to New Zealand. Since on average used cars sold in New Zealand are about eight years old, the effects of the first 2005 and 2010 targets will begin to be felt in 2006, but will not be fully felt until 2017. It is notable that while per capita incomes in New Zealand have been rising over the last decades, New Zealand's vehicle fleet has become older. In recent years, the proportion of cars purchased used has remained relatively flat (see Table 12). In fact, as per capita income has risen, new vehicle purchases as a share of total purchases has remained relatively inelastic, but total vehicle ownership rates have increased along with vehicle-kilometres travelled. In light of this trend, it seems likely that effects from the Japanese Top Runner programme will remain the primary influence on New Zealand's fleet fuel economy in the absence of new government policies.

Table 12

Sales of New and Used Vehicles, 1999 to 2004

	1999	*2000*	*2001*	*2002*	*2003*	*2004*
All sales	189 313	173 742	186 855	200 504	227 425	222 797
Used	131 118	116 124	128 693	136 418	156 972	154 042
New	58 195	57 618	58 162	64 086	70 453	68 755
Share of used vehicles	69%	67%	69%	68%	69%	69%

Note: Data do not include heavy vehicles.

Source: Land Transport New Zealand, *New Zealand motor vehicle registration statistics 2004*.

New Zealand sets vehicle safety and exhaust emissions standards for imported cars by requiring the vehicle to comply with a "qualified standard", by which the vehicle must have complied with an existing or previous standard from the US, the EU, Australia or Japan that is approved by the New Zealand government when the imported car was originally sold. This scheme cannot be used for fuel economy, however, because the qualified standards used for vehicle safety and emissions are minimum standards that must be met by each individual car. International fuel economy standards are fleet or category averages – the fuel economy of individual new cars sold can be well below the average. Thus the fuel economy of all cars imported into New Zealand could be well below the average, but each individual car could still have complied with the applicable fuel economy standard when it was originally sold as a new car.

While the government has not imposed any fuel economy standards, it has begun to collect fuel economy information about vehicles imported into the country from Japan. This mandatory reporting requirement for all cars imported from Japan will give the government data on the actual fuel economy of New Zealand's vehicle fleet, and will help provide information for a website the government is developing to provide fuel economy information to New Zealanders buying new and used cars. The fuel consumption website will display fuel consumption for new and used Japanese cars. The site is intended to operate as a fuel consumption calculator, allowing users to select different vehicle models, driving styles, fuel prices and driving distances. It is expected to be operational on 1 May 2006. The government is also committed to providing point-of-sale information on the fuel economy of both new and used cars (*e.g.* by requiring the posting of energy efficiency labels) based on the information in the database. The programme of work to introduce vehicle labelling and provide consumer information on vehicle efficiency is still under consideration and development and – subject to funding – will be undertaken within the next one to two years following the launch of the website.

Currently there are no policies in place to increase the fuel efficiency of corporate fleet vehicles. However, such initiatives are currently being explored under the climate change work programme. In 2005 the government initiated the *Govt3* project to influence the vehicle purchasing and procurement policies of government agencies and departments. The project is still in its infancy with baseline data of the fleet and procurement practices being collected.

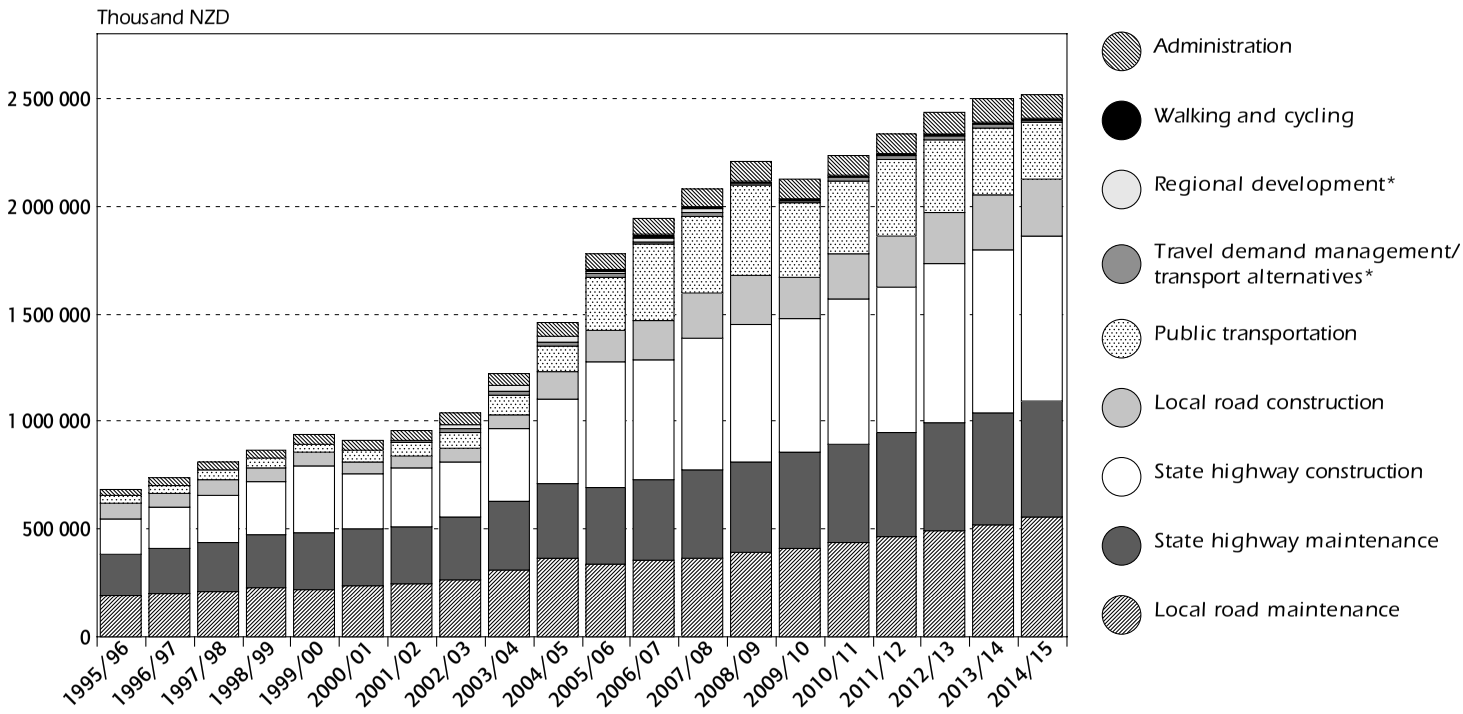
Public transit

Since 2000, Land Transport New Zealand has provided funding to regional councils to support development and operation of regional bus and ferry services. The support provided is based on patronage, thus giving explicit incentives for regional councils to create initiatives to persuade more people to use public transit. Since its introduction, public transport patronage has increased by about 27%. The Ministry of Transport is currently undertaking a review of the patronage funding scheme, as the experience to date has suggested that a more straightforward funding scheme might be more effective.

Overall, funding for land transportation has increased dramatically since 1995 (see Figure 10). While road and highway construction continues to make up the largest share of total funding, public transit funding has grown over six times between 1995 and 2006, and is expected to grow significantly over the next decade. Funding for alternatives to road infrastructure, as well as walking and cycling, has also increased over the same time period.

Figure 10

National Land Transport Expenditures and Allocation, 1995 to 2015



* negligible.

Source: Country submission.

Commuter rail in Auckland is being upgraded, with the government paying 60% and the Auckland Regional Council paying 40% of all rail capital spending[10]. Auckland rail patronage grew by over 30% between 2004 and 2005, and has been growing quickly since 1999. While the system has experienced increased usage, in general the system is very old and does not cover the entire city. There is some discussion by the regional and central governments of major improvements to the system, including rail electrification or a tunnel through Auckland.

The government was the sole owner and operator of virtually all of New Zealand's rail infrastructure and passenger and freight operations until 1993 when the rail network and operations were sold to Tranz Rail Holdings Limited (later renamed Toll NZ). The government retained ownership of the land on which the rail assets were situated and leased the land to the rail operator during this period. The government repurchased the Auckland passenger rail infrastructure in 2001 and the rest of the national rail network in 2004. The New Zealand Railways Corporation, a Crown entity, has held these assets since 1 September 2004, and is now responsible for managing and operating the national rail network on behalf of the government. As part of the rail network repurchase agreement, the government agreed to invest NZD 200 million over the next five years to upgrade previously neglected network infrastructure. In return, Toll NZ agreed to invest NZD 100 million upgrading its rolling stock.

EECA is promoting school and workplace travel planning, as well as developing and making available rideshare-planning software. Land Transport New Zealand and the Ministry of Transport are jointly co-ordinating the government's *Getting there: on foot, by cycle strategy*. The strategy aims to improve environments for walking and cycling, improve safety for pedestrians and cyclists and increase the choice of walking and cycling for day-to-day transport.

Taxes and fiscal policies

As shown in Figures 15 and 16 in Chapter 7, taxes on transport fuels in New Zealand are among the lowest of OECD countries. Unleaded petrol prices are above only those of the US, Canada and Australia. Only diesel prices in the US are lower than in New Zealand.

Low diesel taxes are offset by road user charges for diesel vehicles, which are based on the number of axles on the vehicle as well as tonne-kilometres travelled. Non-diesel vehicles above three tonnes must also pay road user charges. Historically, road user charges were designed to account for the costs imposed by heavy-duty vehicles on roads and highways.

Vehicle registration fees are a flat NZD 200/year. The government has reviewed raising these charges, but is concerned with the social impacts as some low-income residents already find it difficult to pay the current fee.

10. The government is considering revising this funding formula.

There are no import duties on used or new vehicles. New Zealand had an import duty, but this was removed in May 1998. The removal of this import duty helped improve the efficiency of the vehicle fleet by lowering the cost of importing newer, more efficient vehicles.

The Ministry of Transport is currently scoping a work programme investigating fiscal incentives for encouraging the purchase of fuel-efficient vehicles.

Transport costs and payments

A comprehensive study on transport costs commissioned by the government was released in March 2005. The report, *Investigation into Surface Transport Costs and Charges*[11], estimates the costs imposed by road and rail users, and the payments they make for using each mode. Costs estimated included external society-wide costs such as congestion, pollution and climate change. With respect to the road system, the report found that the annual costs in 2001/02 were NZD 3.73 billion. Of the total costs, NZD 1.17 billion was for environmental externalities, including nearly NZD 800 million for climate change and air pollution. Total user payments were estimated at NZD 2.63 billion.

The report will help the government make decisions on the relative competitive position of road and rail transport and associated government policy. The report made no conclusions about relative costs and payments, including, for example, if costs and payments were out of balance or if payments for certain transport modes should be increased or decreased.

ELECTRICITY GENERATION SECTOR

Responsibility for improving electricity efficiency lies primarily with the Electricity Commission (EC) and EECA under the terms of a memorandum of understanding. Efficiency projects are funded by a portion of the levy the EC imposes on the electricity industry. The EC's efficiency policies are intended to help meet its overall objective to reduce load growth rates, in turn reducing the need for investment in transmission and generation infrastructure. The EC has not yet set quantified efficiency targets.

Currently, six pilot efficiency programmes are under way, which the EC will use to inform its long-term efficiency strategy and policies. The EC expects to begin implementing its long-term policies by July 2006. The pilot programmes currently under way include industrial programmes aimed at motor and compressed air efficiency and residential programmes aimed at lighting, refrigerator and hot water efficiency.

11. New Zealand Ministry of Transport, *Surface Transport Costs and Charges*, prepared by Booz Allen Hamilton *et al.*, March 2005.

CRITIQUE

Owing largely to historically low energy prices, energy efficiency in New Zealand has generally not been strong. As energy prices, security of supply concerns and environmental problems have grown, so has the government's focus on energy efficiency. This is an important step in the right direction for New Zealand, as energy efficiency improvements can be the most cost-effective means of addressing these three concerns. While energy efficiency improvements in the economy will flow naturally from rising energy prices, the government can take steps to stimulate cost-effective improvements that would not be made because, among other reasons, energy prices do not reflect the full costs of energy consumption, including environmental and energy security externalities.

In 2001, New Zealand set an ambitious target to improve energy efficiency by 20% by 2012. According to the most recent government estimates, only a 1.1% improvement has occurred over the first two years. While energy efficiency policies do not generally have immediate results and gains are likely to be weighted towards later years, the results highlight the need for continued and vigilant monitoring of efficiency measures. New Zealand has excellent household energy efficiency data that it gained through the HEEP monitoring programme. Building on this strong base, the government should further improve data collection and accuracy, which will allow to evaluate the costs and benefits of particular government efforts, and revise policies or reallocate funding if necessary. To that end, the *Govt3* programme, which aims to better understand government vehicle purchasing behaviour and policies through data collection, is applauded, as the data are being used to inform effective policy development. Data gleaned from the new reporting requirement for imported used Japanese vehicles will also provide base data from which to inform wider transport policy development.

Meeting New Zealand's long-term NEECS efficiency gain targets will require sector-level monitoring, not just economy-wide monitoring. The country has already begun this effort, but should improve upon it. Along with sectoral monitoring, the government is considering setting specific sectoral efficiency targets as part of the NEECS, as it has with the renewables target where a transport-sector target has been set. This effort is laudable and should continue, ensuring that the sectoral targets are measurable, cost-effective and practicable.

As in many IEA countries, responsibilities for energy efficiency rests with many different ministries – including Transport, Buildings, Environment and Economic Development. The government has also established government entities that operate separately from the ministries to implement government policy, including the Energy Efficiency and Conservation Authority (EECA) and Land Transport New Zealand (LTNZ). In some cases each entity's responsibilities are clearly defined, such as with the EC and EECA, where a

memorandum of understanding guides their joint and independent actions. In other areas, allocation of roles and responsibilities are not as clearly defined and could benefit from greater clarity. For example, transport responsibilities lie with EECA and LTNZ as well as with the Ministry for the Environment, the Ministry of Transport and the Ministry of Economic Development, but specific roles and how the entities interact have not been well defined. In the case of vehicle standards and labelling, responsibility for appliance standards and labelling lies with EECA, whereas LTNZ is developing a vehicle fuel economy information website that would inform a future labelling scheme. The two entities are working together, but could potentially improve implementation by a more codified relationship. The government's development of a national energy strategy, which was recently announced, will assist in clarifying these roles and responsibilities.

Transport-sector energy consumption makes up the largest share of total consumption and is growing faster than in any other sector. As a result, there are tremendous gains to be made from improving the efficiency of transportation in New Zealand. The government has taken a commendable first step through the *New Zealand Transport Strategy* (NZTS) to address transport policy in a comprehensive way that includes energy and environmental concerns, not just construction and safety. Furthermore, the government's efforts to better understand the transport sector, through both mandatory fuel economy reporting for imported vehicles and the comprehensive surface transport study, are particularly helpful as they will set the stage for effective transport policies that will improve efficiency in a cost-effective manner. While the transport study made no conclusions about the relative costs and payments of different modes of transport in New Zealand, such analysis would be useful for developing cost-effective policies.

Efficiency in the transport sector is relatively low, in part because New Zealand has a large share of used vehicles and because petrol and diesel taxes are relatively low. Road user charges for diesel vehicles offset low tax rates to some extent, but they are largely based on distance travelled, not fuel used, and thus provide a weak incentive for increased fuel economy. Stronger policies that give incentives for substantially improved fuel economy of new and used vehicles are necessary. The government's review of transport policy as part of the climate policy review should consider fiscal and tax incentives, such as higher transport fuel taxes, financial incentives for purchasing fuel-efficient vehicles (*e.g.* differentiated vehicle registration fees and taxes) and road tolling charges based on car size. The government could look to the example of Korea, where the government has put in place differentiated rates for road tolls, parking and insurance based on car size.

Many countries rely heavily on fuel economy standards to improve the efficiency of their transport fleet. Fuel economy standards in Europe and the US are imposed on car sellers who must meet a fleet-wide fuel economy

average on all cars sold. Japan uses a modified version of this fleet-style standard; average fuel economy standards are applied to more differentiated classes of cars. However, this is a less practical approach for New Zealand, as imports of used cars make up around two-thirds of vehicles and used cars are imported by relatively small entities. A fleet-wide fuel economy average imposed on used car importers would be cumbersome, as importers may import a relatively small number of vehicles and their import choices are largely dictated by the Japanese market for used vehicles. Unlike manufacturers, who can adjust production to meet fuel economy targets, importers make purchases from the available stock, which is not necessarily stable, making adjusting fleet-wide average fuel economy much more difficult. The current import standards process, where cars must meet qualified international standards for safety and exhaust emissions, is also impractical for fuel economy, as international fuel economy standards are a fleet-wide average. Any particular car – even one with very low fuel economy – may have met the standard because it was part of a larger group of cars. A more effective approach, given New Zealand's circumstances, could be to set a minimum standard for all new and used cars. However, such an approach is complex and relatively prescriptive, requiring a standard for each class of car, and would, to some extent, limit customer choice. It may also be costly to implement, so any such costs would have to be weighted carefully against the potential benefits.

Despite these difficulties, the overall fuel efficiency of cars purchased as used vehicles in New Zealand will improve over time as Japanese cars built under enhanced Japanese fuel economy rules make their way to New Zealand. To expedite fuel economy gains, the government could focus on new car purchases in New Zealand through a fleet-wide fuel economy average standard for new cars. While new cars make up just a third of all car purchases, this is still a considerable share of the total. However, the relatively small size of individual New Zealand importers makes this policy potentially very burdensome; voluntary agreements with industry might be a more viable alternative. Labelling can also help encourage the purchase of more fuel-efficient vehicles and New Zealand is considering developing a fuel-economy labelling scheme for new and used vehicles, which is a positive step. The government should make vehicle labelling mandatory and implement the policy as quickly as possible. Mandatory labelling of car tyres would also help improve the fuel efficiency of the existing vehicle fleet.

As a large share of the population lives in urban centres, particularly Auckland, Wellington and Christchurch, reduced reliance on single-passenger vehicles and greater reliance on public transit and alternative modes of transport would have a large effect on transport-sector energy efficiency. In addition, efforts aimed at urban transportation would help improve regional air quality and lower urban traffic congestion. Furthermore, policies that raise the cost of single-passenger transport in urban areas would increase energy

efficiency of the overall transport sector, but would not, in general, raise transport costs for poorer, rural residents. The government's overall funding increases for alternative modes of transportation in urban areas, including walking, cycling and public transit, are positive and should continue. In particular, the gains that have been made in the Auckland area as a result of improved light rail and bus transport options highlight the effectiveness of these efforts. Building on this, and incorporating the knowledge gained from the recent surface transport study, the government should strengthen incentives to reduce single-passenger vehicle transport. Possible strategies include introducing tolls on highways or for entering congested city areas (such as in London), introducing and expanding car-pool lanes, providing corporate discounts or tax incentives for employees to use public transport or alternative transport modes, and limiting or increasing taxes and fees on central district parking. The government is investigating some of these options, but it should expand the scope of possible options and implement a set of policies as soon as possible.

In light of the poor thermal insulation found in many older New Zealand homes, the government has developed a comprehensive strategy to improve thermal insulation in these buildings, which is a very positive step. The building code directly affects the thermal efficiency of new and upgraded homes, and thus should include cost-effective energy efficiency requirements. The government is currently reviewing its building code and considering implementing enhanced energy efficiency requirements. This process should continue and a strengthened building code should be established and put into force as quickly as possible. The code should be written and revised so that it takes into account changing energy efficiency standards to the exten that the standards are cost-effective and the evolving regulations are not unduly burdensome on industry. Compliance with building standards is just as critical to improved energy efficiency as the creation of effective standards in the first place. As New Zealand moves to a regime that includes more energy efficiency elements in its building code, the government should ensure that building code compliance mechanisms and enforcement training evolve with it. In particular, New Zealand should refer to the Californian experience, which has a similar climate – temperate overall but with fairly heterogeneous sub-climates – and a strong building code verification and compliance programme. Expanding the industry that provides insulation services is also essential, an effort New Zealand has already undertaken.

New Zealand, along with Australia, has established a set of minimum energy performance standards for appliances. This strategy is commendable, as it does not segment the small New Zealand market from the larger South Pacific market, improving the efficiency of the programme and choices for New Zealand customers. The joint New Zealand-Australia MEPS programme should continue to expand, adding cost-effective standards for more product classes as quickly as possible. New Zealand's efforts to introduce appliance labelling, which makes

energy use and variable costs of different appliances transparent to customers so they can take informed economic decisions, are also positive and appliance labelling should continue to be expanded and made mandatory for more product classes. Endorsement labelling, which gives endorsements to particularly efficient appliances encouraging their purchase, should continue and expand. MEPS and labelling programmes should be sufficiently flexible to allow them to adapt to new technologies in a timely and cost-effective manner.

Labelling will help increase public awareness of fuel efficiency. Higher energy prices will also make the public more aware of the benefits of energy efficiency improvements by making them more financially attractive. Further public awareness can come from government-sponsored publicity campaigns that give information on low-cost or free energy efficiency improvements that New Zealanders can make to reduce their overall energy costs. EECA provides such information and education through its EnergyWise website. In particular, it provides very useful information to improve transport fuel efficiency, including information on tyre air pressure, driving behaviour and vehicle maintenance. This important programme should continue and be enhanced, perhaps through more aggressive marketing and dissemination. In this case New Zealand does not need to look at the experience of other IEA countries – it can learn from its own successes. The country weathered two electricity shortages stemming from low hydro conditions thanks in large part to aggressive conservation campaigns. These marketing campaigns should be used as models to help develop long-term energy efficiency marketing techniques.

RECOMMENDATIONS

The government of New Zealand should:

- *Continue to improve data collection and data accuracy in order to better evaluate the cost-effectiveness of energy efficiency measures.*
- *Complete the NEECS review in a timely manner and ensure that the revised NEECS establishes sectoral targets that are measurable, cost-effective and practicable.*
- *Ensure that responsibilities for energy efficiency promotion are clearly defined and efficiently organised; ensure effective co-ordination between the relevant authorities.*
- *Introduce policies and measures – such as revised transport fuel tax rates and arrangements, tax incentives or fleet-wide fuel economy standards on new cars – designed to improve the fuel efficiency of New Zealand's vehicle fleet.*

- *Implement fuel efficiency labelling of both new and used vehicles.*
- *Introduce policies and measures that encourage a shift away from single-occupancy cars in order to reduce the energy intensity of transport.*
- *Ensure that revisions to the building code implement cost-effective energy efficiency measures in new and existing buildings as quickly as possible.*
- *Ensure that the revised building code is flexible so that it can incorporate new cost-effective energy efficiency measures for buildings on an ongoing basis.*
- *Ensure compliance with energy efficiency requirements in the existing and revised building code.*
- *Intensify efforts to broaden the scope of and improve minimum energy performance standards and labelling for electrical appliances, consumer electronics and office equipment to the extent that they are cost-effective.*
- *Put sustained emphasis on education and raising public awareness regarding energy efficiency.*

NEW AND EMERGING RENEWABLES

CURRENT AND HISTORICAL PRODUCTION

Renewable energy makes up about one-third of total primary energy supply and two-thirds of electricity consumption. Among IEA countries, only Norway has a larger share of renewables in its total primary energy supply (TPES; see Figure 11). Hydro and geothermal sources dominate total renewable energy supply. As the market for hydro and geothermal resources is already very well developed in New Zealand, this chapter is primarily concerned with smaller-scale renewables, including wind, solar, biomass and small-scale hydro and geothermal. Policies and information concerning large-scale hydro and geothermal resources are chiefly discussed in Chapter 8.

Detailed information on renewable energy supply and consumption between 1985 and 2004 is shown in Table 13. Although renewable energy supply is growing, non-renewable energy use is growing even faster, driven mainly by demand in transport services. Renewable energy supply as a proportion of total supply is slowly declining over time.

GOALS AND STRATEGIES

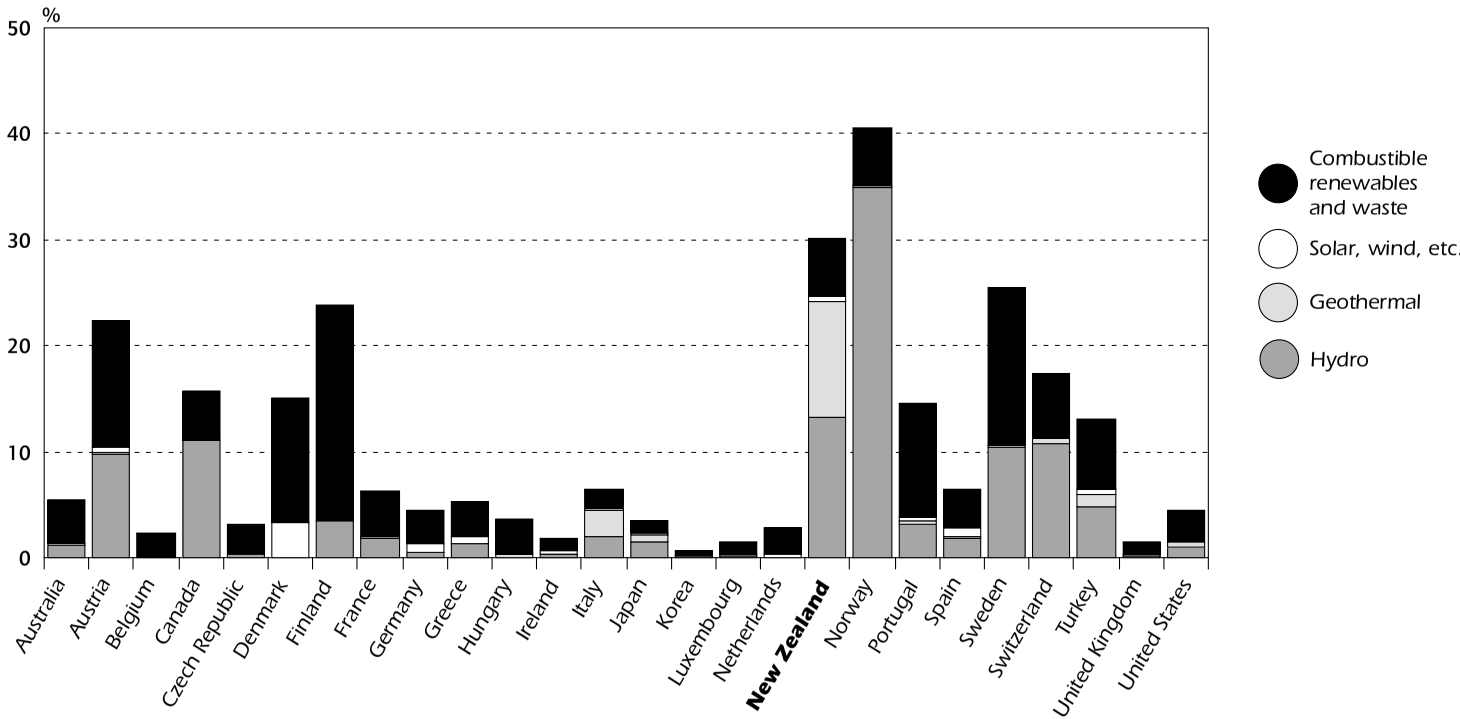
NATIONAL ENERGY EFFICIENCY AND CONSERVATION STRATEGY

Though renewables already make up a large part of New Zealand's energy supply mix, the government is working to further increase the amount of energy produced from renewable resources. Along with improving energy efficiency, the *National Energy Efficiency and Conservation Strategy* (NEECS), set a target in 2002 of increasing by 30 petajoules (0.7 Mtoe) annually the amount of energy produced from renewables by 2012, equivalent to a 22% increase in renewable energy supply over 2001. In October 2002, an indicative renewables target for the transport sector was also set; 2 PJ (0.05 Mtoe) of biofuels should be consumed in the transport sector by 2012.

Key agencies involved in the implementation of the renewables aspects of the NEECS, which is a whole-of-government strategy, include the Ministry for the Environment, the Energy Efficiency and Conservation Authority, the Ministry of Economic Development, the Electricity Commission (EC) and the Ministry of Transport. The NEECS was prepared by the Energy Efficiency and Conservation Authority (EECA) in conjunction with the Ministry for the Environment. EECA reports to the Minister of Energy and has a memorandum of understanding with the EC regarding electricity efficiency.

Figure 11

Renewable Energy as a Percentage of Total Primary Energy Supply in IEA Countries, 2004*



* estimates.

Note: The primary energy equivalent of geothermal reflects primary energy losses, which vary depending on the technology used. If the primary energy equivalent were calculated without taking this into account, the percentage of renewable energy in TPES would be lower.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

Table 13

Renewable Energy Supply and Consumption, 1985 to 2004

Units: PJ	*1985*	*1990*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004* [5]
Total primary energy supply[1]	**180.24**	**210.51**	**227.81**	**223.38**	**222.82**	**240.73**	**251.69**	**227.13**	**217.10**	**226.89**	**220.13**	**237.36**
Hydro	**70.24**	**82.63**	**98.13**	**92.57**	**84.94**	**86.99**	**84.43**	**87.79**	**81.42**	**90.79**	**85.28**	**97.28**
Geothermal[2]	**78.93**	**92.65**	**93.30**	**91.87**	**95.95**	**105.49**	**115.24**	**85.97**	**87.24**	**85.08**	**82.67**	**84.95**
Other renewables	**0.000**	**0.000**	**0.004**	**0.030**	**0.048**	**0.079**	**0.141**	**0.428**	**0.500**	**0.721**	**0.722**	**1.488**
Solar										0.16	0.19	0.20
Wind	0.000	0.000	0.004	0.030	0.048	0.079	0.141	0.428	0.500	0.561	0.532	1.288
Tide, wave and ocean[3]												
Biomass & waste[1, 4]	**31.07**	**35.23**	**36.37**	**38.91**	**41.89**	**48.17**	**51.87**	**52.94**	**47.94**	**50.30**	**51.46**	**53.64**
Woody biomass and animal products	28.02	31.77	32.37	32.09	31.71	34.53	35.21	35.88	31.46	32.19	32.71	35.00
Biogas and landfill gas	1.30	1.62	2.13	1.81	1.74	1.71	1.61	1.41	1.48	1.58	1.59	1.47
Renewable municipal waste[4]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial waste	1.76	1.84	1.87	5.01	8.44	11.93	15.05	15.65	15.01	16.52	17.17	17.17
Total final consumption[1]	**34.76**	**38.69**	**41.49**	**41.24**	**40.93**	**42.72**	**43.76**	**43.39**	**38.89**	**40.52**	**41.66**	**44.43**
Geothermal	**11.30**	**11.38**	**13.53**	**13.17**	**13.26**	**13.61**	**14.31**	**13.83**	**13.12**	**13.30**	**13.48**	**14.64**
Other renewables										**0.16**	**0.19**	**0.20**
Solar										0.16	0.19	0.20
Biomass & waste [1, 4]	**23.46**	**27.31**	**27.96**	**28.07**	**27.67**	**29.10**	**29.45**	**29.56**	**25.77**	**27.05**	**27.99**	**29.59**
Woody biomass and animal products	23.18	26.93	27.52	27.63	27.22	28.64	28.90	29.00	25.15	26.42	27.45	29.12
Biogas and landfill gas	0.04	0.05	0.06	0.06	0.07	0.07	0.14	0.15	0.18	0.19	0.17	0.11
Renewable municipal waste[4]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial waste	0.25	0.34	0.37	0.38	0.39	0.40	0.41	0.42	0.44	0.44	0.37	0.37

1. Totals and sub-totals may not add up because of rounding. 2. Efficiency of geothermal plants for electricity generation had been assumed to be 10% prior to 2000. From 2000, it is assumed to be 15%. 3. No data available. 4. Refers to biomass and waste only. 5. Data for 2004 are provisional.

Source: New Zealand Ministry of Economic Development, *Energy Data File*, Table F-1, p. 117, July 2005.

EECA's *Year Three Report*, which reviews the progress on the NEECS goals through 31 March 2003, shows that there has been a 6 PJ (0.1 Mtoe) increase in renewables after the first two years of the strategy, suggesting that New Zealand is on track to meet the 2012 target. EECA's most recent estimates suggest that renewables will increase by 18-37 PJ (0.4-0.9 Mtoe) between 2001 and 2012 (10-26 from electricity, 4-8 heat from biomass, 2-3 from solar water heating and 2 from biofuels).

POLICIES AND MEASURES

ELECTRICITY GENERATION

Potential future penetration

Based on cost estimates and price forecasting, the Ministry of Economic Development estimates that there is a potential for 3 300 MW of renewable electricity generating capacity to be installed by 2025 (see Table 14).

Table 14

Potential Renewable Energy Generation, 2006 to 2025

	Total cost (NZc/kWh)	*Potential capacity (MW)*	*Potential supply (GWh/year)*	*Potential average load factor (%)*
Wind	6.1-7	630	2 500	45
	7.1-8	680	2 400	40
	8.1-9	590	1 800	35
Geothermal	5.1-6	240	1 900	90
	6.1-7	100	800	90
	7.1-8	30	250	90
Hydro	6.1-8	50	240	55
	8.1-10	530	2 550	55
	10.1-12	110	530	55
Co-generation	5	350	1 700	55

Source: Country submission.

Promotion policy

Owing in large part to the New Zealand government's policy of light-handed regulation and, to a lesser extent, the country's mature hydro, geothermal and biomass heat systems, as well as its high-quality wind resources, in general New Zealand does not have mandatory measures to support renewable electricity production. While most IEA countries with goals to increase the penetration of renewable electricity supply have mandatory government interventions, such as feed-in tariffs or green certificate schemes, the only financial incentive that New Zealand has provided for renewable electricity

generation was through carbon dioxide credits under its *Projects to Reduce Emissions* (PRE) programme, which is currently under review and is discussed in Chapter 4 on the environment. Through this programme, the government awarded carbon dioxide credits that the recipient can sell on the international market. These credits were awarded through a regular tendering process and not all projects received them. Furthermore, only projects that were shown to be uneconomic without the credits were eligible. Some wind developments, such as Meridian Energy's *WestWind* project at Makara near Wellington, were not eligible for PRE credits because the investment was already economic.

Through two tender rounds of this programme, credits have been awarded to 42 projects that, if fully implemented, would add 840 MW of new renewable electricity capacity to New Zealand by 2008, equivalent to almost 10% of the country's current installed base of 8 900 MW. The 42 projects include 13 wind farms, 12 hydro projects, 6 bioenergy projects, 5 landfill gas projects, 4 geothermal projects and 2 co-generation projects.

Other incentives

One key component of the government's strategy to meet its renewables target was through amendment of the Resource Management Act. The act was amended in 2003 to require specific consideration of the benefits of renewable energy when assessing a resource consent application.

EECA works to promote renewable electricity projects by providing information, advice and support for renewable energy projects, helping to improve development proposals and facilitate better decision-making by local authorities. Its efforts include providing submissions during regional or local permitting procedures and commenting on renewable energy project proposals.

RESIDENTIAL AND COMMERCIAL SECTORS

EECA works with renewable energy industry participants to encourage the uptake of small-scale renewable energy technologies such as solar water heating and stand-alone power systems. Activities include providing interest-free loans to purchase solar water heating systems, promoting the benefits of solar water heating and other renewables, supporting the renewable energy industry (*e.g.* through standards, quality assurance, training programmes and demonstration projects) and supporting market research, monitoring and analysis.

Installations of solar water heaters increased markedly in recent years, rising from 900 in 2002 to 2 800 in 2005. This growth rate would put the solar water heater industry on target to meet a medium-term goal of 10 000 new installations per year. About 1-2 PJ (0.02-0.05 Mtoe) of additional renewable energy over 2001 is expected to come from small-scale technologies by 2012.

TRANSPORT SECTOR

New Zealand has set an indicative target to increase the energy produced from biofuels – bioethanol and biodiesel – by 2 PJ (0.05 Mtoe) by 2012, equivalent to about 1% of total transport fuels. The Ministry of Transport leads an inter-departmental working group that includes representatives from EECA, the Ministry for the Environment, the Ministry of Economic Development, the Treasury and Investment New Zealand. The group has already developed a national biodiesel standard and is working to raise public awareness of the benefits of biofuels. The government is considering setting a mandatory biofuels sales target, including one higher than the current 2 PJ (0.05 Mtoe) indicative target.

The government estimates that current domestic production of fuel-grade ethanol – which is sourced from whey, a by-product of the dairy industry – could provide 0.2-0.3% of petrol consumption. Biodiesel feedstock is primarily sourced from tallow from the meat industry. The government estimates that with currently available feedstock and significant investment in manufacturing infrastructure, it would be possible to replace 5% of diesel with biodiesel. At current high oil prices, biofuels produced from industry by-products can be cost-competitive with regular fuels. For example, the government estimates that tallow esters biodiesel can be produced at around NZD 0.85/litre. This is less expensive than diesel produced from oil that costs USD 60/barrel, which costs around NZD 0.90/litre.

To date there has been little penetration of biofuels into the market, though ethanol is already being produced from whey. Some of the difficulties stem from New Zealand's vehicle fleet; half of the existing fleet is used Japanese vehicles and nearly two-thirds of all new additions to the fleet are used Japanese imports. Japan has regulated that all petrol contain 3% ethanol; the automobile industry, including suppliers of new and used vehicles, has argued that any higher proportion of biofuels in New Zealand could damage components in used Japanese cars. (The IEA estimates[12] that biofuels can be blended up to at least 10% with modern conventional gasoline vehicles.) Government agencies are working closely with oil companies and other interested industry parties in an effort to reduce industry resistance to the introduction of biofuels.

WIND ENERGY

As wind makes up the largest and fastest growing share of New Zealand's portfolio of emerging renewables, and because its intermittency can negatively affect grid operations under some circumstances, additional information on the resource is provided here.

12. *Biofuels for Transport*, IEA/OECD Paris, 2004.

EXISTING AND PLANNED WIND FARMS

Existing and planned wind farms are listed in Table 15. Currently, wind farms make up 168 MW, or less than 2% of existing capacity. Wind farms for which planning information has been made public could add over 2 100 MW, which would increase wind capacity by more than five times. However, as with all planned generation, it is likely that only a modest portion of the planned wind farms will be built.

INTEGRATION OF WIND GENERATION INTO THE NETWORK

Though New Zealand's wind resource is comparatively less intermittent than in other countries, high levels of wind generation on the electricity grid can spark concerns about network security. In addition, New Zealand has a small, isolated power system that cannot rely on connections with other countries to enhance system stability and security. These concerns have led the independent electricity system operator, Transpower (under direction from the EC), the Ministry of Economic Development and EECA to investigate the subject.

In May 2005, the Ministry for Economic Development and EECA released a study on the integration of wind energy in New Zealand[13]. Under the report's hypothetical analysis using a low-demand scenario, it found that wind energy could penetrate to over 2 200 MW of capacity – 34% of total capacity – and gain a market share of 20% of total generation.

In 2005, the EC established a long-term *Wind Generation Investigation Project* to identify the detailed system issues and code changes required to accommodate the connection of large-scale wind generation to the New Zealand power system. The project is being supported by Transpower.

Concurrently, the EC, in conjunction with Transpower, has a comprehensive work programme to study the effects of wind power on system operations. In 2005, Transpower released a study under the auspices of the EC on the effects of two Manawatu-area wind generation projects with a combined capacity of 150 MW. The study found that ramp rates – the time it takes to ramp up from zero or low generation to higher levels of production – are extremely quick, that these ramp rates can exceed those of facilities used to maintain system frequency and that while short-term forecasting has improved, medium-term wind forecasting remains poor (see box). In February 2006, as a result of this study, Transpower, in its role as system operator, proposed to the EC some interim changes to system operation rules ahead of the completion of the long-term *Wind Generation Investigation Project*. These changes include proposals to set performance requirements for wind forecasting accuracy and require wind generators to offer into the system more frequently. Transpower recommends that these short-term mitigation efforts be implemented as quickly as possible as an interim solution.

13. Ministry of Economic Development & Energy Efficiency and Conservation Authority, *Wind Energy Integration in New Zealand*, prepared by Energy Link and MWH NZ, May 2005.

Table 15

Existing and Planned Wind Farms

Project	*Company*	*Region*	*MW*	*Status*
Existing				
Te Apiti I	Meridian Energy	Manawatu	90	In operation
Tararua Wind Farm I and II	TrustPower	Manawatu	67.7	In operation
Hau Nui I and II	Genesis	Wairarapa	8.65	In operation
Total			*166.35*	
Planned				
Awhitu Wind Farm	Genesis	Auckland	18	Consented
Hawkes Bay Wind Farm	Hawkes Bay Wind Farm	Hawkes Bay	225	Consented (appealed)
Titiokura Saddle WF/ Mangaharuru Range	Unison/Hydro Tasmania	Hawkes Bay	48	Consented (appealed)
Te Rere Hau	NZ Windfarms (Windflow)	Manawatu	48.5	Consented
Tararua Wind Farm III	TrustPower	Manawatu	93	Consented
White Hill (Mossburn)	Meridian Energy	Southland	70	Consented
Awakino Wind Farm	Ventus Energy	Central NI	27.2-41	Seeking consent
Taumatatotaro/Taharoa	Ventus Energy	Central NI	38	Seeking consent
Te Waka Range	Unison/Hydro Tasmania	Hawkes Bay	100	Seeking consent
West Wind (Makara - Quartz Hill)	Meridian Energy	Wellington	210	Seeking consent
Mokairau Wind Farm	Eastland Infrastructure (w/ Hydro Tasmania)	Hawkes Bay	9	
Turitea	Palmerston North CC/MRP	Manawatu	120-150	
Seddon	TrustPower	Marlborough	80	
MRP at Rototuna Forest/Pouto	Mighty River	Northland	250	
Rocklands (Central Otago)	Meridian Energy	Otago		
Puketiro Windfarm (Whitby)	Greater Wellington Regional Council	Wellington	26	
Belmont Hills	Wellington Regional Council	Wellington	70-80	
Tutira	Esk Hydro Power	Hawkes Bay	2.5	
Horehore Station/East Coast	Genesis	Hawkes Bay		
Te Apiti II	Meridian Energy	Manawatu	90	
Ahipara/Epakauri/Herekino/Ninety Mile Beach Wind Farm	Meridian Energy	Northland	50	
Glinkes Gully Wind (Red Hill)	Northpower	Northland		
Deep Stream, Hobson Hill	Dunedin City	Otago	30	
Central Otago (Several sites)	WindFlow NZ	Otago		
Rock & Pillar Gorge WF (Middlemarch)	WindFlow NZ/Wind Power	Otago	25	
Fonterra Wind	Fonterra	Taranaki		
Tenergy NZ Windfarm	Tenergy	Taranaki	10	
Pigeon Bush Wind Farm (Featherston)	Meridian Energy	Wairarapa	50	
Long Gully	Buckingham Asset Management	Wellington	150	
Wainui Hills	Wainui Hills Wind Farm	Wellington	up to 30	
Raglan	WEL Networks Ltd			
Tiwai Peninsula	Comalco/Meridian Energy	Southland		
Brooklyn Wind Turbine	Meridian Energy	Wellington	1	Existing
Mt Clime - Rimutaka Wind Farm	Wellington Regional Council	Wellington	0	
Waipara	Private: Steve Burke	Canterbury	1 turbine	
Gebbies Pass	WindFlow NZ	Canterbury	0.5	Existing
Total (including existing)			**Approximately 2 100 MW**	

Note: Planned wind farm details are based on publicly available information. As with any form of generation, there are many more wind farms under investigation but on a confidential basis. Likewise, some of the wind farm projects shown may never be developed. TrustPower's Tararua Stage III is an expansion of an existing wind farm. It will add 120 MW to the existing farm capacity of about 70 MW.

Source: Electricity Commission, *Scenarios for the Wind Generation Investigation Project, Consultation Paper*, App. D, December 2005, available from www.electricitycommission.govt.nz/pdfs/opdev/comqual/windgen/ wind-scenarios-cons-dec05.pdf.

Results of Transpower investigation on the integration of wind energy

Transpower's report made the following conclusions about the effects of two wind farms in the Manawatu region, Te Apiti and Tararua, on New Zealand's electricity system operations:

- Sudden large changes in wind generation output (of 50 MW or greater in five minutes) are likely to occur around 20 times per year for the current amount of installed wind generating capacity in the Manawatu region. This estimate is based on an extrapolation of the limited amount of data analysed in the report.
- Large changes in wind generation output over a short period may cause power system frequency excursions.
- The observed rates of change in Manawatu wind generating are at times greater than the minimum ramp rates requirements for frequency-keeping service providers.
- The size of the changes in Manawatu wind generation is at times greater than the typical frequency-keeping MW band dispatched, requiring increased use of reserves to maintain frequency.
- An improvement in the accuracy of Te Apiti's two-hour forecasts has been observed since January 2005. There have been no improvements in the 6- and 12-hour forecasts.

Following the review, Transpower proposed the following short-term system operation rule changes to the EC to mitigate the negative effects of wind generation on system operations in the interim, before a permanent solution is implemented:

- Include the loss of an intermittent generating station in the definition of contingent events for which the system operator provides reserve.
- To avoid having excess generation when there is low system load, require intermittent generators to participate in the must-run auction so they can be dispatched off if they have not secured the right to generate at times of zero prices.
- Set performance requirements on wind generation for forecast accuracy, so the likely dispatch for all generators provided in the schedules published ahead of actual dispatch reflects the actual generation requirements.
- Require wind generation to provide certain indications and measurements.
- Change the definition of "synchronised" to include wind-generating units connected to the power system.

Continued

Transpower also recommended that the EC note that there is a degree of urgency in determining and implementing the optimum long-term solutions (*e.g.* possible introduction of automatic generation control (AGC), centralised wind forecasting and redesign of the must-run dispatch auction process) given the likely additional wind generation that will be commissioned or ordered in the next 2-3 years.

Sources: Transpower, *Manawatu wind generation: Observed impacts on the scheduling and dispatch processes*, Second revision, September 2005; Transpower, *Tactical Wind Generation Project: Rationale for proposed rule changes to accommodate the connection of further wind generation until the* Wind Generation Investigation Project *is complete*, February 2006.

It is important to note that there are network security risks associated with many aspects of the electricity grid, not just wind integration. For example, system operations must manage large risks associated with large thermal power plants tripping offline or disturbances on the HVDC link between the North and South Islands. Put into context, wind integration also has positive aspects with respect to network security, as wind farms tend to be smaller than fossil fuel or large hydro plants so the impacts of wind generation ramping up or down quickly can be relatively smaller than the impacts of a larger, traditional power plant tripping offline. Successful integration of wind resources requires better understanding of wind variability and how best to place and space wind farms geographically, for example.

CRITIQUE

There is much to praise in New Zealand's approach to renewables policy, particularly in the electricity sector. Though renewables already make up a large share of the country's primary energy supply and electricity mix, the government is seeking to further increase the share of renewables in New Zealand's energy supply. It is noteworthy that, unlike many IEA countries, the government has not taken mandatory measures (*e.g.* feed-in tariffs, quota obligations) thanks to favourable and competitive renewable energy sources, particularly for wind. Financial subsidies are limited to the *Projects to Reduce Emissions* programme, and this programme does not supply incentives (in the form of carbon credits) to all projects because of eligibility restrictions and a finite pool of available carbon credits. Furthermore, the subsidies are provided in lieu of funds the government would need to spend on other efforts to reduce GHG emissions, making these financial payments bear little resemblance to true subsidies. This light-handed approach to renewables promotion is consistent with New Zealand's overall approach to energy policy, and is very commendable.

Despite its success to date, New Zealand is aware that growth of fossil fuels is outpacing growth in renewable energy supply. To help remove barriers to the growth of the renewables sector, the government amended the Resource

Management Act in 2003 to require that the benefits of renewable energy be specifically considered when a resource consent application is processed. New Zealand should continue these efforts, taking care to ensure that regional residents remain active and informed stakeholders in the process. In this respect, the efforts in Denmark, where wind power has reached high penetration levels and new projects are encountering local opposition, merit attention. The Danish government has successfully taken steps to overcome difficulties with the siting of new wind farms.

Integration of large amounts of wind into the electricity grid poses some specific challenges for New Zealand's small, isolated power system. The variability of wind and the lack of good wind forecasting techniques combine to create network security and stability risks. These risks are exacerbated by the lack of interconnections with other countries, which would allow system operators to mitigate some negative effects. For example, Denmark, which has high levels of wind energy, has interconnections with nuclear- and hydro-rich neighbours to the north as well as with the rest of the European continent, helping to insulate it from network security risks. Nevertheless, such risks do not preclude wind from growing into a larger and more significant source of New Zealand's electricity supply. Rather, the system operator and all stakeholders must work together to investigate all the risks posed by wind energy and develop the best system and market rules to mitigate them. New Zealand has already taken on this challenge through international research and New Zealand-specific case studies. The system operator has begun to develop short-term solutions to mitigate some of the negative effects revealed by these studies. The EC should work to implement these measures, or other appropriate measures, as quickly as possible. Any solution should ensure that the full costs of integrating and managing energy resources – wind and other – are made transparent and allocated accordingly. Market design solutions should, to the extent possible, rely on incentives rather than requirements. For example, market rules might be designed to provide financial incentives for wind generators to supply more frequent forecasts, rather than requiring them to do so. It is commendable that New Zealand has also begun work to develop a long-term solution through the EC's *Wind Generation Investigation Project*. The development and implementation of a long-term solution will require enhanced collaboration and co-ordination between Transpower, the EC and other stakeholders.

While New Zealand appears to be on track to meet its overall renewables target, it is unlikely to meet its indicative biofuels target of 2 PJ (0.05 Mtoe) by 2012 if further efforts are not made, even though it is a relatively modest target compared to other IEA countries. While EECA estimates suggest the target will be met, this is currently very unlikely given that there has been little measured uptake of biofuels to date and there are no promotion policies in place.

While the uptake of biofuels in the transport sector is promoted in many IEA countries as a means of reducing oil dependence, biofuels are often quite

expensive compared to other transport fuels and can increase feedstock costs in other industries, notably agriculture. Thus care should be taken to ensure that biofuels targets are cost-effective compared with other options of reducing oil dependence. For example, in some countries it could be more efficient to reduce oil dependence by raising fuel economy than by setting biofuels targets. In New Zealand, however, where the vehicle stock is quite old, biofuels might be a relatively efficient means of reducing oil dependence as biofuels impact the oil use of all cars, not just new ones. Furthermore, New Zealand's biofuels target was set on the basis of existing waste by-products used from the dairy and meat industries, whey and tallow. These sources of biofuels are generally much cheaper than most energy sources (*e.g.* corn, wheat, soy), which potentially makes the uptake of biofuels in New Zealand a relatively cheaper means of reducing oil dependence.

Regardless of how high the biofuels target is set, it should be achieved in the most efficient manner possible. In many IEA countries, biofuels are promoted through exemptions from taxes and levies, but it would be difficult to implement this policy in New Zealand because taxes and levies on petrol and diesel are very low, owing in part to the existence of road user charges for all diesel vehicles and some petrol vehicles. Instead, the government is considering requiring suppliers to meet a sales obligation, which is a positive step and could ensure that New Zealand meets its biofuels target. This could be a more flexible option as suppliers could determine the most cost-effective source of biofuels and implement the most efficient means of achieving the target, even purchasing credits from other suppliers who have exceeded their targets. Irrespective of policy choice, meeting New Zealand's biofuels target will necessitate co-operation with the oil industry and the government's work in this area is commendable. One means by which the government can start to promote renewables immediately is through public awareness. The government should build on its efforts with the *EnergyWise* programme to raise public awareness of biofuels.

RECOMMENDATIONS

The government of New Zealand should:

- *Continue to investigate the system effects of greater wind power penetration, such as on grid reliability and stability, and implement appropriate short-term and long-term mitigation measures as quickly as possible.*
- *Design and implement flexible policy measures to achieve appropriate biofuels targets in the transport sector.*
- *Raise public awareness of biofuels.*

Compared to most IEA countries, New Zealand has relatively abundant domestic fossil fuel resources (see Figure 12). It has large reserves of coal – a large share of which is exported – and some reserves of natural gas and oil. While it imports over 80% of its oil resources, it has been fully self-sufficient in natural gas. However, as its natural gas fields rapidly decline and if it does not discover significant new reserves in a timely manner, the country will either continue to dramatically reduce its gas consumption or need to build natural gas import infrastructure.

OIL

MARKET DESCRIPTION

The oil industry was liberalised in the 1980s, removing price controls, government involvement in refining, licensing requirements for wholesalers and retailers and restrictions on imports of refined products. The industry is subject to general competition regulations through the Commerce Commission (CC).

CONSUMPTION

New Zealand's oil consumption has grown steadily since the mid-1980s, primarily driven by transport consumption (see Figure 13). Total consumption grew by over 80% between 1984 and 2004; transportation consumption has grown by nearly 120% and now makes up 84% of total consumption. Oil consumption is expected to grow by 59% between 2004 and 2030 driven only by transportation consumption. Consumption in all other sectors is expected to remain the same or decline.

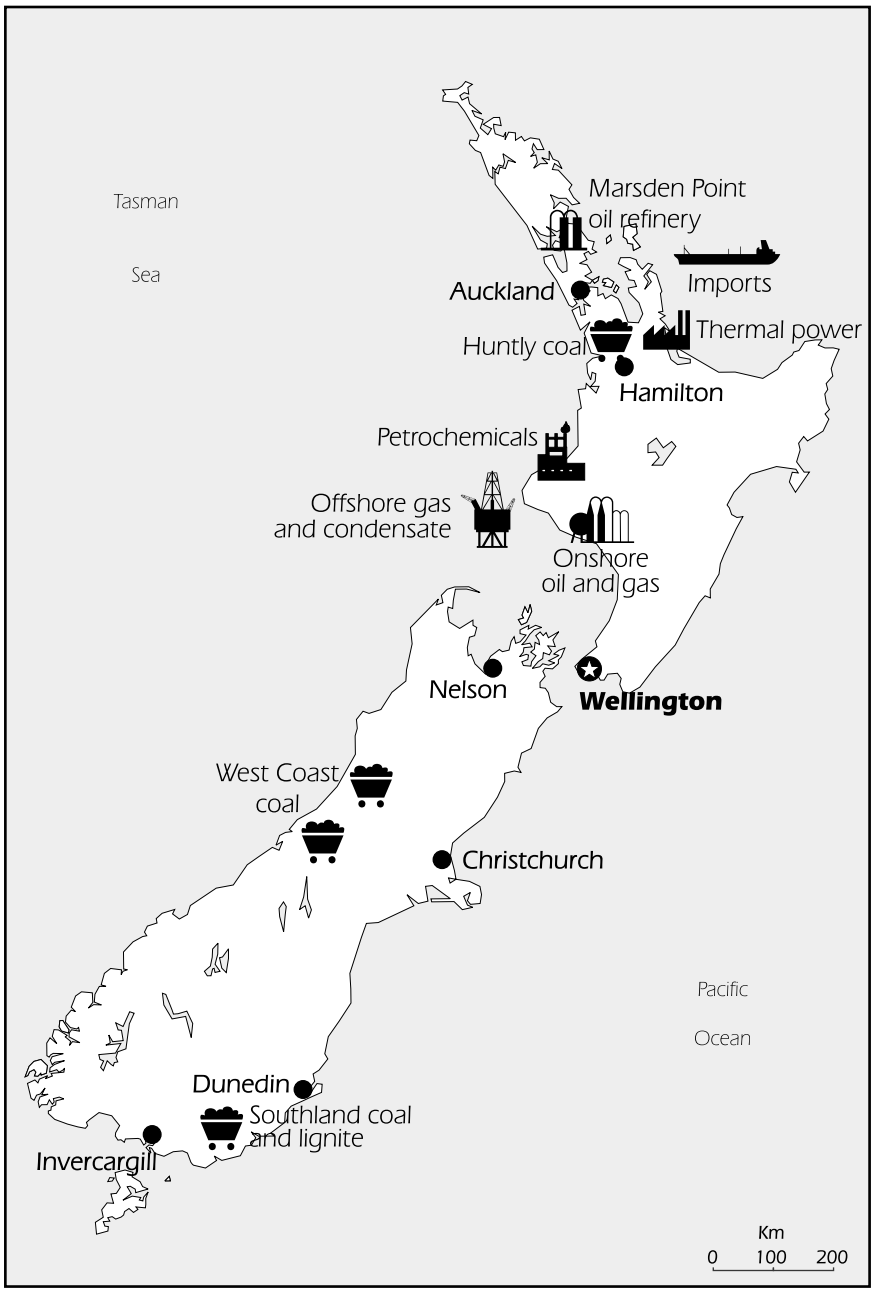
PRODUCTION AND RESERVES

Though New Zealand has some domestic production, the country imports most of its oil. In 2004, domestic production covered 17% of total supply.

As shown in Figure 14, New Zealand's oil production peaked in 1997 at about 60 000 barrels per day (bpd) and has been declining rapidly since. It fell by 65% between 1997 and 2004. However, recent discoveries in the Taranaki basin mean that oil production is expected to rise again in the short to medium term. Oil is currently produced from nine fields, but the Maui field is by far the most important source of production, though its overall share has fallen from 77% to 67% between 1997 and 2004. However, four new fields will soon enter production (Tui, Kupe, Maari and Pohokura).

Figure 12

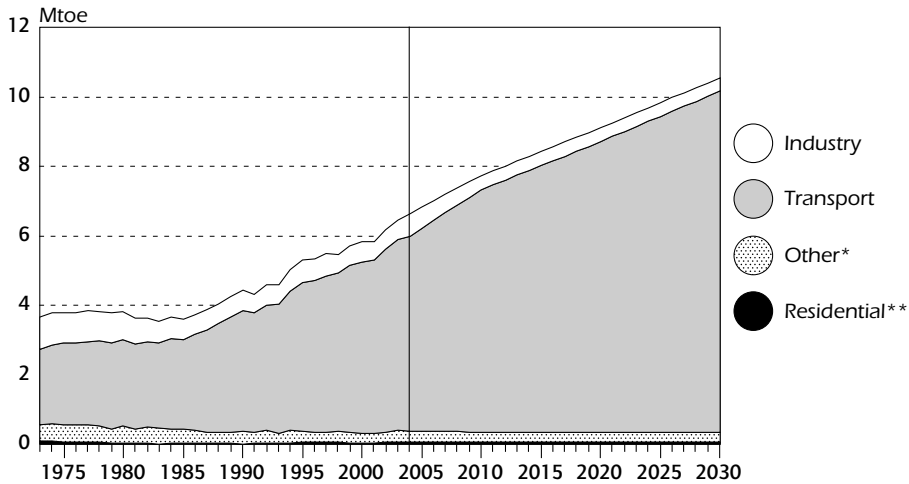
Fossil Fuels Resource Map



Source: Country submission.

Figure 13

Final Consumption of Oil by Sector, 1973 to 2030



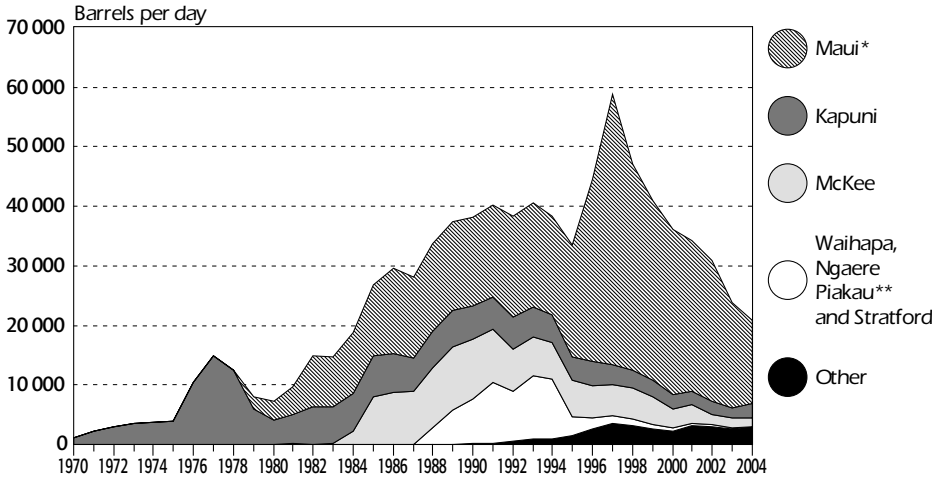
* includes commercial, public service and agricultural sectors.

** negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

Figure 14

Total Production of Oil, 1970 to 2004



* includes condensate, naphtha (from April 1999) and crude oil production from Maui and Maui F Sands. Maui F Sands commenced production in September 1996.

** Piakau has not produced crude oil since September 1999.

Source: New Zealand Oil Statistics, New Zealand Ministry of Economic Development, available from www. crownminerals.govt.nz/petroleum/facts/oil-stats.html.

Upstream oil production is dominated by Shell, which operates the Maui field in partnership with Todd Energy through Shell Todd Oil Services. Shell also has operations in other New Zealand fields. The other two most significant upstream oil producers are Todd Energy and OMV. Other producers include Swift Energy and Greymouth Petroleum. Most oil produced from New Zealand is exported, though occasionally some goes to the New Zealand market via tanker.

Currently, all oil production is in the Taranaki basin on the west coast of the North Island. Most of the basin is located offshore, but the majority of small producing fields are onshore. Maui, which is located offshore, has the largest share of remaining reserves in producing fields, containing 46% of the 40 million barrels (mb) total in New Zealand.

IMPORTS

Crude oil is imported primarily from Australia, Saudi Arabia, Oman, Brunei, the United Arab Emirates, Yemen, Qatar, other near-Middle East countries, Indonesia and Malaysia. Over the past five years, crude oil imports decreased by 2% to 36 mb in the year ending March 2005; total crude oil imports were down 1.8% as compared with the year ending March 2004. In contrast, imports of oil products were up 42%. This is the highest level of oil product imports recorded since 1974.

WHOLESALE, REFINING AND RETAIL ACTIVITIES

There are five players in oil wholesaling and retailing: BP, Caltex, Mobil, Shell and Gull Petroleum. Collectively, BP, Caltex, Mobil and Shell own about three-quarters of New Zealand's only refinery, the New Zealand Refining Company (NZRC) at Marsden Point, near Whangarei. The remaining shares are owned by private and institutional investors. NZRC processes crude oil and condensate for BP, Caltex, Mobil and Shell only. About 5 Mt of crude oil and residue are processed at the refinery each year (about 100 000 bpd), producing about three-quarters of New Zealand's total refined product demand (see Table 16). Some fuel oil is exported. Total refined product output in the year ending March 2005 was 3.7% lower than in the previous year; production of lighter products increased whereas production of diesel and fuel oil dropped. Since 2000, the average refining capacity utilisation rate has been 95%, the highest of all IEA-Pacific countries.

NZRC is a "toll refiner"; it charges a fee to convert crude oil and other feedstock into refined products. This fee is based on the difference between the value of initial feedstocks and final products, according to reported Singapore prices. NZRC's profit is not affected by downstream pricing decisions of the four oil companies that own the majority of the refinery.

NZRC also owns the Refinery to Auckland pipeline (RAP), which transports refined products to bulk storage facilities in the greater Auckland area, New

Table 16

NZRC's Share of New Zealand's Fuel Supply in 2004

Product	*Share of total New Zealand demand produced by NZRC*
Petrol	69.5%
Jet fuel and kerosene	76.2%
Automotive and marine diesel	72.0%
Fuel oil	100.0%
Road bitumen	78.6%
Total	**74.0%**

Note: In addition to fuel products, NZRC also produces sulphur for fertiliser production and carbon dioxide for use in the beverage industry.

Source: NZRC, *Annual Report*, 2004.

Zealand's major petroleum market. About half of the refinery's production is distributed via the RAP pipeline; the balance is transported by coastal tanker and road to the rest of New Zealand. The coastal tanker operation is also owned collectively by these four companies. Unlike the refinery, the refinery pipeline and the coastal tankers, the road tankers that transport petroleum products from storage facilities and port depots to the rest of the country are independently owned or contracted by each oil company.

Gull, an independent oil company, has its own oil terminal and storage facilities at Tauranga in the North Island, to which it imports its own product from Singapore and South-East Asia. It also has its own fleet of delivery vehicles.

Oil is distributed in three ways in New Zealand: independent distributors purchase product from oil majors at wholesale prices for sale through their own network of service stations; independent distributors are employed by oil majors to distribute fuel to sites within each oil major's network of service stations; or oil majors distribute their own fuel. The number of service stations in New Zealand has fallen from a high of more than 4 000 in 1976 to around 1 500 in 2001.

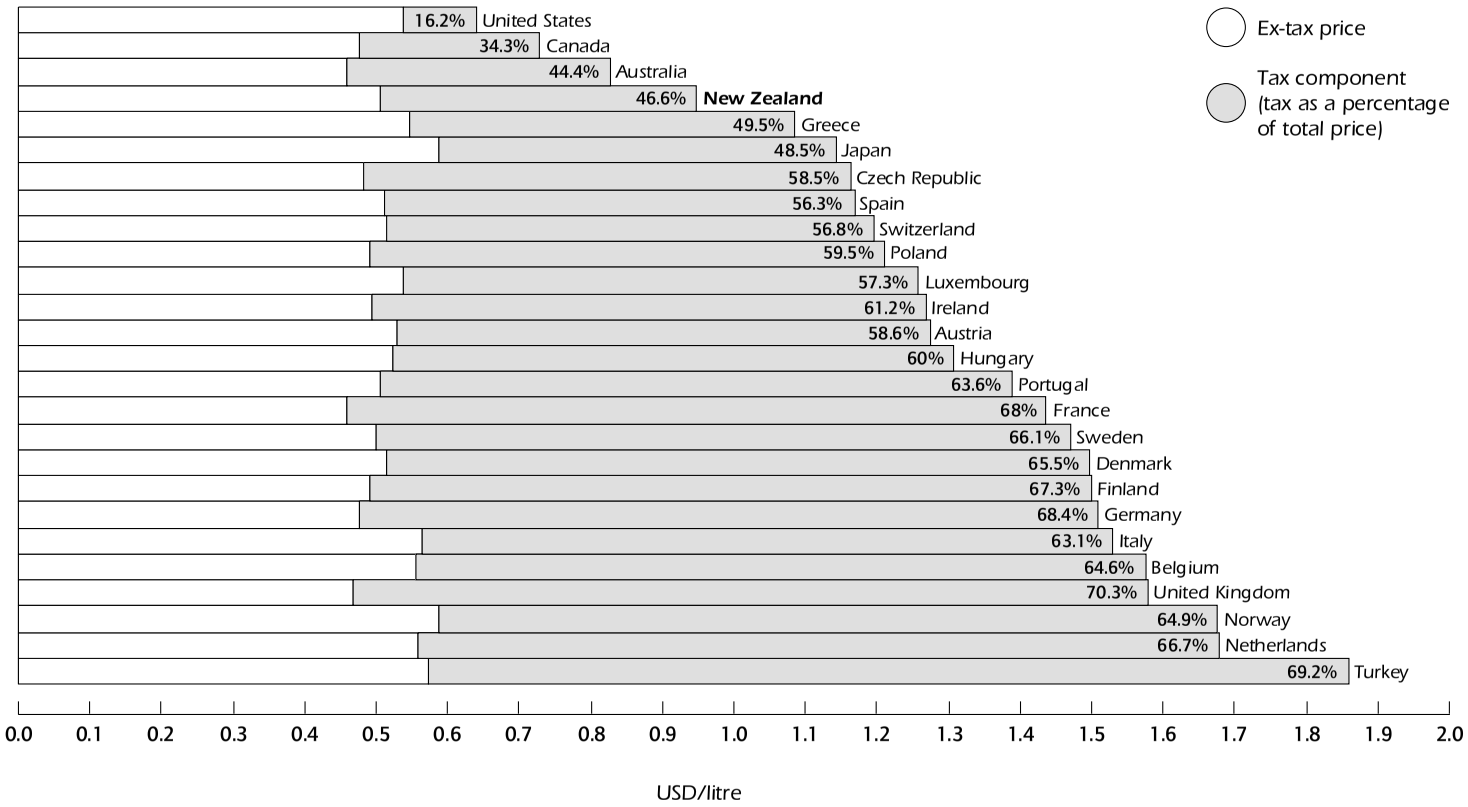
PRICES

In New Zealand and other OECD countries, prices for unleaded petrol and diesel, including both the ex-tax component and the tax component, are shown in Figures 15 and 16. Taxes on transport fuels in New Zealand are among the lowest of OECD countries. According to the Ministry of Economic Development[14], in 2005, the average margin between the Singapore wholesale unleaded petrol price and the New Zealand retail price was NZD 0.16/litre, a 2% decrease from 2003. The average diesel margin was NZD 0.22/litre, a 9% increase from 2003[15].

14. For up-to-date information, see www.med.govt.nz/ers/oil_pet/prices/prices.html.
15. Both margin calculations exclude transport costs.

Figure 15

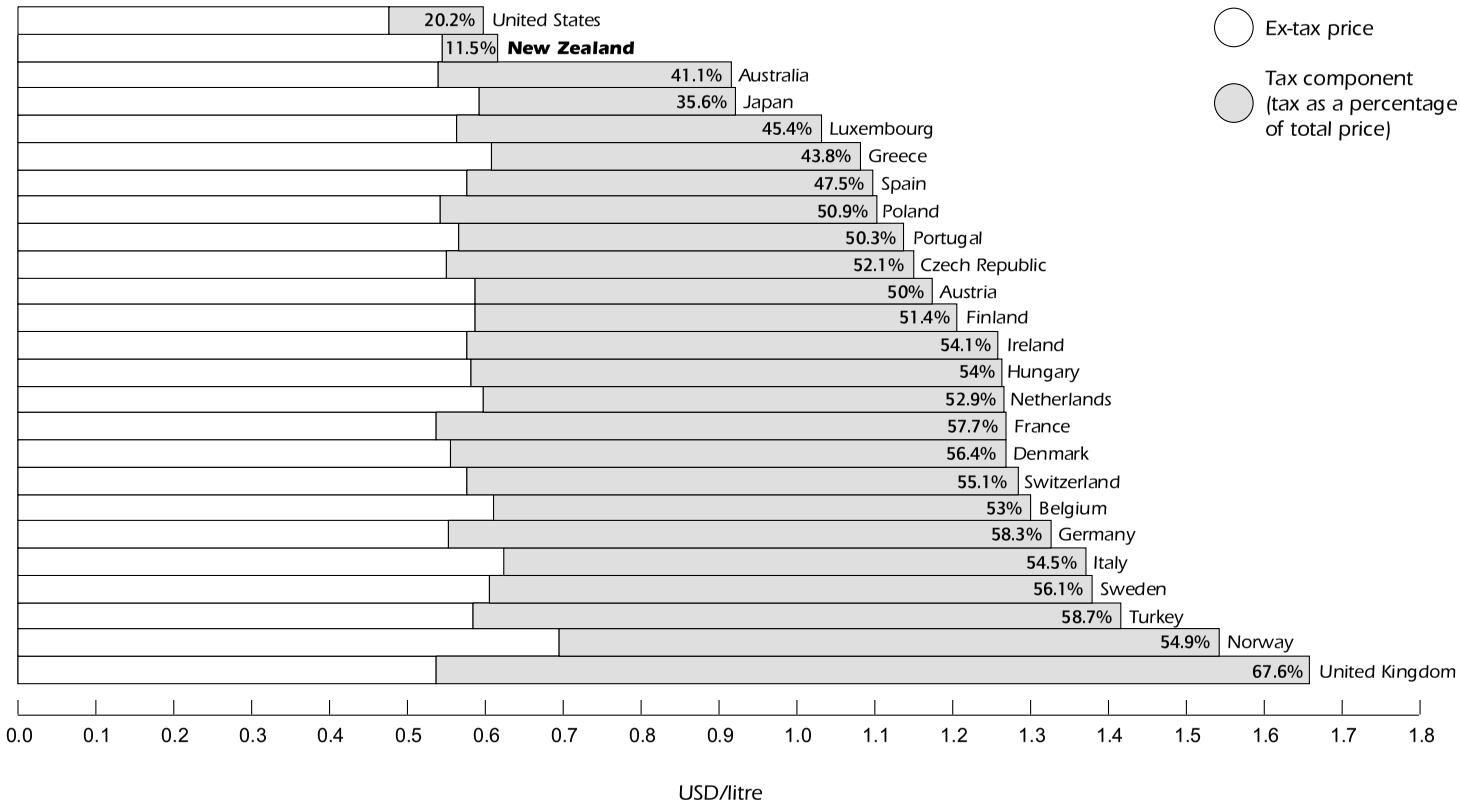
OECD Unleaded Gasoline Prices and Taxes, Second Quarter 2005



Note: Data not available for Korea, Mexico and the Slovak Republic.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

Figure 16

OECD Automotive Diesel Prices and Taxes, Second Quarter 2005



Note: Data not available for Canada, Korea, Mexico and the Slovak Republic.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

STOCKHOLDING REQUIREMENTS

As New Zealand's net imports have grown, so have the oil stocks it is required to hold (90 days of net imports) under the IEA's International Energy Program (IEP). Until now, the government has relied on voluntary industry stocks to fulfil its stockholding obligation. However, for the last several years industry stocks have been insufficient to meet New Zealand's IEA obligation, and the situation has deteriorated as New Zealand's net imports have increased. New Zealand is currently nearly 30 days below the 90-day IEP obligation. To meet its stockholding obligation now and in future, New Zealand has determined that it needs to lease additional stocks through government tenders.

The government will not own the stocks, but will have the right to acquire and release the stocks in an emergency. These additional stocks could be held abroad in IEA countries under government-to-government bilateral agreements. The government has reported to the IEA that it was its original intention to introduce new legislation early in 2006 that will codify these oil stockholding activities. The government expects to come back into compliance with the IEP obligation by the end of 2006, behind its original mid-2006 schedule. Recent oil discoveries in the Taranaki basin soon to enter production will also assist with bringing New Zealand back into compliance as they will reduce net import levels and, accordingly, the size of New Zealand's stockholding requirement.

PRODUCT QUALITY

From 1 January 2006, sulphur standards for diesel tightened to 50 parts per million (ppm); standards were 3 000 ppm in 2002 and 500 ppm in 2004. Diesel with the new specifications entered the market in September 2005. NZRC is currently making refinery investments of NZD 180 million under its *Future Fuels* project. As a result of the project, diesel, with reduced sulphur content, and petrol, with reduced benzene content, became available as from 1 September 2005.

The New Zealand government has issued additional product specification standards since 2002:

- The standard for benzene in petrol tightened from 4% to 1%; other petrol aromatic levels were also lowered.
- Up to 10% of ethanol was allowed in petrol.
- Methyl tertiary butyl ether was banned.
- Restrictions on the addition of manganese to petrol were instituted.

NATURAL GAS

MARKET DESCRIPTION

The natural gas market was liberalised along with the oil market in the 1980s. The government sold its remaining interest in the upstream market in 1988 but it still retains an interest in downstream retailers through Genesis Energy and Mighty River Power, which are both state-owned enterprises (SOEs). In addition, Genesis Power and Mighty River Power have recently become involved directly in upstream permits. The industry is subject to general competition regulation through the Commerce Commission (CC), which enforces competition regulation and, with respect to gas, regulates some of the pipelines. It is also now subject to industry-government co-regulation through the Gas Industry Company (GIC).

GAS INDUSTRY REGULATION AND THE GAS INDUSTRY COMPANY

The GIC arose out of a government review of the gas sector undertaken in 2001 and 2002. At the time, the industry was only subject to general competition law by the CC. Following that review, in March 2003 the government released its *Policy Statement on Gas Governance*, which provided for industry self-regulation. The gas industry subsequently determined that industry self-regulation was not suitable and recommended industry-government co-regulation as the best option for achieving the government's objectives. In October 2004, a new policy statement was released entitled *Government Policy Statement on Gas Governance*. This sets out one primary objective: to ensure that gas is delivered to existing and new customers in a safe, efficient, fair, reliable and environmentally sustainable manner. As part of this overall objective, the government also seeks additional specific outcomes:

- The facilitation and promotion of the ongoing supply of gas to meet New Zealand's energy needs, by providing access to essential infrastructure and competitive market arrangements.
- Energy and other resources are used efficiently.
- Barriers to competition in the gas industry are minimised to the long-term benefit of end-users.
- Incentives for investment in gas processing facilities, transmission and distribution, energy efficiency and demand-side management are maintained or enhanced.
- The full costs of producing and transporting gas are signalled to consumers.
- Delivered gas costs and prices are subject to sustained downward pressure.
- The quality of gas services and, in particular, trade-offs between quality and price, reflects customers' preferences as far as possible.

- Risks relating to security of supply, including transport arrangements, are properly and efficiently managed by all parties.
- Consistency with the government's gas safety regime is maintained.
- The gas sector contributes to achieving the government's climate change objectives by minimising gas losses and promoting demand-side management and energy efficiency.

In December 2004, the GIC became the gas industry's regulatory body. The GIC's governing board has seven members: an independent chairman plus three independent members, and three members selected by industry. By the end of 2005 the GIC was fully staffed.

The GIC is required to consult with consumer and major industry groups. In developing regulatory policies, the GIC makes recommendations to the Minister of Energy that he can either accept or reject, but cannot accept with modification. The GIC makes recommendations on a wide range of industry matters, including the making of rules and regulations in relation to the wholesaling, processing, transmission, distribution and retailing of gas.

The GIC currently has three working groups. *i)* The wholesale markets working group is responsible for investigating and making recommendations on the development of a secondary market for the trading of excess and shortfall quantities of gas. The working group will also look at developing a balancing and reconciliation mechanism. *ii)* The switching and registry working group is considering mechanisms to facilitate customer switching and other associated processes. *iii)* The model contracts working group is examining contractual issues between retailers and their customers and developing contract guidelines and model arrangements for domestic retail contracts.

CONSUMPTION

New Zealand currently relies only on domestic natural gas supply as it has no import infrastructure.

The three major groups of users of gas in New Zealand are petrochemicals, electricity generation and direct reticulated users. Petrochemicals, the bulk of which were produced by the Methanex plants, accounted for about 33% of total consumption. Methanex has two methanol plants in New Zealand. One was mothballed in late 2004 and the other in late 2005 when its 20-year gas contract came to an end. However, the plant mothballed in late 2005 has recently started again because Methanex has been able to secure additional reserves of gas on a short-term contract for at least one year. The sharp drop in 2003 shown in Figure 17 represents the downturn in methanol production due to gas supply constraints that eventually led to the mothballing of these plants.

Table 17 shows natural gas consumption by sector. Figure 17 shows total final consumption (TFC) of natural gas by sector, but excludes natural gas used for electricity generation. It also shows long-term forecasts up to 2030, which are based on New Zealand scenarios provided to the IEA. In 2004, about 38% of New Zealand's natural gas production was used for electricity generation (including co-generation). Direct residential consumption accounted for 4.5% of total consumption in 2004 and industrial consumption accounted for 44% of the total, a drop from nearly 50% in 2002.

Table 17

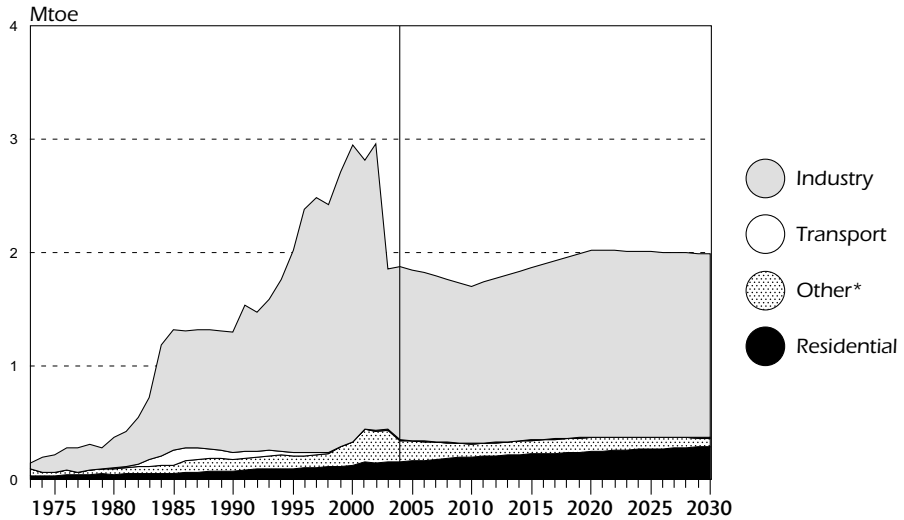
Natural Gas Consumption by Sector, 2000 to 2004

Units: Mtoe	*2000*	*2001*	*2002*	*2003*	*2004*
Electricity generation	1.9	2.4	1.9	1.9	1.3
Share	*38.1%*	*45.1%*	*37.5%*	*48.0%*	*37.6%*
Industry	2.6	2.4	2.5	1.4	1.5
Share	*51.7%*	*44.5%*	*49.9%*	*36.8%*	*44.3%*
Residential	0.1	0.2	0.1	0.2	0.2
Share	*2.4%*	*2.9%*	*2.9%*	*4.1%*	*4.5%*
Other	0.4	0.4	0.5	0.4	0.5
Share	*7.8%*	*7.5%*	*9.7%*	*11.0%*	*13.6%*
Total	**5.1**	**5.3**	**5.1**	**3.9**	**3.5**

Notes: 2004 data are provisional. "Other" includes transport, losses and other transformations.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

Figure 17

Final Consumption of Natural Gas by Sector, 1973 to 2030



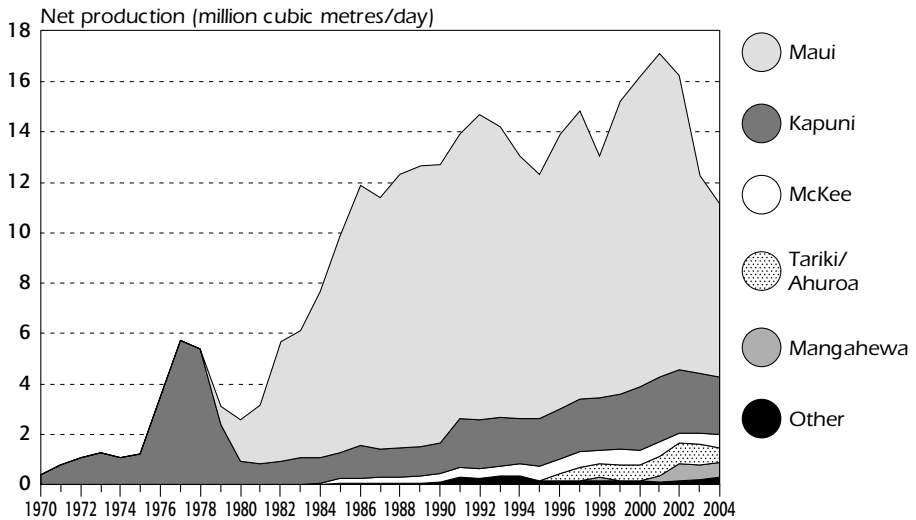
* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

PRODUCTION AND RESERVES

As shown in Figure 18, total natural gas production peaked in 2001 at about 17 million cubic metres (mcm) per day. It declined by 35% between 2001 and 2004, an average annual decline of 13%. Production at the Maui field – which produces the lion's share of New Zealand's natural gas – fell even more sharply over the period. Since 2001 it has fallen by 47%, an average annual decline of 19%. Maui provided 62% of New Zealand's total gas production in 2004.

Figure 18

Total Production of Natural Gas, 1970 to 2004



Source: *New Zealand Oil Statistics*, New Zealand Ministry of Economic Development, available from www. crownminerals.govt.nz/petroleum/facts/oil-stats.html.

About 25-30% of New Zealand's remaining 32 billion cubic metres (bcm) of natural gas reserves are contained in the Maui field. Given its rapid depletion rate, production from the Maui field is expected to cease around 2010. Even if new significant gas reserves are not found, supply for residential and small to medium-sized commercial customers is not at risk in the medium term. However, supply to industrial customers and power plants will be affected. The government estimates that a supply-demand gas imbalance will arise between 2010 and 2014 if new supply is not discovered or an import mechanism is not established in time.

WHOLESALE, PROCESSING AND TRANSPORT ACTIVITIES

Like oil production, upstream natural gas production is dominated by Shell who, in partnership with Todd Energy, owns Shell Todd Oil Services, which

operates the Maui and Kapuni fields (accounting for over 80% of total gas production). Other operators in the upstream production market include Todd Taranaki (independently from Shell), Swift Energy and OMV New Zealand. NGC, Contact Energy and Genesis Power operate in the gas wholesale market. Natural gas from the country's producing fields is transported by two high-pressure, privately owned pipelines – the Maui pipeline and the NGC pipeline (see Figure 19). The NGC pipeline is subject to open access. The Maui pipeline became subject to open access on 1 October 2005. It had previously been reserved exclusively for transporting Maui contract gas from the Maui field by Shell, Todd and OMV. The open access regime will allow other gas to be transported to market from fields that are currently under development. It will also be operated by NGC, the company that currently operates the NGC pipeline. There are no gas storage facilities in New Zealand; all storage is provided by line pack.

There are three gas processing companies, with gas production/treatment stations at Kapuni (NGC), Oanui (Maui/Shell Todd), Waihapa (Swift) and Rimu (Swift).

DISTRIBUTION AND RETAIL ACTIVITIES

Natural gas is only reticulated in the North Island, through the high-pressure NGC pipeline and local gas utilities' networks. Gas companies are under no obligation to serve any particular customer.

There had been five gas distributors – NGC Infrastructure, Nova Gas, Wanganui Gas, Vector and Powerco – but in mid-2005 Vector purchased NGC. Recently, the CC imposed price controls on the gas pipeline businesses of Vector and Powerco because of their market power positions in New Zealand. Vector and Powerco were found to be earning excess profits on their pipeline businesses.

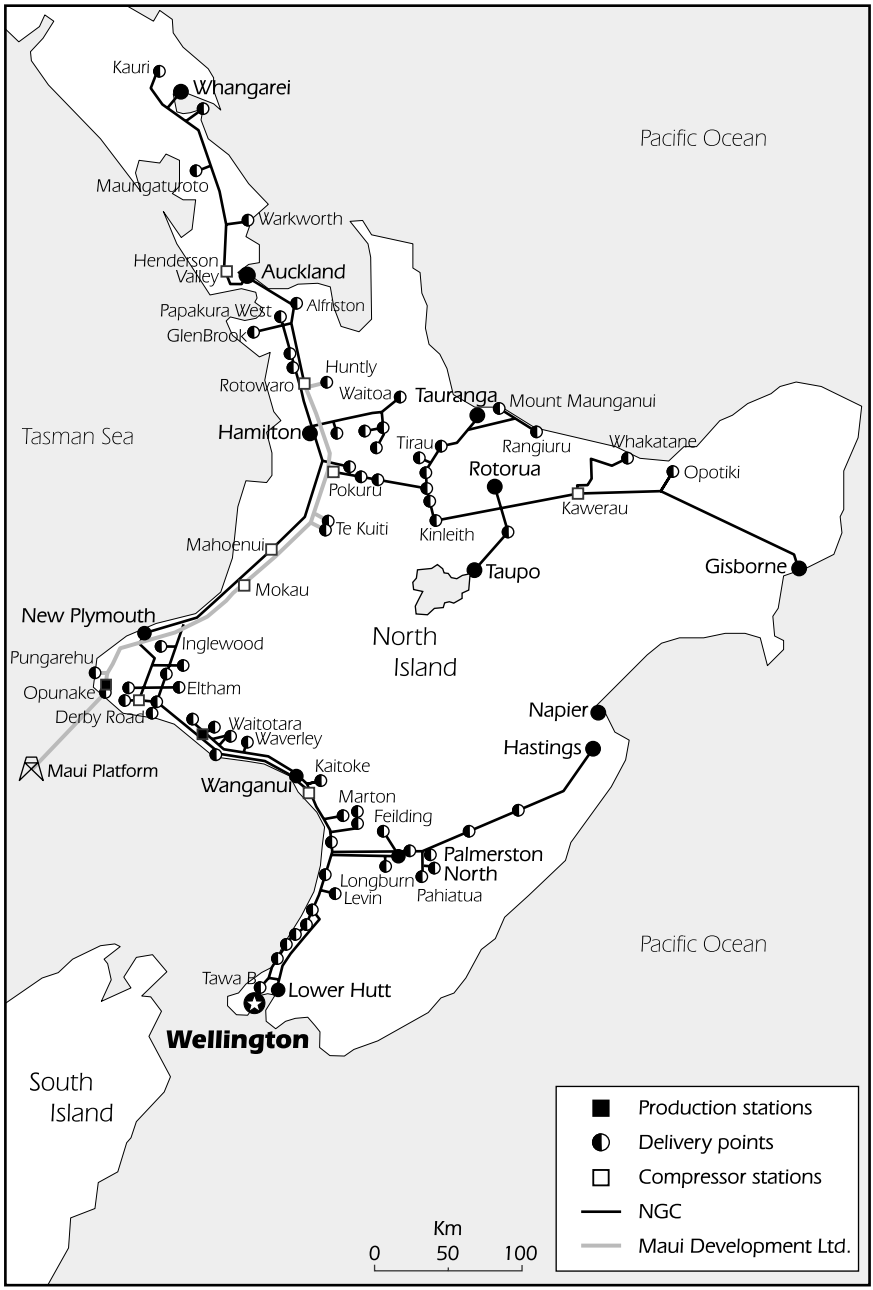
There are nine retailers: NGC (which retails only to larger commercial and industrial customers), Nova Gas, Wanganui Gas, Contact Energy (a gas wholesaler/retailer), Genesis Energy, Mercury Energy, Bay of Plenty Electricity, E Gas and Auckland Gas Company.

Options for imported natural gas

Players within New Zealand's gas industry are currently investigating the possibility of importing natural gas into the country. They are reviewing two possible options. The first is liquefied natural gas (LNG), which many countries in the Pacific basin rely on for gas supply. In order to import LNG, New Zealand must first build an LNG regasification terminal to accept gas deliveries. An LNG terminal in New Zealand could cost about NZD 600 million and would take about three years to construct. An LNG terminal of the size likely to be built in New Zealand would only meet part of the country's projected yearly demand – it could process about 1.5-2 bcm per year out of an annual requirement of 3 bcm.

Figure 19

Natural Gas Network Map



Source: Vector.

Genesis Power and Contact Energy, two large generators in New Zealand that operate gas-fired power plants, are currently investigating two locations for a proposed LNG terminal, Taranaki and Marsden Point. Despite undertaking these site investigations, the companies have not confirmed that they will build an LNG terminal. The government has not indicated any willingness to underwrite part or all of the investment required to construct an LNG terminal. Any new LNG terminal would need to comply with the existing requirements of the Resource Management Act (RMA) .

Another option the industry is investigating is to import compressed natural gas (CNG), from countries such as Australia and Papua New Guinea. CNG shows some promise for economically delivering relatively small amounts of natural gas short distances via tanker, but this technology has not yet been shown to be commercially viable. The primary benefit of CNG over LNG is that it requires a much smaller capital investment as it does not require an expensive LNG regasification terminal. This allows CNG imports to be smaller and more flexible than LNG imports, which may be more appropriate for smaller import needs. Some also argue that CNG is preferable because LNG necessitates a large investment that would require significant long-term contracts for gas imports, reducing incentives for local oil and gas exploration and crowding out other supply options. Genesis Power and Contact Energy are also investigating CNG importation, along with their review of LNG. In March 2006, Vector, an energy network company, announced plans to import CNG from Papua New Guinea. In addition, Todd Energy is also exploring CNG imports.

OIL AND NATURAL GAS EXPLORATION

While the government sees that gas imports may be necessary, it has focused on improving conditions for oil and gas exploration. To that end, the government has developed oil and gas exploration policies that reduce royalty payments over a specific window. In addition, it is strictly enforcing existing rules requiring permit holders to honour work commitments, including schedule commitments.

EXPLORATION INCENTIVES

In May 2004 the government revised its exploration policy through various initiatives:

- Acquiring and interpreting seismic and other technical data to better attract competitive bids for exploration permits.
- Improved information technology (IT) systems to make data readily and freely available to explorers.
- More frequent competitive tenders for permits in frontier petroleum basins.
- Targeted marketing to bring larger international exploration companies to New Zealand.
- Enforcing licence-holder obligations more rigorously by requiring them to carry out their projected work programmes.

Tax and royalty policies

A revised royalty regime that increases incentives for natural gas and oil exploration and production was introduced on 1 January 2005. The new regime reduces royalty rates on gas discovered in New Zealand between 30 June 2004 and 31 December 2009[16]. In addition, the government removed tax rules that had created incentives for companies to keep offshore drilling rigs and seismic vessels in operation for less than 183 days in New Zealand waters.

Under the Energy Resources Levy Act of 1976, a levy is imposed on the production of natural gas, with the exception of any natural gas produced from any discoveries made after 1 January 1986.

Exploration

At present there are 110 current permits for oil and gas exploration and mining (19 production/mining permits and 91 exploration permits)[17]. The number of new wells drilled has increased from 17 in 2001 to 34 in 2005. In 2004, two new oil and gas mining permits were granted by Crown Minerals. On 8 October 2004, the offshore Pohokura field, discovered in early 2000, was granted a petroleum mining permit (PMP). Shell Todd Oil Services, the operator, has indicated that the field has reserves of 19.8 bcm of gas and 42.8 mb of condensate, making it the third-largest field to be discovered in New Zealand. It will be New Zealand's second offshore operation. Initial production is expected to be 1.34 bcm of gas and 3 mb of condensate per year. The other mining permit granted in 2004 was for the Kahili field, onshore Taranaki, a very small field with reserves of 0.13 bcm of gas and 0.141 mb of condensate.

Five more PMPs were granted during 2005 (two offshore), bringing the total PMPs in New Zealand to 19. One of the offshore PMPs granted in 2005 was for the 504 km^2 Tui oilfield in November (with estimated condensate reserves of 26.8 mb). The other was for the 34.17 km^2 Maari oilfield in December (with estimated condensate reserves of 49.0 mb).

There are now four offshore fields scheduled to be developed over the next 24-36 months – Maari, Tui, Pohokura and Kupe. At least 20 wells will be drilled during the development of these fields. New Zealand is expected to become around 50% self-sufficient in liquid petroleum output as a result of expected output from the four offshore fields in 2007. In addition, at least one development well will be drilled from the Maui-A platform during the first half of 2006 to tap into additional reserves accessible from the current Maui- infrastructure.

With regard to onshore fields, two of three onshore PMPs granted during 2005 were for relatively small accumulations. In May 2005, a 22.48 km^2 PMP was granted over the Radnor field in the onshore Taranaki basin (with estimated

16. The new regime also applies, to a limited extent, to oil discoveries.
17. Updated information is available from www.crownminerals.govt.nz/petroleum/index.asp.

gas reserves of 0.014 bcm and 0.8 mb of oil reserves). This permit was granted as a result of good flow rates obtained from the Radnor-1 well drilled in the third quarter of 2004. The second onshore PMP was granted in 2005 over the 22.48 km^2 Windsor field (with estimated gas reserves of 0.014 bcm but no oil reserve estimates issued to date). The third onshore field granted a PMP during 2005 is substantially larger than both the Radnor and Windsor fields. In April 2005 a 35.24 km^2 PMP, straddling both onshore and offshore areas in the south Taranaki region, was granted for the production of oil and gas from the Kauri field. This permit covers an area that lies immediately to the south of the existing Rimu PMP (granted in early 2002). The PMP operator has indicated that the field holds 1.2 bcm of gas and 5.7 mb of oil of P50 ultimate recoverable reserves, which means that it is equally likely the field holds more or less than this estimate.

With regard to exploration, oil and gas exploration permits were issued in 2003 (15 permits), 2004 (31 permits) and 2005 (11 permits). In 2005, the government offered four blocks for oil and gas exploration permits. Seven blocks covering 8 500 km^2 were offered in offshore Taranaki, four blocks covering 43 300 km^2 were offered offshore to the east of the North Island, five blocks covering 34 700 km^2 were offered north-west of the North Island and three blocks covering 33 700 km^2 were offered further offshore at Taranaki. Blocks covering over 11 000 km^2 were awarded in February 2006 with decisions on the other blocks pending. In mid-to-late 2006, the government intends to offer 40 blocks covering about 9 000 km^2 in the Great South basin – the southern offshore region of the South Island. Any natural gas discoveries in the Great South basin would require a significant investment in domestic transportation infrastructure as there is currently no means of delivering natural gas from the South Island to users in the North Island. A large discovery resulting in natural gas production that exceeds domestic demand would likely require significant upstream infrastructure investment, including the construction of an LNG liquefaction terminal, in order to serve the international market, unless New Zealand expanded its industrial base to take up any excess gas domestically.

With regard to downstream players, there has been a recent increase in downstream market participants taking on exploration risk, including electricity generators and industrial companies such as Contact Energy, Genesis Power, Mighty River Power and Methanex. Origin Energy, the Australian company that is majority shareholder of Contact Energy (with whom a proposed merger has recently been announced), is also involved in upstream exploration (and soon production) in New Zealand.

2005 activity

As noted, exploration and development activity remained buoyant during 2005 with 34 wells being drilled (including numerous sidetracks and a water disposal well). All wells drilled during 2005 were in the onshore Taranaki

basin; no offshore wells were drilled during 2005. A total of approximately 86 900 metres (m) of oil and gas wells were drilled during 2005. This reflects an 8 700 m increase over the 2004 figure of approximately 78 200 m when 33 wells were also drilled. By comparison, only 16 wells were drilled during 2003, totalling approximately 35 200 m. Of the 33 wells drilled in 2005, 19 were exploration wells, 13 were appraisal or development wells and one well was for water disposal from the Pohokura development. Discoveries were made on two exploration wells, indicating a 10% success rate. Results from at least three exploration wells are still unknown.

Highlights of exploration drilling campaigns conducted during 2005 included positive results from Swift Energy's Paikau North-A1 sidetrack well, Greymouth Petroleum Holdings' Turangi-1 well and the Supplejack South-1 sidetrack well. Swift Energy reported test flow rates of 0.2 mcm per day of gas and 400 bpd of condensate from the Paikau North-A1 sidetrack well. An application for a PMP was filed by Greymouth Petroleum Holdings (and subsidiaries) in November 2005 over their entire petroleum exploration permit area (in which their exploratory Turangi-1 well is located). Well-testing operations are scheduled to be conducted on the Supplejack South-1 sidetrack well. In terms of development activity, Swift Energy drilled a total of six wells in the Kauri field during 2005 and the Pohokura joint venture completed the second of three extended-reach production wells (from an onshore location) using the largest onshore rig ever mobilised to New Zealand. Both of these extended-reach wells set new records for the greatest measured length attained by a well in New Zealand, both being in excess of 6 500 m.

Coupled with this increase in drilling activity was a substantial increase in the number and size of 3-D seismic-acquisition surveys conducted during 2005. A large 3-D seismic-acquisition vessel was mobilised to New Zealand waters early in the first quarter of 2005 and conducted a multi-permit programme. The third-largest onshore 3-D seismic survey was conducted by Todd Exploration Limited during the first half of 2005. More 3-D seismic data were acquired during the first half of 2005 than in any other year to date. An extensive offshore seismic campaign was undertaken in the summer of 2005/06, both 2-D and 3-D. Taranaki and East Coast surveys are being taken by permit holders while the Crown is undertaking an extensive 2-D survey in the Great South basin, which will be part of a data package for the Great South basin bid round.

COAL

MARKET DESCRIPTION

Solid Energy, a state-owned enterprise (SOE) established in 1987, mines about 80% of the 5 Mt of coal that is produced in New Zealand annually. The remainder is produced by a number of smaller, private-sector coal companies:

including Francis Mining and New Vale, which mine in the South Island, and Glencoal and MacDougall, which mine in the North Island. The country is self-sufficient in coal and exported more than 2 Mt of premium-grade coking coal in 2004, about 40% of its production, though recently it has imported some steam coal to cover short-term needs. This was the case for the Huntly power station, which was used more heavily than normal during a period of low hydro levels in 2004 and reduced gas availability, and relied on some imported coal because domestic production from the Huntly fields could not ramp up quickly enough. Coal imports to the Huntly plant are now the norm as there have been difficulties producing sufficient coal domestically for Huntly.

There are no government restrictions on the import or export of coal. The government does not provide coal production subsidies. As an SOE, the government does not control the operations of Solid Energy, nor direct its business decisions. It is subject to the same rules, regulations and taxes as privately owned coal companies in New Zealand (see box).

Solid Energy

Solid Energy has 630 employees who work at seven opencast and underground mines, five distribution/coal-handling facilities and the corporate offices. An additional 600 people work under contract at its opencast mining or related operations. In 2005, the company had an operating revenue of NZD 400 million.

As an SOE, the seven directors on the board of Solid Energy are selected by government ministers. Solid Energy's shareholders are the Ministers of State-owned Enterprises and Finance.

Solid Energy is evaluating new coal-fired power generation of 150 to 250 MW at Buller on the South Island and continues to investigate the opportunity for lignite-fired generation in the Southland.

CONSUMPTION

As shown in Table 18, total consumption of coal grew by about 34% between 2003 and 2005. By far, the greatest rise was in coal used for electricity generation, which grew by 131% over the period. A small amount of coal is still used in the residential sector for heating.

Major domestic coal customers are Pacific Steel, New Zealand Steel and Genesis Power, owner of the 1 000 MW Huntly plant in the North Island – New Zealand's only coal-fired power station, which can also run on natural gas. Other coal users are the dairy and cement industries, meat and timber processors, other industrial processing and a gradually increasing number of residential consumers.

Table 18

Coal Consumption by Sector, 2003 to 2005

(years ending March)

	2003			*2004*			*2005*		
	PJ	*Mtoe*	*Share*	*PJ*	*Mtoe*	*Share*	*PJ*	*Mtoe*	*Share*
Agriculture	0.6	0.01	1%	0.6	0.01	1%	0.5	0.01	1%
Industrial*	37.4	0.89	59%	38.2	0.91	49%	33.2	0.79	39%
Commercial	5.2	0.12	8%	5.4	0.13	7%	5.4	0.13	6%
Residential	0.6	0.01	1%	0.8	0.02	1%	0.9	0.02	1%
Domestic transport	0.1	0.00	0%	0.1	0.00	0%	0.1	0.00	0%
Electricity**	19.1	0.46	30%	32.5	0.78	42%	44.1	1.05	52%
Total	**63**	**1.50**	**77.5**	**1.85**		**84.2**	**2.01**		

* includes co-generation. ** excludes co-generation.

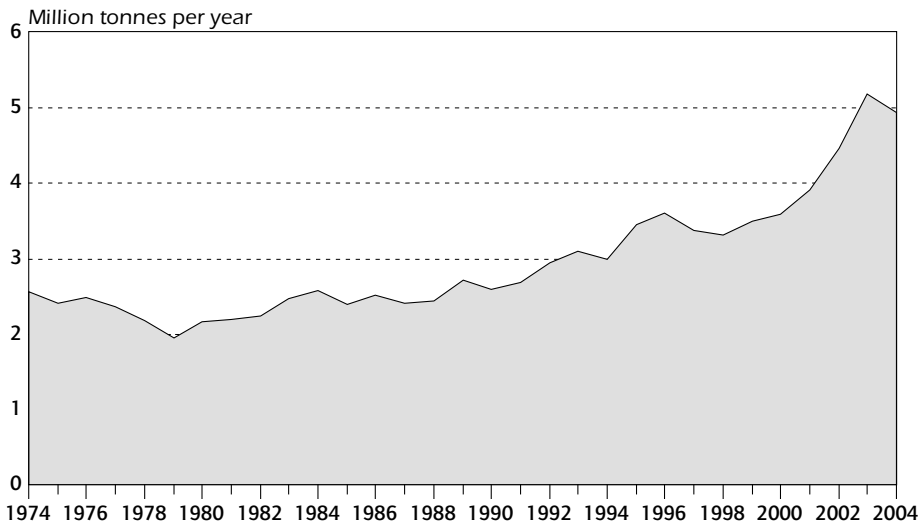
Source: Country submission.

PRODUCTION, RESERVES AND TRANSPORTATION

As shown in Figure 20, coal production has risen dramatically over the last few years. Production has risen by 49%, from 3.3 Mt in 1998 to 5 Mt in 2004, an average annual increase of 6.9%.

Figure 20

Historical Coal Production, 1974 to 2004



Source: New Zealand Energy Data File, New Zealand Ministry of Economic Development, available from www.med.govt.nz/ers/en_stats/statistics/edf/200507/200507-c.pdf, Table C.2, p. 40, July 2005.

New Zealand's total in-ground coal resources are estimated at 15.6 billion tonnes; about 8.6 billion tonnes are considered recoverable resources. Over 90% of recoverable resources are located in the South Island.

About 20% of the country's reserves are bituminous and sub-bituminous coal. This type of coal accounted for 95% of production in 2004. In the North Island, there is some high-quality coal near Huntly, which is used for the country's coal-fired power plant, as well as feedstock for industrial plants`(in particular for Blue Scope's steel mill at Glenbrook). The Taranaki region also has extensive sub-bituminous coal resources; this coal would only be economic to extract if prices rise above current world levels.

The remaining 80% of coal reserves are lignite, a type of coal that has a high moisture and ash content and is generally not cost-effective to transport because of its low energy intensity. As a result, mined lignite is typically used in adjacent coal-fired power plants. However, as New Zealand's lignite is primarily located in the very south of the South Island – away from consumption centres – lignite makes up only 5% of annual coal production. Lignite is used domestically in the South Island for industrial purposes, including drying and steam generation. It is also used in boilers for heating, for example in schools and private homes. Recently there have been advances in mining systems, gasification technologies and carbon dioxide capture and storage that improve the efficiency and reduce the environmental effects of lignite-fired power plants, potentially making lignite a more viable energy source in the future. In addition, because of its chemical and physical properties, lignite is being evaluated for its potential for conversion to syngas and further transformation to fertiliser and transport fuels such as diesel, gasoline and hydrogen.

Most coal is transported via rail, but some coal is transported via road and by sea barge. Coal for export and most coal from the South Island is transported by rail to port depots. The transport route that brings coal from the west coast to the east coast of the South Island is running at full capacity. The railway track is owned by the New Zealand government (through the New Zealand Rail Corporation or OnTrack), and the rolling stock is provided and operated by Toll Holdings (the monopoly private-sector rail operator in New Zealand). The track is in need of substantial upgrade, and Solid Energy is contributing to this work and has begun to undertake some investments. When the railroad was repurchased from Toll Holdings in September 2004, the government agreed to spend a one-off amount of NZD 200 million to upgrade the rail network infrastructure. In exchange, Toll Holdings agreed to spend NZD 100 million on upgrading the rolling stock.

IMPORTS

Despite its coal production and exports, New Zealand does import some coal, and this amount grew dramatically in 2003 and 2004. In 2002, imports accounted for 4% of total coal consumption – in 2004 imports rose to 25%.

This increase in coal imports is due in large part to imports by Genesis Power from Indonesia for use in the Huntly power plant, which ran more often in 2004 to compensate for low hydro levels and reduced gas availability and is continuing to run more often on coal because of continued lack of gas availability. The power plant switched from gas to coal in mid-2003. Coal was imported because domestic production could not ramp up quickly enough. Solid Energy has co-operated with Genesis Power to construct a rail-receiving facility, haul road and stockpile at its Huntly West mine to manage imports.

TAX AND ROYALTY PAYMENTS

Coal producers pay a standard corporation tax and royalty on coal production, the amount depending on the regime under which the right to extract coal was granted – the Mining Act of 1971 (now repealed), the Coal Mines Act of 1979 or the 1991 Crown Minerals Act and associated 1996 Minerals Programme for Coal. Current royalties paid under the 1991 and 1996 legislation amount to 1% of sales or 5% of profits, whichever is greater. Under the Energy Resources Levy Act of 1976, a levy is imposed on the production of opencast coal and natural gas.

CRITIQUE

New Zealand is facing a tremendous challenge as its critical oil and gas field, Maui, rapidly approaches the end of its producing life. While New Zealand can import oil from the world market, the decline of gas production poses a particularly acute challenge for the country, as there is no import infrastructure. The government is well aware of this, and has implemented a set of measures to stimulate exploration for natural gas. The government has revised the royalty regime to give incentives for near-term discoveries, has provided high-quality geological data to the market through investments in IT systems that make data readily and freely available, has accelerated the schedule for making new offshore acreage available for exploration, has revised the taxation regime for seismic vessels and drill rigs, and has increased promotion of New Zealand's petroleum basins to targeted companies.

All of this has led to an increase in exploration, improving the chance that new fields will be discovered to replace Maui. Though the initial response to the enhanced exploration incentives has been positive, consideration may also need to be given to additional or alternative initiatives to further hasten exploration in an increasingly competitive world exploration market. As new supplies are needed in the near term in New Zealand, it is important that the government continues to monitor the effectiveness of its revised policies, and modifies or enhances them if necessary, to improve the conditions for – and the odds of – finding new supplies. New Zealand can benefit from the experience of other member countries facing similar challenges. For example,

Norway recently changed its tax rules, reducing the financial risk to operators if they fail to find exploitable resources in their petroleum licence area. Operators are now allowed to reclaim exploration expenses up to the level of the petroleum tax if they are not successful in discovering resources in their acreage.

The government's successful implementation of an open access regime on the Maui pipeline, which brings natural gas onshore and transports it north, is another positive step that will help encourage hydrocarbon exploration by providing greater access to the downstream market. In addition, successful integration of the open access regime on the Maui pipeline with the existing regime on the NGC pipeline will aid natural gas market competition. Finally, the open access regimes on New Zealand's two gas transportation pipelines may also encourage the development of gas import infrastructure, as open access will give confidence to resource owners that they can get access to the downstream market. The government should monitor this new regime to ensure that it achieves the twin policy goals of increased exploration and supply security, and a well-functioning gas market.

Whether or not New Zealand should begin to import natural gas is a hot topic in the country. While the development of domestic gas resources is considered a first-best solution for the country, New Zealand may need to import natural gas in order to maintain the fuel as a significant part of its supply mix in the medium and long term. To that end, the government should continue to ensure that there are no undue regulatory barriers for market participants to construct an LNG regasification terminal or invest in CNG import infrastructure. The government might also consider regulatory incentives for new infrastructure, such as making a new LNG terminal temporarily exempt from open access rules, as is done in the US by the Federal Energy Regulatory Commission. Such a policy may not be appropriate in New Zealand, however, as a single LNG terminal will significantly affect the energy market in New Zealand, whereas it does not in the US. Consequently, the government must take care that any incentives it provides are not at the expense of competition from other supply options.

In late 2004, New Zealand established the Gas Industry Company (GIC), which is owned by New Zealand gas industry participants and funded by levies on all industry participants. The GIC is a co-regulatory body for the gas industry whose board members are both independents and representatives from industry. The GIC board makes recommendations to the Minister of Energy who may accept them without modification or reject them. As discussed in Chapter 3 on general energy policy, while the evolution of the regulatory regime for the gas sector may improve competition in the medium term, in the short term the new institution may give rise to uncertainty. The government and the GIC should work to establish a stable regulatory regime as quickly as possible to minimise the negative effects of the transition period. At the same time, the effectiveness of the GIC should be closely monitored so that any necessary changes can be made as soon as possible.

New Zealand has not been in compliance with its IEP oil stockholding requirement for several years and is currently nearly 30 days below its 90-day obligation – the lowest reported level of stocks by an IEA member country in over a decade – stemming from decreasing domestic production and increasing consumption, coupled with lower stockholding rates by industry. In this context, the government undertook a comprehensive review of how it will meet its future oil needs and its IEA stockholding obligation. As voluntary stocks held by industry have fallen, the government intends to tender for additional stocks, possibly to be held abroad in other IEA countries, but has fallen behind its original mid-2006 compliance target. The recent co-ordinated IEA release of country oil stocks underscores the importance of maintaining sufficient supplies at all times so that IEA member countries can respond quickly, collectively and with fair burden-sharing to world oil market events. To remedy this unacceptable situation, the New Zealand government should speed up implementation of its tendering plan or, as alternatives to tendering or options for the future, require that industry hold mandatory stocks or create a special industry stockholding agency for this purpose.

Solid Energy, a state-owned enterprise, mines four-fifths of total New Zealand coal production. Despite the government's role in the sector, there are no restrictions on the import or export of coal and the government does not provide coal production subsidies. Both of these policies are commendable. Nonetheless, as discussed in Chapter 3, the government should continue to evaluate the need for Solid Energy to remain a state-owned enterprise and consider privatisation if this would improve efficiency.

Despite the country's large reserves, little lignite is extracted in New Zealand owing to the relatively high cost of transporting coal or electricity generated from coal from the south of the South Island to consumption centres in the North Island. In light of the country's growing electricity and transport fuel needs and emerging technologies that improve the efficiency and reduce the emissions of burning this type of coal for electricity production, the government should consider evaluating the potential of lignite to become a cost-effective electricity source for New Zealand, and disseminate this information to the market.

RECOMMENDATIONS

The government of New Zealand should:

- *Monitor the effects of the measures taken to stimulate exploration activity and evaluate the need for further actions to accelerate and bring forward exploration and development of oil and gas reserves in an increasingly competitive world market for hydrocarbon investments.*

- *Ensure that the newly instituted open access regime for the Maui gas pipeline supports competition and contributes to the development of the market, as well as provides incentives for new hydrocarbon exploration and production.*
- *Ensure that there are no undue regulatory barriers for market participants to invest in natural gas import infrastructure.*
- *Maintain a stable mandate for and closely monitor the work of the Gas Industry Company in order to provide more regulatory certainty and predictability and ensure efficient and competitive functioning of the gas market.*
- *Complete urgently the necessary legal and administrative arrangements to bring New Zealand into compliance with the 90-day IEA stockholding obligation as quickly as possible.*
- *Consider requiring industry to hold mandatory stocks or to create an industry stockholding agency for this purpose.*
- *Consider evaluating the potential of South Island lignite resources to be competitive with other energy sources given emerging energy technologies for lignite use in electricity generation and conversion to transport fuels, and disseminate this information to the market.*

New Zealand liberalised its electricity market relatively early. The market has been progressively open to competition since 1987. In recent years, the regulatory structures and market design features have changed as New Zealand has gained more experience with liberalisation and has faced electricity shortages.

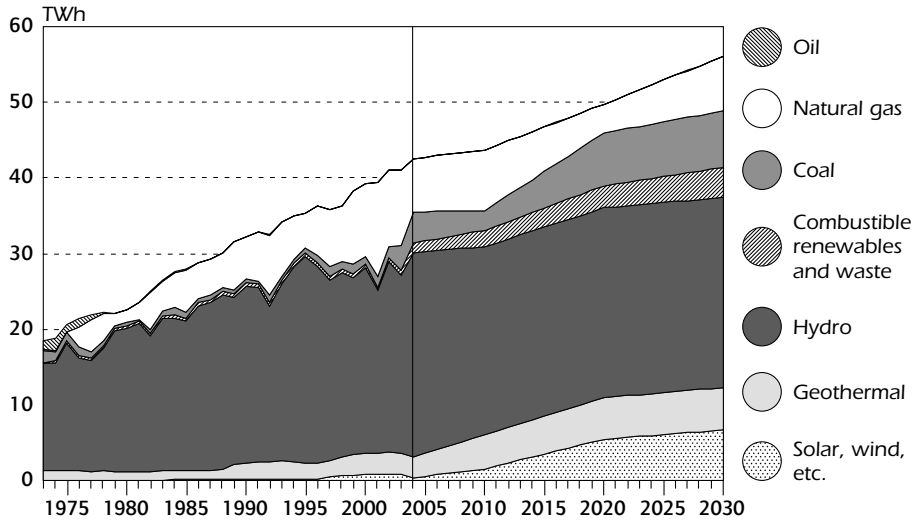
CAPACITY, PRODUCTION AND DEMAND

LONG-TERM TRENDS

As shown in Figure 21, New Zealand's electricity supply is dominated by conventional renewables – hydro and geothermal have historically made up a majority of the country's electricity generation. Between 1974 and 2004 this combined share fell from 82% to 70%. At the same time, natural gas-fuelled generation has grown from less than 2%, rising to a peak of 32% in 2001 before falling to 17% by 2004.

Figure 21

Electricity Generation by Source, 1973 to 2030

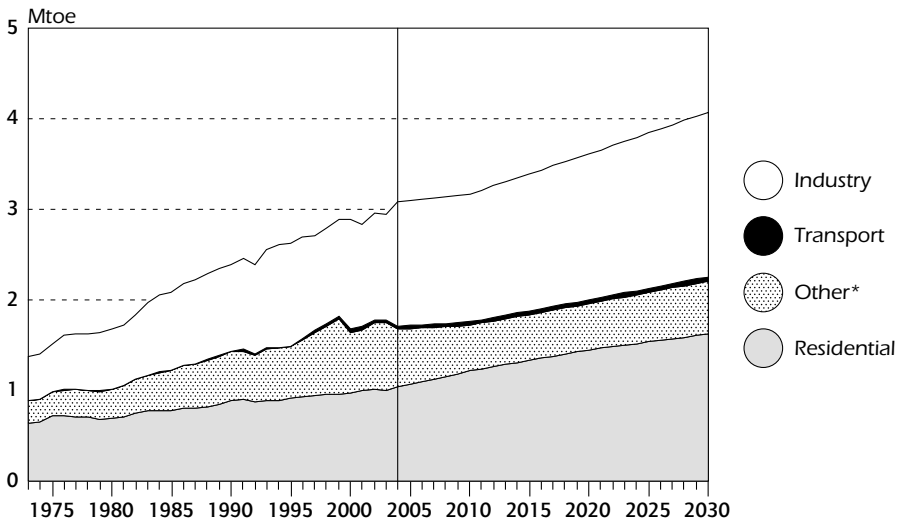


Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

As shown in Figure 22, total final consumption (TFC) of electricity has more than doubled since 1974. Between 1974 and 2004, the residential sector's share of TFC fell from nearly a half to about a third. Between 1974 and 2004 the industrial sector's share of TFC has grown from 36% to 45%. Sectors identified in the chart as "other", which includes commercial and agricultural consumption, have seen their share of TFC rise from 18% in 1974 to 20% in 2004.

Figure 22

Final Consumption of Electricity by Sector, 1973 to 2030



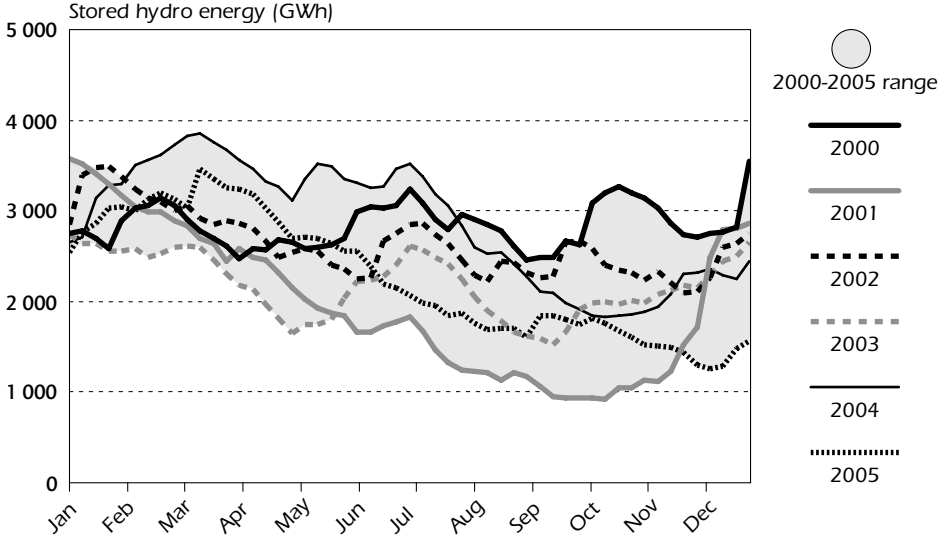
* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and country submission.

HISTORICAL HYDRO RESERVOIR LEVELS

New Zealand's hydro resources have limited storage capacity. In total, New Zealand has about 12 weeks of reservoir storage under normal circumstances. The hydro system benefits from winter rains that fill North Island reservoirs during peak demand in winter. In the spring, the South Island's reservoirs are filled by rainfall and snow melt. Stored hydro energy levels from the last six years are shown in Figure 23, which indicates that, between 2000 and 2005, the peak amount of hydro storage in a calendar year has ranged from a low of 2 742 GWh to a high of 3 856 GWh. Furthermore, as Figure 23 illustrates, the variability between historical low and high storage levels can at times exceed the average or expected storage volume. For example, the range between historical high and historical low storage in October is over 2 100 GWh, whereas average storage itself is just above 2 000 GWh. This high variability makes the prediction of potential hydro storage a difficult task in New Zealand.

Figure 23

Historical Stored Hydro Energy Levels, 2000 to 2005



Source: Electricity Commission.

CURRENT LEVELS

Current electricity capacity and generation is detailed in Table 19. It is noteworthy that the capacity factor of New Zealand's wind generation is very high. Wind turbines are generating on average at nearly 32% of their total capacity, a high level.

Table 19

Electricity Capacity and Generation, Year Ending March 2005

	Capacity (MW)	*Capacity share*	*Generation (GWh)*	*Generation share*	*Capacity factor*
Hydro	5 345	60%	26 389	64%	57%
Gas	1 765	20%	6 700	16%	44%
Coal	796	9%	4 006	10%	58%
Geothermal	470	5%	2 634	6%	64%
Wind	166	2%	460	1%	32%
Oil	155	2%	20	0%	1%
Combustible renewables, waste and other	177	2%	779	2%	51%
Total	**8 874**	**100%**	**40 988**	**100%**	**53%**

Source: Country submission.

MARKET REFORM

In the 1980s, spurred by concerns about overall economic performance, New Zealand undertook wide-ranging micro- and macro-economic reforms that liberalised some industries. In 1987, the Electricity Corporation of New Zealand (ECNZ) was established as a state-owned enterprise, and given responsibility for owning and operating the government's generation and transmission assets. Transpower was established as a subsidiary of ECNZ in 1988; it was spun off as a separate state-owned enterprise (SOE) in 1994. Retail supply contestability was introduced progressively from 1993; contestability for consumers without interval meters was meaningfully implemented in 1999. ECNZ's split into two SOEs in 1996 coincided with the establishment of a wholesale spot market, the New Zealand Electricity Market (NZEM) in 1996. In 1999, the remainder of ECNZ was further split into three SOEs and Contact Energy was privatised. TrustPower also entered the market as a generator-retailer in 1998 (it existed as a distribution company and retailer before the electricity reforms) when it sold its lines business and acquired generation assets from ECNZ and some of the distribution companies who had to sell their generation assets.

In 1998, government-mandated ownership separation of distribution from the competitive segments of the industry (*e.g.* retail and generation) was completed. In late 2000, the government codified its preference for industry self-regulation, as well as its intention to step into the market if industry self-regulation failed to deliver adequate policies and solutions. Following two supply shortages in 2001 and 2003 and the failure of self-regulation, in mid-2003 the government announced the establishment of the Electricity Commission (EC), which took over governance of the electricity sector at the end of the year.

MARKET DESIGN

New Zealand's wholesale electricity market is operated under the Electricity Governance Rules and Regulations 2003. At its inception, NZEM was a voluntary pool that covered about 70% of wholesale electricity sales. The remaining transactions were conducted bilaterally outside the market and scheduled directly with Transpower, the system operator. The system is now a mandatory pool. The EC administers the market through a number of service providers (clearing manager, system operator and pricing manager). The Marketplace Company Limited (M-co), a private company, has a contract to provide many of these services. In September 2005, Energy Market Services Limited, a subsidiary of Transpower, sought clearance from the Commerce Commission (CC) for approval to purchase M-co. The application was declined in December 2005.

Generators bid their supply into the pool and retailers buy electricity from this pool. M-co clears the market on the basis of the generators' supply offers and electricity demand bids and sets a price for each half-hour period of the day.

This process is completed two hours prior to each half-hour period, although final prices are not published until the following day. All bids and offers – even those not accepted – are made public two weeks after the market has cleared. Overall, there is a high degree of transparency in the New Zealand market – market participants can access data on prices, load, bids, offers and reservoir levels, as well as the status of generation and transmission capacity.

NZEM is a nodal market; the market has 266 nodes that represent the connection points at various points in the grid. The market determines 48 unique half-hour prices for each one of these nodes every day. Price separation – when the prices at different nodes diverge – occurs as a result of losses and when the market operator must take higher-priced generation to supply demand in particular areas that lower-priced generation cannot serve because of transmission constraints. Excess funds generated from the price separation, so-called loss and constraint rentals, are rebated back to distribution companies and companies directly connected to the grid in proportion to their transmission charges. Rentals from the direct current (DC) link between the two islands are paid back to South Island generators that pay the DC transmission charges.

EnergyHedge

EnergyHedge is a financial market that was established in 2004 by four of the five generator-retailers in New Zealand: Contact Energy, Genesis Power, Meridian Energy and Mighty River Power. M-co is the market provider. The market trades standardised derivative contracts.

- Currently, only one point is available, the Haywards node.
- The term of the derivative is one calendar month. Strips of contracts are available, out to 27 months (specified in quarterly lots).
- Contracts are traded only in multiples of 0.25 MW and the minimum contract is 0.25 MW.

EnergyHedge functions as a web-based platform for over-the-counter (OTC) contracts that matches specific buyers with specific sellers. Credit risk is borne by each counterparty. The exchange does not offer credit-clearing services.

There is no limitation on who can trade on EnergyHedge. However, the platform requires that participants post two-way bids (*i.e.* both an offer to sell electricity and a bid to buy electricity). This has effectively limited the market to existing generator-retailers.

Traded volumes on the platform are very small – only a tiny fraction of physical electricity supplies. In December 2005, an average bid-ask spread (the difference between offers to sell and bids to buy) was more than NZD 5 per contract, underscoring the lack of liquidity.

There are no price or bid caps in the electricity market. In addition, there is no capacity market that pays generators for available capacity (as opposed to actual electricity supplied). There is also no centrally managed market that allows market participants to hedge the risk associated with transmission constraints. Many electricity markets also operate a market that allows market participants to protect themselves against higher costs or lower selling prices resulting from transmission constraints (*e.g.* financial transmission rights in the PJM market in the US, and inter-regional settlement residues in the NEMMCO market in Australia).

A market for electricity derivatives, which allow market participants to hedge the risk associated with price volatility, was recently established by four of New Zealand's five electricity generators. The market, EnergyHedge, trades forward contracts for one New Zealand node. Trading on the market is very illiquid (see box).

The demand side is able to participate in the market through flexible contracts offered by many retailers to industrial customers, such as interruptible or time-of-use contracts.

INDUSTRY STRUCTURE

GENERATION

Generation ownership

There are five main generators in New Zealand: Meridian Energy, Contact Energy, Genesis Power, Mighty River Power and TrustPower. Their capacity is shown in Table 20. Combined, these five companies have a 92% share of the market. Meridian, Genesis and Mighty River are SOEs. Combined, the SOEs have a market share of 61% of capacity, including 76% of total hydro capacity.

Table 20

Electricity Capacity by Company, Year Ending March 2005

		Generating capacity (MW)						
	Market share	*Total*	*Hydro*	*Gas/coal/ oil*	*Geo-thermal*	*Co-generation*	*Wind*	*Other**
Meridian Energy	29%	2 539	2 448	0	0	0	91	0
Contact Energy	26%	2 293	752	1 137	360	44	0	0
Genesis Power	18%	1 602	502	1 040	0	54	6	0
Mighty River Power	14%	1 260	1 090	12	33	125	0	0
TrustPower	6%	491	423	0	0	0	68	0
Other	8%	689	130	164	72	159	1	164
Total	**100%**	**8 874**	**5 345**	**2 353**	**465**	**382**	**166**	**164**

* biogas, waste heat and wood.

Source: Country submission.

Recently the CC announced that it will undertake an investigation into both the wholesale and retail electricity markets as a result of complaints about company profits, issues around customer switching and a perceived low level of competitive activity. In December 2005, the EC announced that it was launching a study into the electricity market, including generators' investments and profits, beginning January 2006.

Reserve generation

Overall, the EC is responsible for managing the electricity sector so that electricity demand can be met in a 1-in-60 dry year without the need for emergency conservation campaigns. In mid-June 2004, Whirinaki, a 155-MW oil-fired power plant, was commissioned by the government to provide reserve generation. In April 2005, the government entered into a reserve "generation capacity agreement" with the Electricity Commission. The agreement is for the output of the Whirinaki plant and makes provision for the commission to "instruct" as to how the generation is to be offered into the wholesale electricity market. The government maintains ownership and maintenance responsibility for the plant. The Electricity Commission is also responsible for tendering for additional reserve capacity if necessary.

Contact Energy is under contract to operate and maintain Whirinaki. The trigger for how Whirinaki's energy is offered into the market is based on both price and hydro levels. Under normal circumstances, Whirinaki supply is offered into the market at NZD 1 000/MWh. When prices at the Whirinaki node exceed NZD 200/MWh for four hours, Whirinaki's supply is offered into the market at NZD 200/MWh. This trigger is designed as a clear, transparent proxy for system security problems (such as, for example, certain kinds of network failure and unforeseen outages). When hydro levels are low and forecasts indicate that there is a more than 1-in-60-year risk that demand cannot be met for the next 12 months, Whirinaki's supply is offered into the market at NZD 200/MWh at all times[18].

Since going on line in 2004, the Whirinaki plant has run for a small number of hours for monthly testing or in response to high prices. During 2005, the plant was dispatched for a total of 69 hours for reasons other than testing. Between 5 and 14 December 2005, the plant ran for a few hours on most days owing to high prices resulting from low hydro levels and planned generation outages.

New generation

As New Zealand's economy is growing and is expected to continue to grow at a relatively fast rate, demand is also forecast to rise considerably. The government estimates that around 800 GWh of new generation is required each year, on

18. This is a simplified description of the Whirinaki offer triggers and instructions. Complete instructions can be found at www.electricitycommission.govt.nz/pdfs/opdev/secsupply/pdfssecurity/whirinaki-offer-strat.pdf.

average, to match demand, which is growing at around 2-2.3% per year. This amount of generation could be covered by, for example, a 100-MW thermal plant operating at a high load factor or by wind farms totalling 220 MW.

A number of power plant projects are under construction or have been proposed (see Table 21). Despite the proposed new generation, there is still risk related to medium-term electricity supply, particularly in the Auckland area owing to transmission constraints. Given its reliance on hydro, the system is energy, and not capacity, constrained. Peak demand is about 6 000-6 500 MW, whereas total capacity is about 9 000 MW. In this context it is not useful to quote a reserve margin value, the difference between installed capacity and peak demand.

Table 21

New or Upgraded Power Plants (proposed or under construction)

	Company	*Plant name or description*	*Location*	*Fuel*	*Capacity (MW)*	*Status*[3]
2007	Contact Energy	Poihipi Road	Wairakei	Geothermal	25	CUA
2007	Genesis Power	Huntly - e3p	Huntly	Gas	365	UC
2007	Meridian Energy	White Hill	Southland	Wind	58	C
2007	TrustPower	Tararua-3	Manawatu	Wind	93	UC
2007	TrustPower	Deep Stream	Otago	Hydro	4	C
2007	NZ Windfarms	Te Rere Hau	Tararua Ranges	Wind	48.5	C
2007	Hawke's Bay Wind Farm	Te Pohue Wind Farm	Titiokura Summit	Wind	225	CUA
2008	Genesis Power	Awhitu Peninsula	Waiuku	Wind	19	C
2008	Meridian Energy	Manapouri[2]	Lake Manapouri	Hydro	16	UC
2008	Mighty River Power	Kawerau	Kawerau	Geothermal	70	CDP
2008	Top Energy	Ngawha-2	Ngawha	Geothermal	15	C (testing)
2008	Unison Networks Ltd	Titiokura Windfarm Stage[1]	Te Pohue	Wind	48	CUA

1. Will add to annual generation with no increase in capacity. 2. Efficiency improvements - phase 2. 3. CDP = consent decision pending, C = consented, CUA = consent under appeal, UC = under construction.

Source: Country submission.

In August 2004, the government agreed to partially underwrite the long-term gas supply for the 385 MW combined-cycle power plant, e3p, built by Genesis. The government has agreed to compensate Genesis, a state-owned enterprise, in the event that it is unable to secure all the gas that it needs. Compensation is based on a formula that shares the risk between Genesis and the government. Most terms of the contract, including total government financial liability, are confidential. The government has characterised the deal as a "one-off" arrangement.

Physical grid characteristics

Transpower, an SOE, owns and operates the high-voltage transmission network (see Figure 24). New Zealand's high-voltage network is a radial network; it is long and stringy as opposed to a meshed network. The North and South Islands are connected by a high-voltage direct current (HVDC) link that has a capacity of 1 040 MW in the south-to-north direction. In the north-to-south direction the capacity is 600 MW. The grid includes 12 175 km of high-voltage transmission lines.

Grid investment policy

Grid investments are made on the basis of grid reliability standards and the grid investment test. They fall into two categories: reliability investments and economic investments. Grid reliability standards are developed by the EC, and are consistent with the traditional "n-1" standard[19] used internationally. Any upgrade necessary to meet the grid reliability standards is considered a reliability investment. Grid investments that are not necessary for reliability may be undertaken, but only if they pass the grid investment test. A project passes this test, which is developed and approved by the EC, if its net market benefit is positive. Included in the assumptions of the grid investment test are any new generation projects to which market participants have committed. The grid investment test assumes that the value of lost load – the value of each MWh of electricity demand that is not met – is NZD 20 000/MWh (unless specified otherwise by the EC). Additionally, the grid investment test must also model alternatives to the proposed investment.

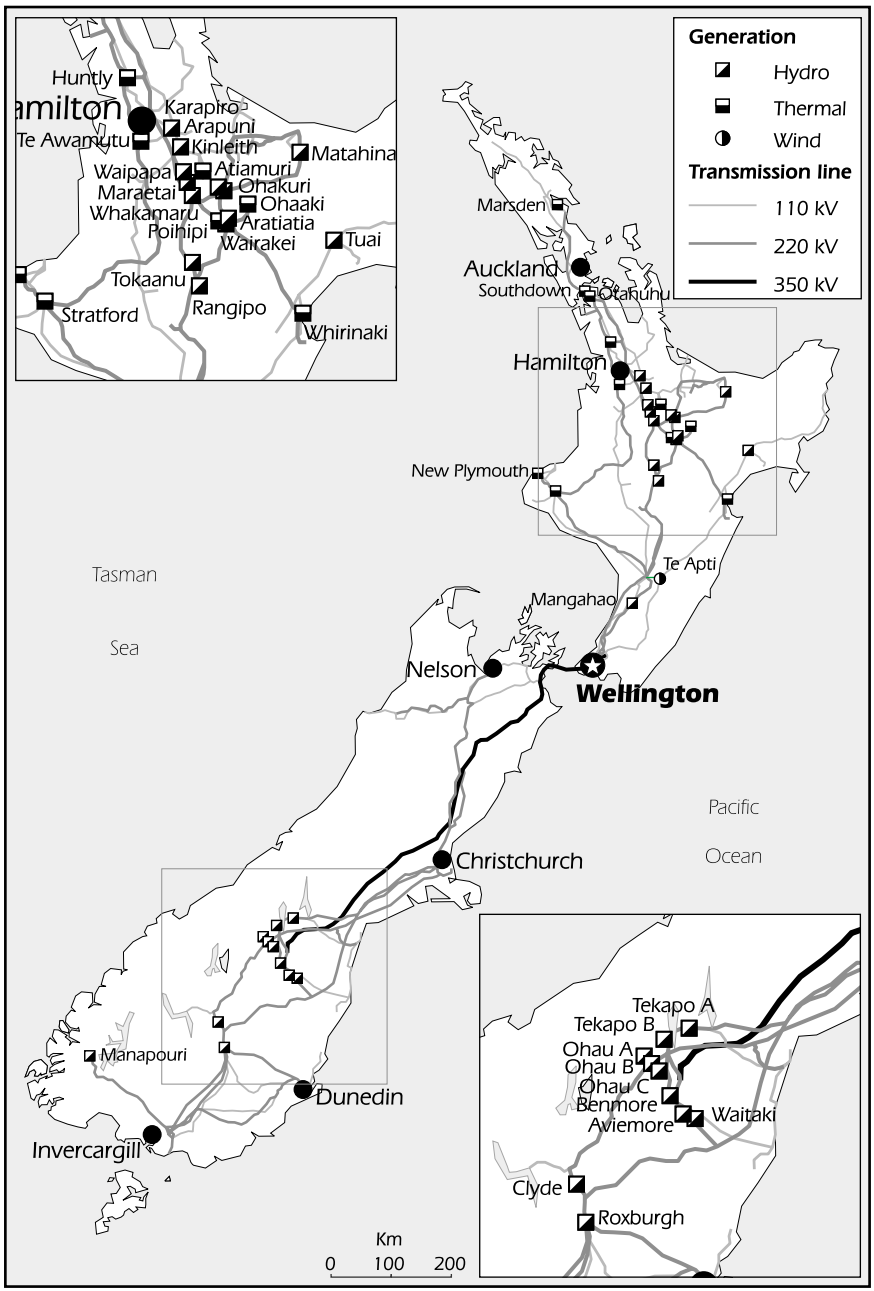
Transpower includes any proposed investments in its grid upgrade plans. Grid upgrade plans can be prepared at any time at the discretion of Transpower. They are also prepared at the request of the EC. All grid upgrade plans must be approved by the EC, but not all grid upgrades need to go through the comprehensive grid upgrade plan process. There are interim expenditure rules for EC approval of individual projects deemed necessary by Transpower on a more immediate time frame.

Grid investment decisions are also subject largely to *ex post* regulation by the CC. Under threshold regulation, which is also applied to electricity and natural gas distribution companies, the CC reviews – and can impose price or revenue controls on – companies that breach price and quality thresholds (see box).

19. A power system can be described as being n-1 secure when it is capable of maintaining normal operations (*i.e.* reliably delivering electricity at a given frequency and voltage subject to technical limits) in the event of a single contingency event, like the unplanned loss of a transmission line, generator or transformer.

Figure 24

Map of the Transmission Network



Source: Transpower.

Threshold regulation by the Commerce Commission

Also called the targeted control regime, the threshold regulatory mechanism is used to identify electricity transmission, electricity distribution or natural gas distribution companies whose performance may warrant further investigation and, if required, control by the Commerce Commission (CC). If a company comes under CC control, the CC can set its prices, revenues and quality standards. All companies are assessed annually against the thresholds.

The purpose of the thresholds is to create a regulatory mechanism that provides incentives to reduce costs and maintain quality, but allows flexibility to meet those thresholds. It is also meant to increase transparency and reduce the burden associated with reviewing the business decisions of regulated monopolies. With threshold regulation, companies do not need to justify individual expenditures if they remain below the thresholds.

There are two thresholds:

- Under the current **price path threshold**, prices must not be greater than what is allowed by the threshold. The threshold allows prices to increase annually by no more than the rate of consumer price index inflation minus X%, where X is an annual rate set by the CC for a particular business. The CC sets rates based not only on historical price increases, but also increases likely to stem from projected investments. For Transpower, price increases for investments that have been approved by the EC can be exempt.
- There are two criteria of the **quality threshold**. First, there should be no material deterioration in reliability, as measured by the number and duration of outages. Outages are averaged across an entire distribution company, so reliability problems in one area may be masked by the lack of any reliability problems in another area. The second criterion is that the company has made "meaningful engagement" with the public regarding the level of service quality they demand.

The CC has recently commenced investigation into a number of companies under this regulatory regime:

- In September 2005, the CC found that Unison Networks Limited had breached its price path thresholds as a result of price increases in April 2002 and March 2004 and declared its intention to take control of the company. The CC has not yet taken control of Unison; proceedings related to this case are continuing and Unison is currently preparing an administrative settlement offer for the Commerce Commission that, if accepted, would avoid a declaration of control by the CC. This was the commission's first proposed use of its powers to take control of companies that breach thresholds.

Continued

- Transpower is under investigation by the CC for breaching price thresholds and future price increases it has announced. In December 2005, the Commerce Commission announced its intention to declare control of Transpower. As with Unison, the CC is undertaking consultation with interested parties before deciding whether to declare control. On 31 March 2006, it was announced that Transpower was seeking to negotiate an administrative settlement with the CC that, if approved, would avoid a declaration of control by the CC.

Transmission investment

Transpower is proposing to undertake a major investment – building the country's first 400-kV line from the centre of the North Island to Auckland, in the north of the island. The 200-km high-voltage line is expected to cost NZD 620 million (in nominal terms). If approved by the Electricity Commission in July 2006, Transpower expects the project to be completed and connected to the grid before the winter of 2010. The Electricity Commission expects to release its draft decision on whether to approve the transmission line in late April 2006.

Another major project proposed by Transpower is an upgrade to the HVDC link between the two islands. The NZD 800-million project will upgrade parts of the link, increasing the HVDC capacity to 1 400 MW. Transpower expects the project to be completed by 2010. Like the 400-kV line project, this project is contained in Transpower's 2005 grid upgrade plan, and is subject to approval by the Electricity Commission.

Policies for new connections to the grid

New generators may be connected to the grid if they successfully complete Transpower's generation connection application. The application process ensures that any new grid connection does not negatively affect transmission system assets or system operational security. Any new grid connections pay the full costs of the new connection, from the existing transmission line to the new generation.

Transmission pricing

Transmission costs, which cover transmission operations and investments (excluding HVDC link charges), are primarily charged to distribution companies that pass them on to end-use customers via retail rates. Distribution companies pay about 70-75% of transmission fees. The remainder are paid by Comalco, a very large electricity user directly connected to the transmission grid that operates the aluminium smelter in the far south, and other directly connected large industrial users.

Electricity generation companies pay connection charges to Transpower to recover the cost of connection assets. They receive no direct incentives from Transpower to locate generation near major load centres. Instead, they receive investment signals indirectly through locational marginal price differentials for energy.

South Island generators pay for use of the HVDC cable between the two islands, which is used to bring excess South Island generation to the North Island where most electricity is consumed.

Distribution companies are charged via a "postage stamp" rate, at a single flat rate per kW of maximum demand, similar to US methods. In November 2005, Transpower announced that it would raise its transmission charges by an average 19%, as from April 2006. This price increase will be considered as part of the inquiry by the CC (see previous box).

DISTRIBUTION

There are 28 distribution companies that own the local distribution networks throughout New Zealand. The ownership of distribution companies is a mix of public listings, shareholder co-operatives, community trusts and local body ownership, with most companies being owned by trusts. The largest company is Vector, which makes up one-third of the sector (based on the number of connections); the four largest companies supply 66% of all connections.

Reforms in 1998 required full ownership unbundling of other services from distribution companies, the strongest unbundling rules among countries that have unbundled their electricity markets. Since that time, however, regulation changes now allow distribution companies to own some generation and to sell their output. Distribution company ownership of generation above the limits set in regulation is subject to approval by the CC.

The CC has declared its intention to take price control of Unison Networks Limited, a distribution company, for breaching price thresholds (see previous box).

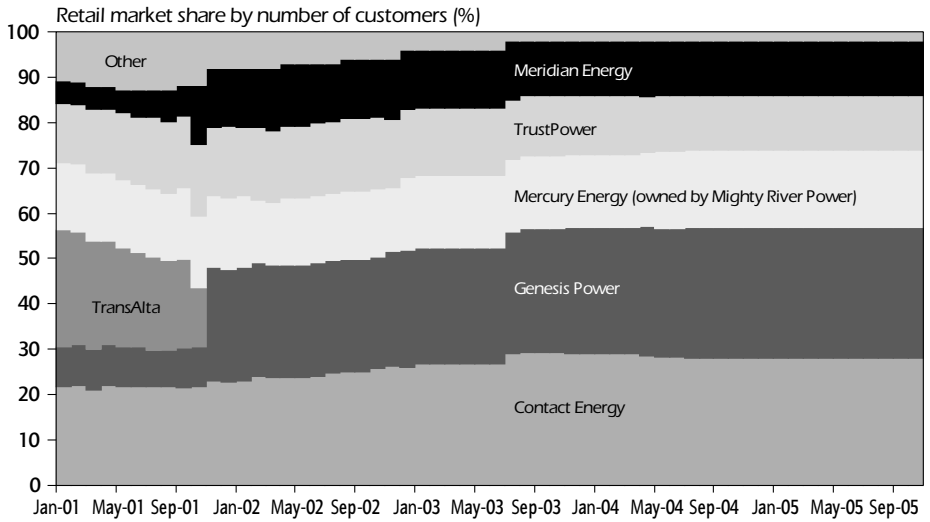
Retail

The retail market is completely contestable, and almost all end-use customers purchase electricity through a retailer, though customers can choose to purchase directly from the wholesale market. There is a high degree of vertical integration between generation and retail activities. The five main generation companies supply 98% of the retail market (see Figure 25). TransAlta, which was a significant generator, sold its North Island customer base to Genesis Power and South Island customer base to Meridian Energy in 2001. The percentage of customers supplied by other[20] companies has decreased from a high of 13% in mid-2001, to 2% since mid-2003.

20. "Other" is defined as retailers with less than 5% market share by installation control point (ICP) for the current month.

Figure 25

Retail Market Share, 2001 to 2005



Source: *Retailer Market Share by ICP*, Electricity Commission, available from http://www.electricitycommission.govt.nz/opdev/retail/regstats.

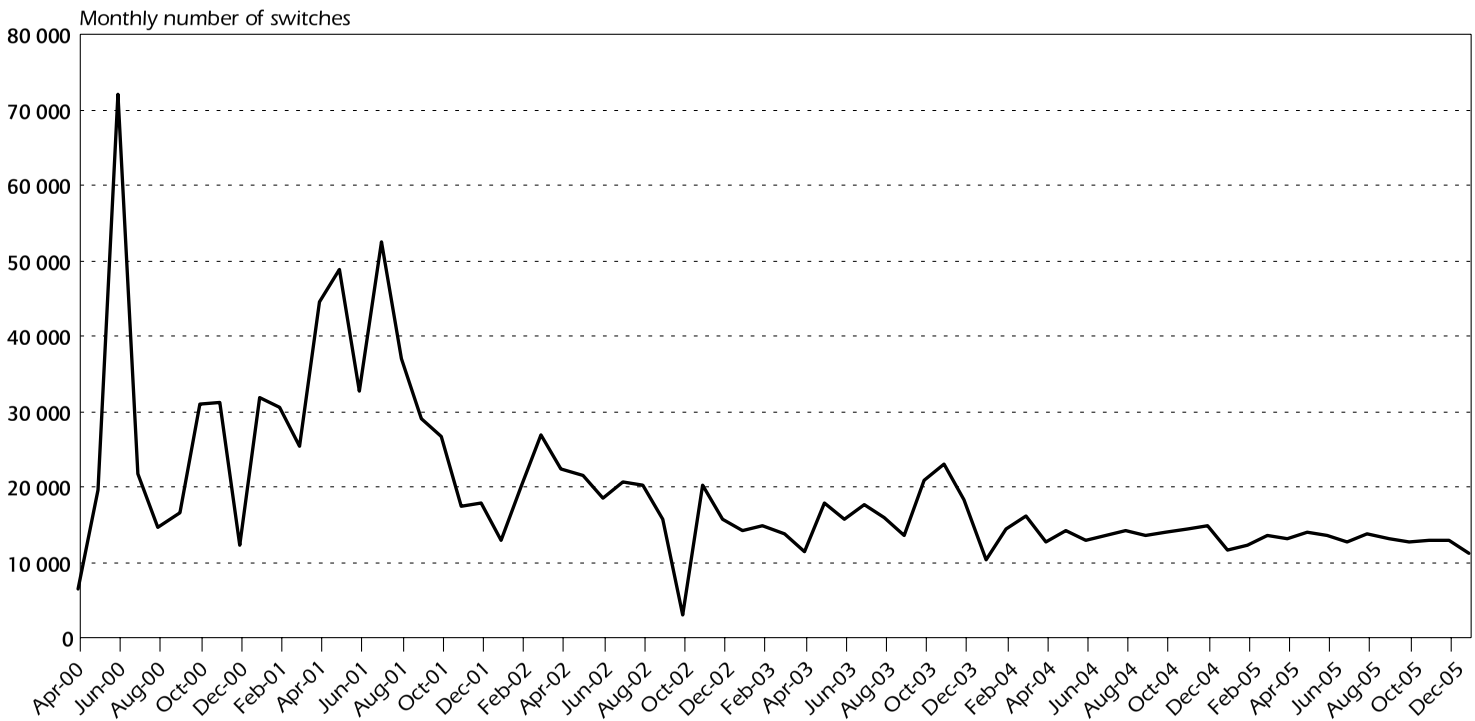
Recently, there has been some regional realignment of generator-retailers. Some companies have traded their retail customer base so that they better match the location of their generation. In large part, this is due to transmission constraints – New Zealand's nodal LMP system can result in large price separations, or differences, between regions. This creates a significant risk for companies that have generation in one region and retail load in another, because they buy and sell at different prices. Currently, this risk cannot be easily managed by financial products, so the five main generator-retailers have opted to reduce their risk by more closely matching their load base to their generation base geographically.

Customer switching rates

Industrial customer switching began in the early 1990s. Domestic customers were able to switch beginning in 1999. As shown in Figure 26, customer switching peaked in 2000 and stabilised at around 10 000-20 000 switches per month in 2003. The churn rate, or percentage of all customers switching, is now about 1%, comparable to the UK. Most regions have three to five different retail suppliers competing for customers. In a small number of areas, covering about 2% of residential customers, there are only two retailers. Three-quarters of all residential customers have access to at least four retailers.

Figure 26

Retail Electricity Customer Switching, April 2000 to January 2006

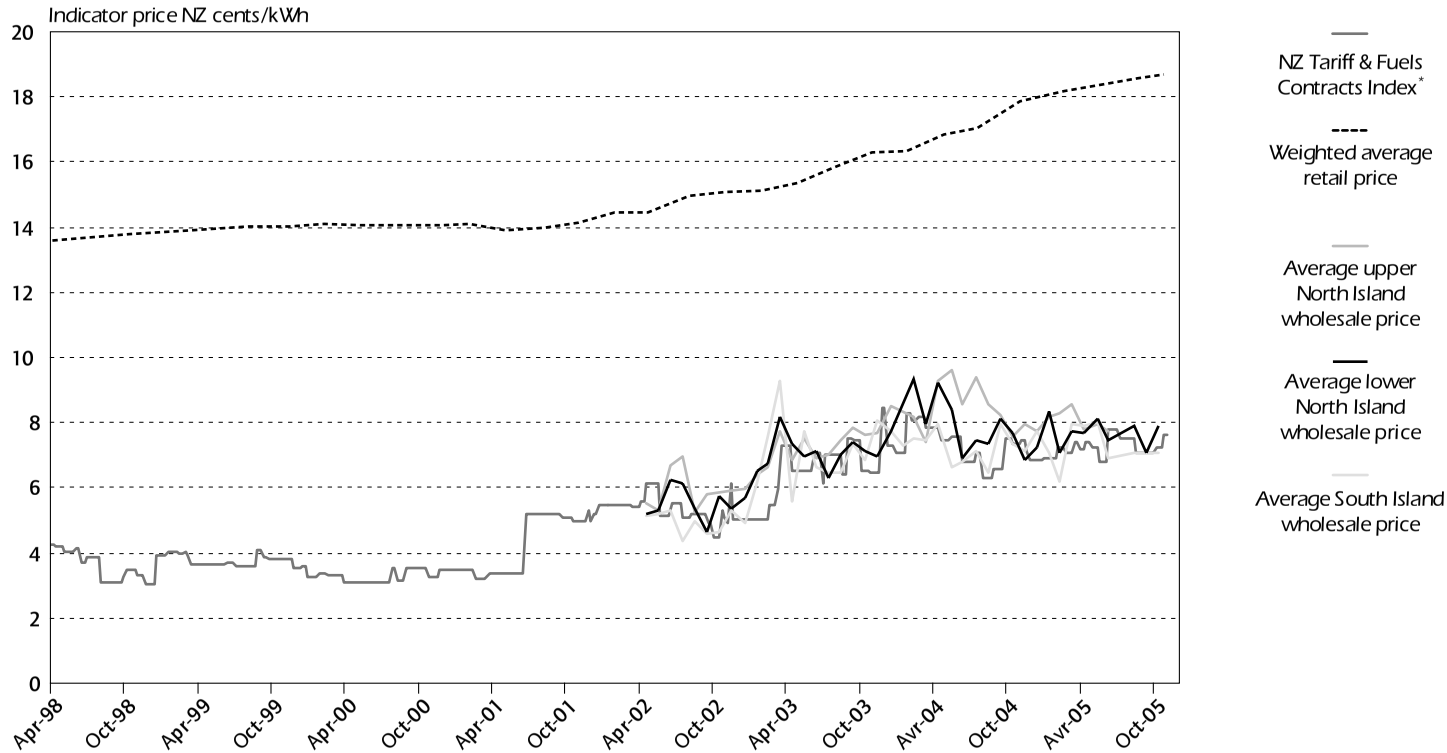


Note: A customer switch is recorded each time a consumer changes retailer, including if a consumer moves house and changes to a retailer other than the retailer already supplying that house.

Source: *Registry Statistics*, Electricity Commission, available from http://www.electricitycommission.govt.nz/opdev/retail/regstats.

Figure 27

Wholesale Electricity Prices in New Zealand, 1998 to 2005



* the NZ Tariffs & Fuels Contracts Index is a leading indicator of wholesale electricity price movements in New Zealand.
Source: Country submission.

WHOLESALE PRICES

Wholesale electricity prices in New Zealand have risen, roughly doubling since 2001 (see Figure 27). This is due in large part to higher-priced fuels and the growing number of hours of operation when the generator is a thermal plant, as compared with the relatively cheaper marginal cost of New Zealand's hydro resources.

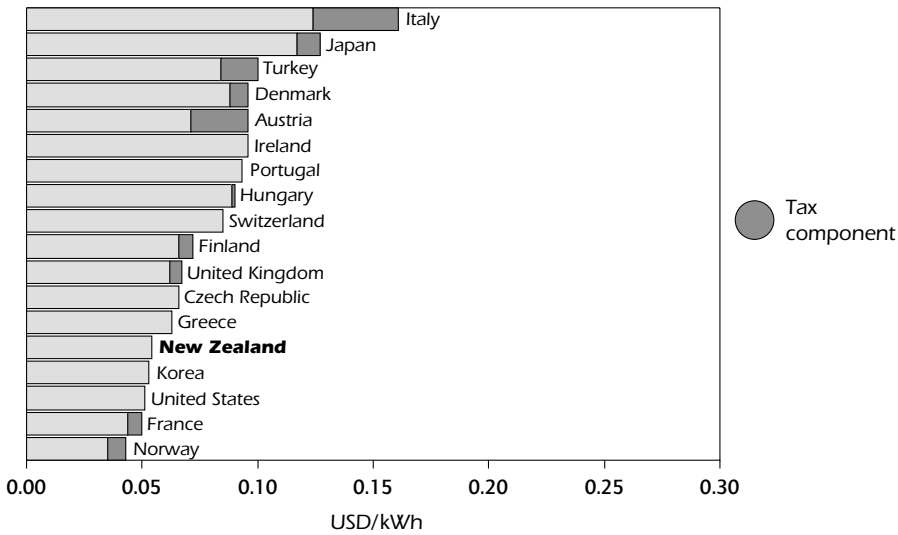
Retail prices

Retail electricity prices in New Zealand are relatively low. As compared with 17 IEA countries, New Zealand's electricity prices for industrial customers rank as the fifth-lowest (see Figure 28). As shown in Figure 29, prices for residential customers rank as the seventh-lowest of 20 countries.

Retail electricity prices for residential customers have increased steadily since 1985 (see Figure 30). Prices have risen by more than 50% since 1985. In contrast, prices for commercial customers have decreased markedly since 1985, falling by over 25% in total at an average annual rate of 1.5%. Overall industrial rates have increased by about 25% since 1985, but rates have not experienced a steady rise. Instead, prices have ranged up and down within the +25% band.

Figure 28

Industrial Electricity Prices in IEA Countries, 2004

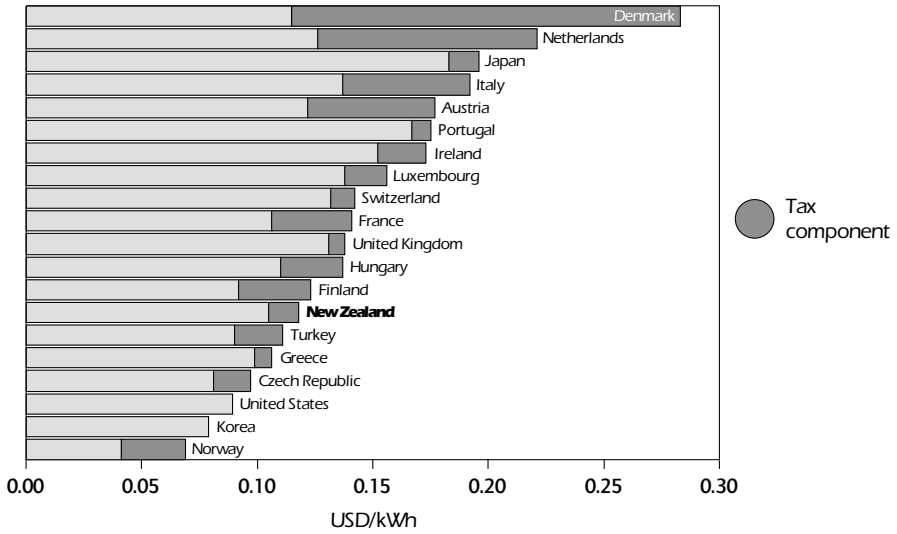


Note: Price excluding tax for the United States. Tax information not available for Korea. Data not available for Australia, Belgium, Canada, Germany, Luxembourg, Netherlands, Spain and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

Figure 29

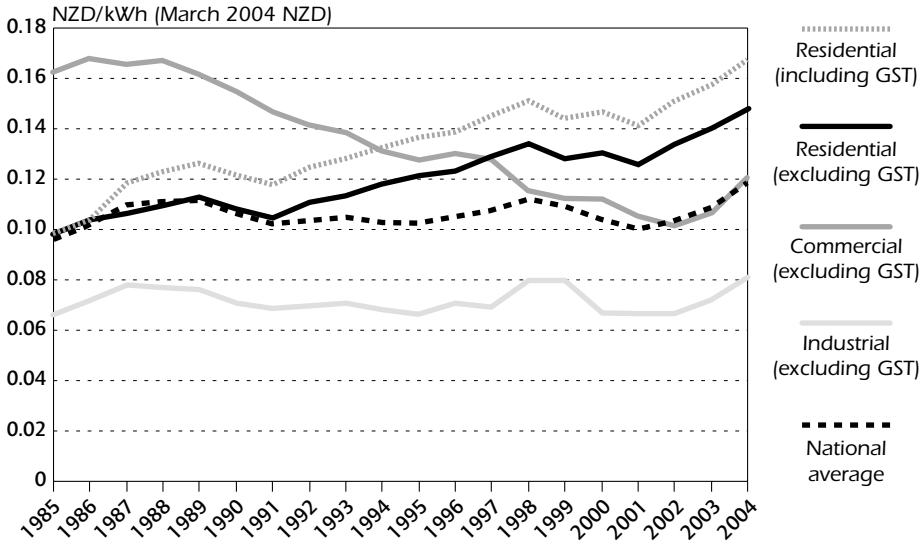
Domestic Electricity Prices in IEA Countries, 2004



Note: Price excluding tax for the United States. Tax information not available for Korea. Data not available for Australia, Belgium, Canada, Germany, Spain and Sweden.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

Figure 30

Electricity Customer Prices, 1985 to 2004



Source: *New Zealand Energy Data File*, New Zealand Ministry of Economic Development, July 2005, Table 1.2, p. 145.

CRITIQUE

New Zealand has continued to develop its electricity market since it first began liberalising it in the 1980s and 1990s. As discussed in Chapter 3 on general energy policy, the latest regulatory changes to the market have led to uncertainty, but in the longer term these changes are likely to benefit the market and New Zealand electricity customers. New Zealand's sustained commitment to a liberalised market is commendable, as is its commitment to improving it. In this context, there are a number of issues that, if properly addressed, could further advance New Zealand's market. It is critical to note that in further developing its electricity market, New Zealand faces a number of country-specific challenges stemming from the market's small size, its lack of connections to any other markets, its reliance on hydro and its radial network geography. As a result of its unique characteristics, the country cannot always look to the experience of other successful electricity markets for guidance and lessons on how to improve its own.

Given its small size, it is not surprising that New Zealand only has five generators. In fact, this number could be considered evidence of a competitive market. Nonetheless, the small number of market participants – exacerbated by the vertical integration between generators and retailers – is cause for concern. Market power, the ability of a firm to keep prices artificially high by raising offer prices or withholding output, is a real threat in the New Zealand market. The CC's inquiry of wholesale and retail markets is therefore a positive step that will keep pressure on market participants to behave competitively. Such pressure is particularly critical in a small market prone to abuse of market power. In addition to applying regulatory pressure to generator-retailers, there are steps New Zealand can take to remove barriers to entry to the market and increase competitive pressure on all participants.

Most notably, the lack of liquid and transparent financial markets to hedge energy price risk and locational basis risk[21] (risk from price separation between locations) is a significant barrier to entry. Retailers cannot readily hedge price risk financially by purchasing futures contracts for power, so they can either take on the risk themselves and buy all electricity on the spot market, or they can own generation outright. It is not surprising, then, that the five main generators are also the five main retailers. To reduce their locational basis risk,

21. In energy markets, basis risk refers to the risk associated with price separation due to location differences. This is different from price risk, which in large part reflects temporal risks associated with needing to buy or sell a commodity at a point in time. An example of a company exposed to basis risk: the company has an obligation to serve load in the North Island and owns equivalent amounts of generation in the South Island. In addition to transportation costs, there may be transmission constraints bringing power from the South Island to the North Island, which could lead to much higher prices in the North Island than in the South Island. In the absence of other physical or financial contracts, the company would have to sell South Island electricity and buy North Island electricity at a net loss. In efficient markets, basis risk represents a market signal to build generation or transportation infrastructure. If the total cost of the infrastructure is less than the long-term basis differential, then market participants will build.

generators have realigned their retail generation portfolios so that they better match the geographic locations of their customers. While this vertical integration reduces price and basis risk for these companies, it does it at the expense of competition. Vertically integrated generator-retailers can limit competition because they operate in two markets and can cross-subsidise their operations. In addition, potential new retail supplier entrants must take on energy price risk that generator-retailers can hedge through their generation ownership. Finally, the generation-retail structure means that companies are managing risk internally, to the detriment of transparency and price discovery – prerequisites for a competitive market. Geographically matched, vertically integrated generator-retailers are particularly problematic for competition in the retail market. Though there is still regulated open access to distribution, it is less important because the regional vertically integrated generator-retailers effectively create unregulated regional monopolies that can raise prices to retail customers above competitive levels. Financial markets that allow companies to hedge both price and basis risk would help reduce commercial incentives for generation-retail vertical integration, reduce barriers to entry and increase competition. It would also build on New Zealand's already impressive level of transparency in the physical market.

Introducing a means to hedge locational basis risk is relatively easier than establishing a liquid market for hedging price risk because it can be integrated with the existing market in which participants are already operating in each half-hour period. Other electricity markets already have well-established locational risk-hedging mechanisms, including financial transmission rights (FTRs) in PJM in the US, contracts for differences in Nord Pool in Europe and the auction of inter-regional settlement residues in NEMMCO in Australia, to which New Zealand can look for guidance. New Zealand is already working to develop a means of hedging basis price risk, and all associated stakeholders should now select an appropriate measure and implement it without delay. It is of critical importance to establish a means of hedging locational basis risk in order to counter incentives that have led to integration of generation and retail along geographic lines at the expense of new entry and competition, particularly in the retail sector.

Developing a means of hedging energy price risk is more challenging – in general it is difficult to develop deep, liquid futures and forwards markets because fewer market participants want to contract for energy in any particular time period in the future. To that end, the creation of EnergyHedge is a positive step as it is a good starting point for the development of a true financial market. However, as currently designed, there are significant barriers for EnergyHedge to develop into a liquid, and therefore useful, market. Most importantly, the requirement that participants post two-way bids effectively limits the market to existing generator-retailers. This approach has benefits – it creates so-called "market makers" that are willing to both buy and sell (and thus help add liquidity) – but the approach shuts out potential new entrants

and could be improved by allowing other participants to only post one-way bids or offers, but still creating incentives for generator-retailers to post two-way bids. Furthermore, the lack of effective credit risk management mechanisms further inhibits the development of liquidity. Finally, the ownership structure of EnergyHedge is problematic. While it is not a problem to have a platform that is owned by market participants, it can be a drawback if it is the only transparent platform available. An independent platform or exchange that cannot be easily influenced by incumbent market participants with an incentive to reduce competition is critical to supporting competition and reducing barriers to entry. To that end, the government could consider requiring the system operator or other entity to create and operate a futures or forward electricity market. While it might be preferable for the market to develop its own risk hedging solutions, the small number of market players and the vertical integration between generation and retail will likely inhibit its creation. New Zealand should look to the example of Nord Pool, the power exchange owned by the state-owned transmission system operators of the Nordic countries. In addition to operating the spot market, Nord Pool also operates a trading platform for futures contracts[22]. While the development of a liquid market for electricity futures or forwards would greatly benefit New Zealand's overall energy market, this is certainly no easy task. Government action to help start a market might help achieve this ultimate goal, but it will be challenging. Even in the regional markets of the US – which are significantly larger than the New Zealand market – liquid futures and forward markets in electricity have been elusive.

New Zealand's energy mix includes a large amount of reservoir hydro. As a result, the country is generally energy-constrained – constrained by the amount of water held in its dams – as opposed to capacity-constrained. Furthermore, the country's growing electricity usage means that new capacity must be built to ensure sufficient supply, particularly in drought years. For this reason it is positive that New Zealand does not cap its electricity prices, as this does not suppress the high peak price signals that encourage new generation investment. The country's locational marginal pricing system creates appropriate incentives for investors to build new capacity when and where it is needed.

However, the government's 155-MW reserve power plant, Whirinaki, operates in a way that acts as a soft electricity price cap – it buffers prices when the plant is the marginal generator. It is offered into the market at all times at NZD 1 000/MWh, and when prices are high or hydro levels are low, it is offered into the market at NZD 200/MWh. As this can restrain prices, it can reduce market incentives for generation investments. It is understandable that the government has commissioned its own power plant – in part because New Zealand's electricity supply is hydro-based and vulnerable to droughts, but primarily because, as a remote island with no interconnections, it cannot

22. The futures market operated by Nord Pool is owned only by the state-owned transmission system operators of Norway and Sweden.

import electricity during drought periods. Thus emergency reserve generation is a reasonable mechanism to insure the country against a worse than 1-in-60-year drought. However, the operation of Whirinaki is not only linked to drought risk but also to other system risks. Because New Zealand's system is a radial network – as opposed to a more integrated, and thus secure, meshed network – Whirinaki has the flexibility to mitigate certain system failures and unforeseen outages. As a proxy for this risk, the plant is dispatched when prices rise for a sustained period of time. However, the sustained high price trigger is meant to insure against a broad set of "risks" that are better solved by normal market investments driven by price signals, not government intervention. The problem that New Zealand seemingly needs to solve is insufficient generation investment, not inherent system security risks, and a reserve power plant that runs whenever prices rise will critically undermine proper investment signals. Instead, the government should work to remove barriers to generation investment. In New Zealand, one large barrier to new investment is likely uncertainty about long-term gas supplies. Thus the government should continue to focus on improving the climate for domestic hydrocarbon exploration and production, and ensuring no undue barriers to investment in import infrastructure. Overall, the government should work to reduce and remove this and other barriers to investment and not intervene in the market to address system reliability concerns in ways that will inhibit – and not enhance – overall market investment. To that end, Whirinaki's trigger mechanism should be revised so that it only runs under worse than 1-in-60-year drought risks, not when prices rise.

As the EC is responsible for contracting for future reserve energy to insure against worse than 1-in-60-year drought risks, it has the opportunity to do so in a way that is less distorting to the market. If the country procures more reserve generation in future, it should consider tendering for financial products that are not tied to specific facilities. The EC could authorise the system operator to buy options for a certain number of megawatt-hours of electricity supply (or demand reductions) from the market that would be triggered by transparent criteria. Such a mechanism is preferable to the Whirinaki model for a number of reasons. First, it would put the responsibility for securing physical assets into the competitive market, which would procure the supply more efficiently. Second, it would contribute to building a financial market in New Zealand, a critical but, as described above, missing piece of New Zealand's market. Overall, such an approach would minimise distortions that contracting for reserve energy has on the competitive market. Particularly given the country's medium-term supply constraints, minimising any disincentives for new generation is critical. There is an argument that financial options would not provide the same level of security as a physical asset, like the Whirinaki plant. It is argued that companies that sell options to the government would not necessarily set aside additional generation assets to meet possible calls on the options by the government. While physical assets can provide a secure physical insurance policy, it is only half the story. Market participants already take the existence of the Whirinaki plant into

account in their decision-making, potentially reducing their infrastructure investments. If the government established a transparent tendering process and bought financial options with clear – and costly – penalties for not delivering the contracted energy, market participants would take into account the government's total market purchases when making investment decisions, and likely invest more in new infrastructure to take into account total government demand. In the end, physical assets set aside by the government are isolated from normal market operations but not from market investment decisions. These assets will not necessarily result in more overall infrastructure investment, just less efficient investment.

New Zealand allows the demand side of the market to participate through flexible contracts, which is positive. While increasing the ability of customers to respond to price is a powerful means of regulating the market because it reduces the ability of generators to exercise market power, increasing competition and lowering prices, it is less critical in New Zealand. As the country is energy-constrained, meeting peak load is less of a challenge than meeting total demand over a sustained period. Nevertheless, the government should continue to improve the role of the demand side in the market, in part by improving price signals to customers, but also by making as much market and customer data available as possible as this makes it easier for retailers to provide innovative contracts to customers with attractive load profiles. New Zealand already provides flexible industrial contracts that give customers price signals to reduce consumption during high-priced periods, such as during droughts when energy supply is constrained. Building on this, such contracts might be extended to retail customers. In this case New Zealand can look to Norway, which has a history of providing flexible contracts to residential customers that send price signals during times of energy shortages. Existing use of interruptible industrial contracts might be expanded to complement government tendering for reserve energy supply.

New Zealand's threshold regulatory mechanism for transmission and distribution businesses is an innovative regulatory approach. It increases transparency and reduces the regulatory burden on companies. It also gives companies greater business flexibility and does not encourage gold-plating of infrastructure. However, the mechanism increases regulatory uncertainty because it is applied on an *ex post* basis; new investments a company undertakes might be deemed unacceptable by the CC after they have already been made. Companies are subject to formal review only if they breach the thresholds; reviews can then trigger price controls. Particularly as investments in transmission tend to be lumpy, as opposed to steady, this can discourage necessary investments since these may be out of line with previous investments. Thus it is positive that the CC does not set threshold levels that ignore a company's actual circumstances and potential need for higher levels of investment and, potentially, higher prices. New Zealand should consider adding further regulatory certainty to the threshold regime. In certain

situations, it might be prudent to allow companies to apply for *ex ante* approval of particular projects from the CC. Such an option would give companies more regulatory certainty to make necessary grid investments, without removing the overall flexibility of the thresholds regime. In addition, any reviews conducted under the threshold mechanism should be completed as quickly as possible to ensure regulatory certainty.

The quality threshold mechanism provides incentives for distribution and transmission companies to maintain grid quality – in part counteracting the price incentives that can discourage investments. However, the threshold mechanism may mask electricity grid problems because it averages across wide areas; problems in one area may be drowned out by good overall quality. The threshold system should be reviewed to ensure local grid reliability for all users. To prevent against small pockets where service is relatively unreliable, the government and regulators should consider modifying the threshold standards, or add a minimum quality standard for all local regions, perhaps linking it to performance-based incentives.

RECOMMENDATIONS

The government of New Zealand should:

- *Remove any inefficient barriers to entry for new market participants.*
- *Implement a financial mechanism that allows market participants to manage locational basis risk, and implement the appropriate mechanism without delay.*
- *Revise the triggering mechanism for the Whirinaki power plant so that it is triggered only by hydro levels; ensure that the Electricity Commission's ongoing tendering for capacity minimises any distortion of the competitive market.*
- *Ensure that the Commerce Commission's threshold mechanism provides appropriate incentives for network investment and that regulatory reviews are completed in a timely manner.*
- *Consider providing for* ex ante *approval of investment projects on request in order to increase regulatory certainty.*
- *Ensure that the Commerce Commission's quality thresholds take into account local, not just regional, electricity quality so that pockets do not experience undue risk of outages or unreliability.*
- *Further develop the ability of the demand side of the market – including residential and industrial customers – to respond to price signals, including through the development of financial instruments.*

RESEARCH AND DEVELOPMENT

The Ministry of Research, Science and Technology (MoRST) develops research and innovation policies and oversees the publicly funded part of R&D. Working at a high level, it contracts with other agencies, particularly the Foundation for Research, Science and Technology (FoRST) to manage the actual funding of research and innovation projects.

Historically, the New Zealand government has not taken a strong lead in setting priorities for energy R&D, which makes up a small part of total government R&D funding. Instead, energy R&D has relied on project-by-project funding from FoRST. Recently, however, the government has begun to develop priorities for energy R&D. In 2004, the government released *Sustainable Energy: Creating a Sustainable Energy System*, which highlights the need to better support energy innovation and the need for stronger strategic leadership in energy research. The government is also studying the Australian R&D model and considering more clearly identifying categories for energy R&D funding priorities.

Specific energy funding priorities for the current funding cycle are detailed in FoRST's *Target Outcomes and Themes for the Foundation's Investment Portfolio*, released in April 2005, which outlines all government-funded R&D priorities. Energy R&D falls into a number of FoRST's 18 investment portfolios, but is primarily funded through the *Optimising Physical Resource Use and Infrastructure Services* portfolio. The policy goals of this portfolio are improved energy management and supply, wealth from New Zealand's natural resources and improved infrastructure in transport, water, waste and design.

MoRST is currently developing an energy research "roadmap". This will review the range of government energy policy outcomes, identify critical energy research capabilities and provide some high-level direction for energy research to meet current and future energy challenges.

Given New Zealand's limited size and resources, R&D funding is generally focused more on applied research that addresses New Zealand's challenges (*e.g.* by modifying technologies to suit local conditions) than on basic energy research. For example, while carbon capture and storage may be considered a research area more appropriate for a large country, New Zealand focuses on areas that look at the country's geological options so that any advances in the field can be incorporated as quickly as possibly.

In general, New Zealand considers itself to be largely a fast technology taker, but can still take the occasional world lead in some research. For example, it believes there is an opportunity for the country to be a world leader in agricultural research on greenhouse gases (GHGs), an area where few other

countries face such an acute challenge. Although not directly energy-related, reductions in methane emissions from agriculture – which make up over half of the country's GHG emissions – would assist New Zealand in meeting its Kyoto commitments and could offset the need to make reductions in the energy sector. In addition, given the unique characteristics of New Zealand's wind resources – wind is generally more powerful and gusty – the country may focus research on computerised short-term wind forecasting, as well as on other areas.

R&D INSTITUTIONS AND STAKEHOLDERS

In addition to MoRST and FoRST, other stakeholders in energy R&D are the Ministry of Economic Development, the Energy Efficiency and Conservation Authority, the Ministry for the Environment, the Ministry of Foreign Affairs and Trade, the Ministry of Transport and New Zealand Trade and Enterprise. State-owned enterprises, including Mighty River Power, Meridian Energy and Genesis, are also involved in the R&D process.

Academic institutions involved in energy R&D are the Massey University Centre for Energy Research, Otago University, Auckland University and Canterbury University Centre for Advanced Engineering. A number of private research institutions are involved, including Industrial Research Limited, Coal Research Limited and Building Research Association of New Zealand.

FUNDING

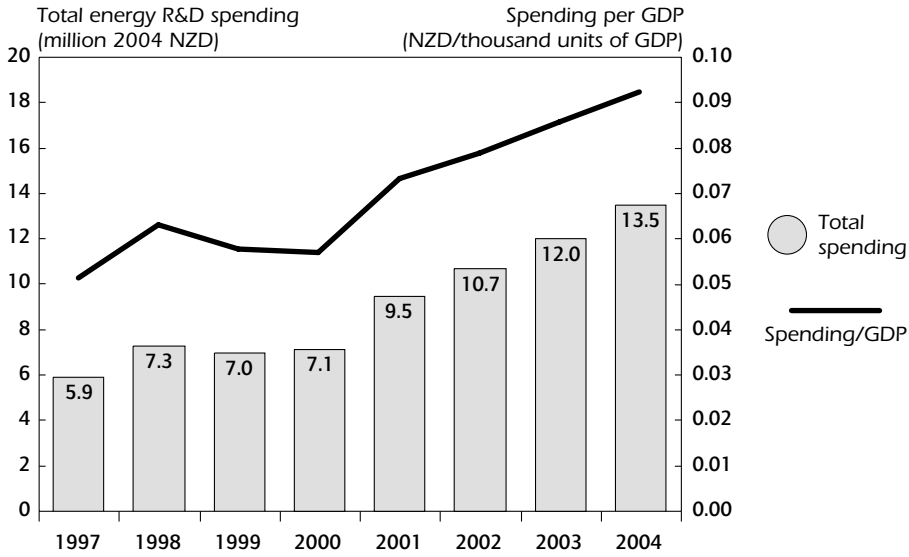
Research funding is invested on an annual cycle with funding terms being from 3 to 12 years. An external review of priorities was completed in 2004/05 and this will set directions for four to six years. Research priorities will be refreshed during this time by detailed reviews of specific areas. The government is currently setting funding priorities and levels for the next funding cycle. While funding remained relatively steady until 2000, it has been increasing quickly since then (see Figure 31). Since 2000, energy R&D spending has increased at an average annual rate of 17%. Since 1997, total spending has more than doubled. This rapid rise has also increased New Zealand's energy R&D spending as a share of GDP.

Despite the rapid rise in spending, relative to 21 IEA countries for which data are available, New Zealand's energy R&D funding as a share of GDP ranks as the eighth-lowest when nuclear-related R&D is excluded (see Figure 32). In percentage terms, New Zealand's investments are one-third less than the 15-country average.

FoRST invests over NZD 460 million a year in research, science and technology across all disciplines, with the exception of health, through a number of portfolios. Direct public funding for energy R&D is approximately NZD 12-14 million annually, excluding university-funded energy research. This

Figure 31

Energy R&D Funding, 1997 to 2004



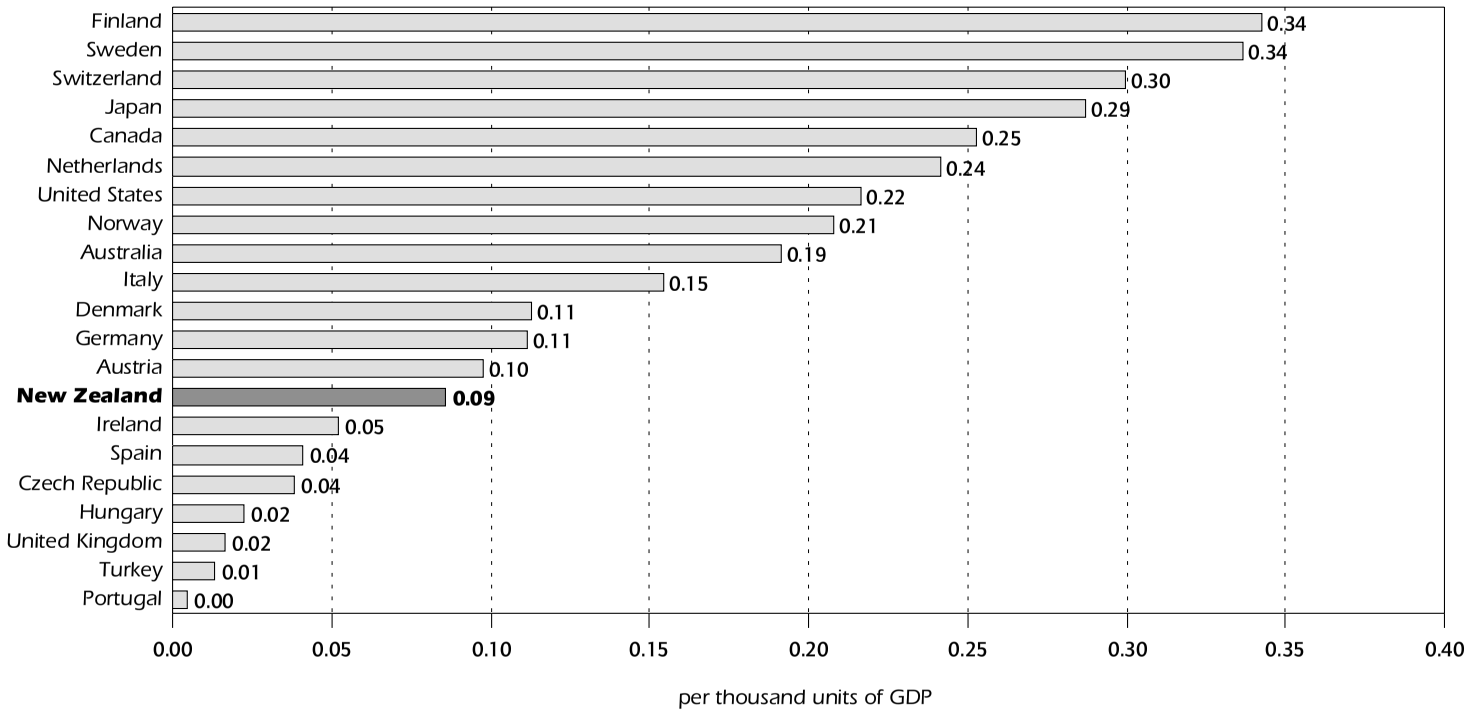
Sources: *OECD Economic Outlook No. 77*, OECD Paris, 2005, and country submission.

breaks down to: 35.4% for conventional energy resources, 41.1% for renewable energy resources and 23.5% in domestic/commercial energy-efficiency. Funding levels in the 2004/05 financial year by topic area are shown in Figure 33. There is some funding for industrial energy efficiency and energy-efficient networks, as well as for distributed generation. Oil and gas research has the largest share of total energy research funds. Hydrogen and geothermal research funding makes up the largest share of renewables research funding. While hydrogen is an energy carrier and not a renewable source of energy, New Zealand's hydrogen research programme has a strong emphasis on the production of hydrogen from renewable sources of energy. There is an additional pool of funds for climate change research of about NZD 20 million, which includes non-energy topics such as how to reduce GHG emissions from agriculture. In addition, there is some small-scale public funding that comes from agencies other than FoRST. According to the 2003/04 Climate Change Research Inventory, in addition to funding from FoRST, NZD 6.7 million comes from other central government agencies.

In addition to direct energy R&D funding, the government promotes the development and adoption of advanced technologies by business through Technology New Zealand, a business unit of FoRST. In the 2005/06 budget Technology New Zealand's funding was increased by NZD 55.7 million over four years. This funding covers all areas of science, but a proportion will support funding of private-sector energy R&D.

Figure 32

IEA Government Budget on Non-nuclear Energy R&D per GDP, 2003

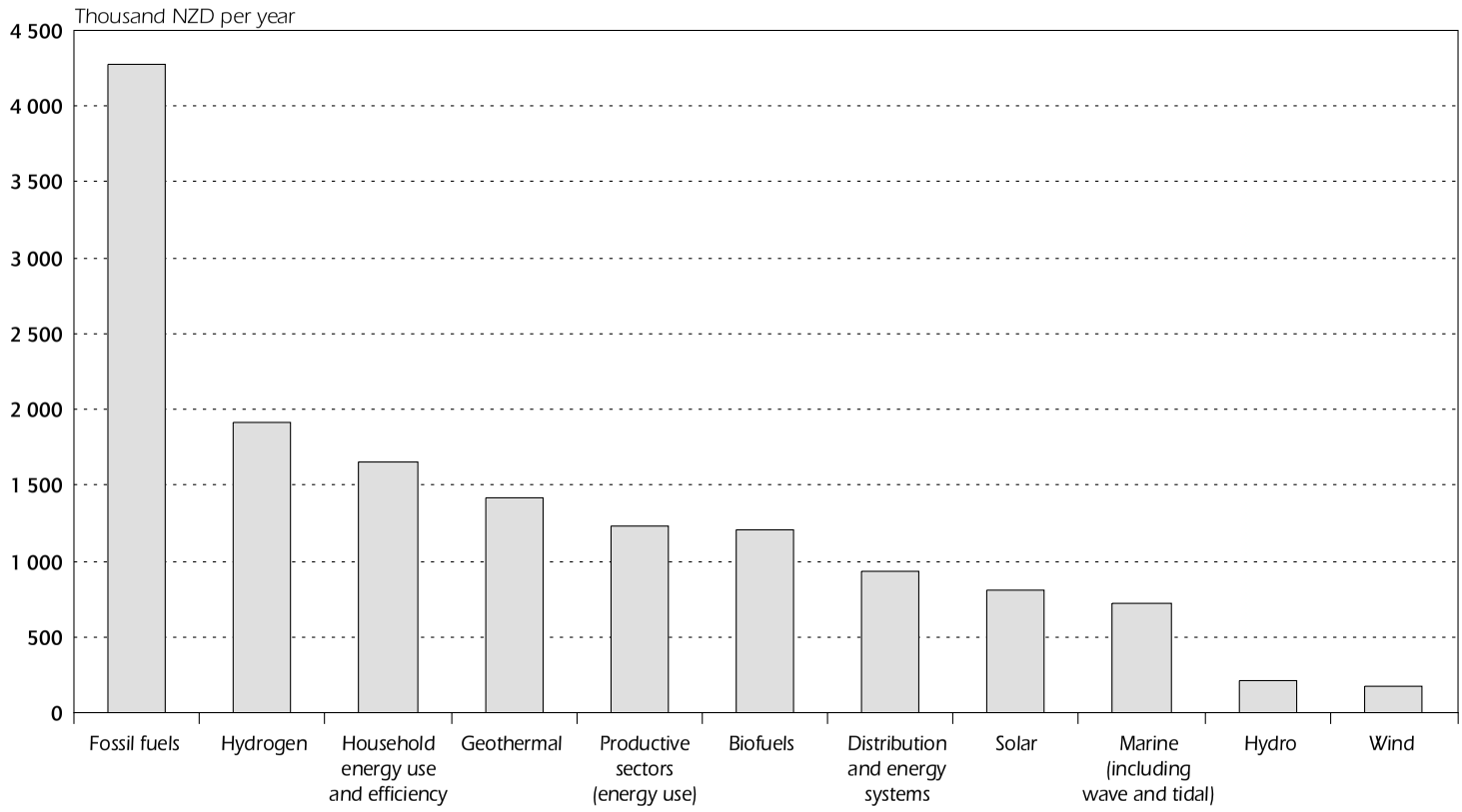


Note: Data not available for Belgium, France, Greece and Korea. Luxembourg has no energy R&D programme. Canada data refer to the fiscal year, April 2003 to March 2004.

Sources: *OECD Economic Outlook No. 75*, OECD Paris, 2005 and country submissions.

Figure 33

FoRST Energy-related Funding by Subject Area in 2004/05 Financial Year



Source: Country submission.

EVALUATION AND MONITORING

In co-operation with Statistics New Zealand, MoRST conducts evaluations of R&D programmes and funding. They undertake regular surveys of the R&D sector and funding expenditures. In addition, performance information is provided to MoRST from FoRST and other funding agencies through mandatory quarterly reporting and annual progress and achievement evaluations. MoRST is currently developing policies to better evaluate R&D funding performance and efficiency.

INTERNATIONAL COLLABORATION

New Zealand belongs to, and is an active participant in, the IEA; the Energy Working Group (EWG) of APEC, the Science and Technology Working Group of APEC (ISTWG) and has more recently joined the International Partnership for the Hydrogen Economy. Results of research carried out in these forums are disseminated to various industry associations and by the distribution of relevant publications.

New Zealand also belongs to six IEA implementing agreements relating to solar heating and cooling, geothermal energy, energy end-use technologies for building and community systems, bioenergy, hydrogen and GHGs. New Zealand is considering membership of the Carbon Sequestration Leadership Forum (CSLF).

New Zealand and Australia both have large domestic deposits of lignite. The two countries are working together to develop high efficiency technologies that could help make lignite a more economically and environmentally viable energy source. Australia and New Zealand see this as an area of interest unique to their two countries that other countries will not undertake.

CRITIQUE

Consistent with its limited resources, New Zealand's energy-related R&D portfolio is quite small. Instead of targeting its funding on research areas that are too large and complex for small grants to be effective, the government generally focuses research money on projects where smaller grants can help bring innovative ideas to market that directly benefit New Zealand's supply security and economic efficiency. New Zealand seeks to gain the benefits of other countries' larger research efforts by being a fast technology taker. Such a strategy takes the greatest advantage not only of the country's small R&D funding portfolio, but also of its flexible market economy and energy sector. The country should continue this sound strategy, and not be tempted to overspend on basic science research as it begins to face new energy challenges.

New Zealand has generally not set out energy R&D funding priorities that are linked to its overall energy policy goals. In the past, this linkage has been less important because New Zealand had been well endowed with abundant domestic energy resources. However, now that the country faces the twin challenges of rapidly declining natural gas resources and stringent GHG emissions reduction targets, such linkages are critical. In this light, it is positive that the country has started to develop explicit R&D priorities that match its energy and environment needs. In the process, strong co-operation among MoRST, the Ministry of Economic Development, EECA and the Ministry for the Environment is essential. The government's evaluation of the priority-setting process in Australia is a good sign, as Australia's energy R&D funding priorities well reflect its policy objectives. New Zealand should continue this process so that its R&D funding roadmap and future funding priorities reflect its energy policy goals and new energy challenges. It should also ensure that actual R&D funding matches these priorities.

New Zealand has strong international collaboration on energy R&D, through multilateral groups (IEA, APEC, etc.) that work on many issues, as well as through bilateral arrangements with Australia that target areas of particular importance to the two countries. In contrast, collaboration between the public and private sectors is poor. Given the small size of New Zealand's public and private R&D community, the government can help foster communication across these sectors. The government should make the development of public-private partnerships a priority, as such collaborations can increase the benefit of government R&D spending. Technology New Zealand, which facilitates uptake by the private sector of advanced technologies, is a step in the right direction. New Zealand could also look to the OG21 programme in Norway, an example of a successful programme that leverages government funding for energy R&D by relying on private-sector leadership. The government can also build on its efforts to use international collaborations to help disseminate knowledge and remain a fast technology taker. For example, the country might look to the Netherlands, where the government has defined which technologies are important to help meet the country's energy objectives and further defined in which technology areas the government can help facilitate knowledge import and dissemination.

MoRST's commitment to evaluating the cost-effectiveness of its R&D efforts is commendable as this increases the value of R&D spending. Also commendable is the government's continued efforts to improve and refine the evaluation process.

New Zealand rapidly increased government funding of energy R&D from NZD 7.1 million in 2000 to NZD 13.5 million in 2004. Accordingly, the share of energy R&D budget per unit of GDP has also increased. This is a very encouraging development, particularly as the R&D budget of many IEA countries has remained steady or declined during the last few years. The

government should strive to continue this growth, particularly as New Zealand's energy R&D spending per unit of GDP remains relatively low compared with that of other member countries, and because the country now faces more serious energy challenges than it has in the past.

RECOMMENDATIONS

The government of New Zealand should:

- *Ensure that the R&D roadmap for the energy and environmental sectors well reflects New Zealand's new energy challenges, in part by enhanced co-operation between the different ministries involved in energy policy and R&D.*
- *Stimulate co-operation and communication between public and private sectors in energy R&D.*

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	2003	2004P	2010	2020	2030
TOTAL PRODUCTION		**4.05**	**12.02**	**13.17**	**13.71**	**16.72**	**19.26**	**21.68**
Coal[1]		1.29	1.39	3.11	3.26	3.52	4.79	4.99
Oil		0.18	1.96	1.30	1.24	1.21	1.01	1.25
Gas		0.28	3.90	3.86	3.45	3.38	2.82	3.48
Comb. Renewables & Waste[2]		–	0.55	0.83	1.29	2.20	3.00	4.09
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.03	2.32	2.15	2.16	2.16
Geothermal		1.07	2.21	1.97	2.12	4.15	5.01	5.13
Solar/Wind/Other		–	0.01	0.07	0.03	0.13	0.47	0.58
TOTAL NET IMPORTS[3]		**4.27**	**1.79**	**3.88**	**5.33**	**5.23**	**6.61**	**7.81**
Coal[1]	Exports	0.02	0.23	1.62	1.43	1.80	2.00	2.00
	Imports	–	0.01	–	0.48	–	–	–
	Net Imports	–0.02	–0.22	–1.62	–0.95	–1.80	–2.00	–2.00
Oil	Exports	–	1.47	1.02	0.88	0.86	0.71	0.88
	Imports	4.60	3.80	6.75	7.38	8.28	9.76	11.25
	Bunkers	0.31	0.32	0.23	0.23	0.39	0.43	0.56
	Net Imports	4.29	2.01	5.50	6.28	7.03	8.61	9.81
Gas	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
Electricity	Exports	–	–	–	–	–	–	–
	Imports	–	–	–	–	–	–	–
	Net Imports	–	–	–	–	–	–	–
TOTAL STOCK CHANGES		**–0.05**	**–0.04**	**0.33**	**–0.40**	**–**	**–**	**–**
TOTAL SUPPLY (TPES)		**8.27**	**13.77**	**17.37**	**18.65**	**21.96**	**25.87**	**29.48**
Coal[1]		1.26	1.13	1.81	2.00	1.72	2.79	2.99
Oil		4.42	3.96	6.80	7.43	8.24	9.62	11.05
Gas		0.28	3.90	3.86	3.46	3.38	2.82	3.48
Comb. Renewables & Waste[2]		–	0.55	0.83	1.29	2.20	3.00	4.09
Nuclear		–	–	–	–	–	–	–
Hydro		1.23	2.01	2.03	2.32	2.15	2.16	2.16
Geothermal		1.07	2.21	1.97	2.12	4.15	5.01	5.13
Solar/Wind/Other		–	0.01	0.07	0.03	0.13	0.47	0.58
Electricity Trade		–	–	–	–	–	–	–
Shares (%)								
Coal		*15.3*	*8.2*	*10.4*	*10.7*	*7.8*	*10.8*	*10.1*
Oil		*53.5*	*28.8*	*39.1*	*39.9*	*37.5*	*37.2*	*37.5*
Gas		*3.4*	*28.3*	*22.2*	*18.5*	*15.4*	*10.9*	*11.8*
Comb. Renewables & Waste		*–*	*4.0*	*4.8*	*6.9*	*10.0*	*11.6*	*13.9*
Nuclear		*–*	*–*	*–*	*–*	*–*	*–*	*–*
Hydro		*14.9*	*14.6*	*11.7*	*12.5*	*9.8*	*8.3*	*7.3*
Geothermal		*12.9*	*16.1*	*11.4*	*11.4*	*18.9*	*19.4*	*17.4*
Solar/Wind/Other		*–*	*0.1*	*0.4*	*0.2*	*0.6*	*1.8*	*2.0*
Electricity Trade		*–*	*–*	*–*	*–*	*–*	*–*	*–*

P is provisional.

0 is negligible, – is nil, .. is not available

Please note: Forecast data, except GDP and population, refer to the fiscal year.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	2003	2004P	2010	2020	2030
TFC	**6.05**	**9.84**	**13.29**	**13.64**	**15.23**	**17.87**	**20.40**
Coal[1]	0.87	1.00	1.05	0.97	1.10	1.17	1.24
Oil	3.67	4.43	6.45	6.64	7.74	9.11	10.54
Gas	0.14	1.30	1.86	1.88	1.71	2.02	1.99
Comb. Renewables & Waste[2]	–	0.45	0.67	0.71	1.21	1.65	2.25
Geothermal	–	0.27	0.32	0.35	0.31	0.31	0.31
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	1.37	2.39	2.95	3.09	3.17	3.61	4.07
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*14.4*	*10.1*	*7.9*	*7.1*	*7.2*	*6.5*	*6.1*
Oil	*60.6*	*45.1*	*48.5*	*48.7*	*50.8*	*51.0*	*51.7*
Gas	*2.4*	*13.2*	*14.0*	*13.8*	*11.2*	*11.3*	*9.8*
Comb. Renewables & Waste	–	*4.6*	*5.1*	*5.2*	*7.9*	*9.2*	*11.0*
Geothermal	–	*2.8*	*2.4*	*2.6*	*2.0*	*1.7*	*1.5*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.6*	*24.3*	*22.2*	*22.6*	*20.8*	*20.2*	*20.0*
Heat	–	–	–	–	–	–	–
TOTAL INDUSTRY[4]	**2.18**	**4.08**	**4.94**	**5.29**	**5.65**	**6.58**	**7.36**
Coal[1]	0.69	0.87	0.93	0.79	1.09	1.16	1.24
Oil	0.96	0.59	0.55	0.65	0.41	0.40	0.39
Gas	0.05	1.06	1.42	1.53	1.39	1.65	1.62
Comb. Renewables & Waste[2]	–	0.39	0.61	0.65	1.10	1.51	2.05
Geothermal	–	0.22	0.27	0.29	0.25	0.25	0.25
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.48	0.96	1.17	1.38	1.41	1.61	1.82
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*31.5*	*21.3*	*18.7*	*15.0*	*19.2*	*17.7*	*16.8*
Oil	*43.9*	*14.4*	*11.2*	*12.2*	*7.3*	*6.1*	*5.3*
Gas	*2.4*	*25.9*	*28.8*	*28.9*	*24.6*	*25.0*	*22.0*
Comb. Renewables & Waste	–	*9.5*	*12.3*	*12.2*	*19.5*	*22.9*	*27.9*
Geothermal	–	*5.4*	*5.4*	*5.6*	*4.4*	*3.8*	*3.4*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*22.2*	*23.6*	*23.6*	*26.0*	*25.0*	*24.5*	*24.7*
Heat	–	–	–	–	–	–	–
TRANSPORT[5]	**2.15**	**3.54**	**5.54**	**5.65**	**7.02**	**8.41**	**9.86**
TOTAL OTHER SECTORS[6]	**1.72**	**2.22**	**2.81**	**2.70**	**2.56**	**2.89**	**3.18**
Coal[1]	0.19	0.13	0.12	0.18	0.01	0.00	0.00
Oil	0.57	0.37	0.40	0.39	0.35	0.35	0.35
Gas	0.09	0.18	0.44	0.34	0.31	0.37	0.37
Comb. Renewables & Waste[2]	–	0.06	0.06	0.06	0.10	0.14	0.19
Geothermal	–	0.05	0.05	0.06	0.06	0.06	0.06
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	0.88	1.42	1.75	1.68	1.72	1.96	2.21
Heat	–	–	–	–	–	–	–
Shares (%)							
Coal	*10.7*	*5.7*	*4.4*	*6.6*	*0.5*	*0.1*	–
Oil	*32.8*	*16.6*	*14.0*	*14.3*	*13.7*	*12.1*	*11.0*
Gas	*5.3*	*8.1*	*15.5*	*12.8*	*12.2*	*12.9*	*11.5*
Comb. Renewables & Waste	–	*2.9*	*2.3*	*2.3*	*4.1*	*4.9*	*6.1*
Geothermal	–	*2.4*	*1.9*	*2.0*	*2.3*	*2.1*	*1.9*
Solar/Wind/Other	–	–	–	–	–	–	–
Electricity	*51.2*	*64.3*	*62.0*	*62.1*	*67.2*	*67.9*	*69.5*
Heat	–	–	–	–	–	–	–

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	2003	2004P	2010	2020	2030
ELECTRICITY GENERATION[7]							
INPUT (Mtoe)	**3.16**	**5.28**	**6.38**	**6.89**	**8.91**	**10.64**	**12.10**
OUTPUT (Mtoe)	**1.59**	**2.78**	**3.54**	**3.66**	**3.76**	**4.28**	**4.83**
(TWh gross)	18.53	32.27	41.11	42.55	43.70	49.77	56.11
Output Shares (%)							
Coal	*8.5*	*1.5*	*8.1*	*9.8*	*6.1*	*14.0*	*13.4*
Oil	*6.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Gas	*1.4*	*17.6*	*24.4*	*16.5*	*18.2*	*7.6*	*12.8*
Comb. Renewables & Waste	*–*	*1.3*	*1.3*	*2.9*	*4.9*	*5.9*	*7.1*
Nuclear	*–*	*–*	*–*	*–*	*–*	*–*	*–*
Hydro	*77.3*	*72.3*	*57.5*	*63.5*	*57.1*	*50.5*	*44.8*
Geothermal	*6.7*	*6.9*	*6.7*	*6.4*	*10.2*	*11.0*	*10.0*
Solar/Wind/Other	*–*	*0.4*	*1.9*	*0.8*	*3.5*	*11.0*	*11.9*
TOTAL LOSSES	**2.35**	**4.01**	**4.00**	**4.57**	**6.73**	**8.00**	**9.08**
of which:							
Electricity and Heat Generation[8]	1.57	2.51	2.85	3.23	5.15	6.36	7.28
Other Transformation	0.36	0.60	–0.04	0.25	0.30	0.30	0.30
Own Use and Losses[9]	0.43	0.90	1.19	1.10	1.27	1.33	1.50
Statistical Differences	**–0.13**	**–0.08**	**0.08**	**0.44**	**–**	**–**	**–**

INDICATORS

	1973	1990	2003	2004P	2010	2020	2030
GDP (billion 2000 USD)	32.37	39.46	58.46	60.57	70.24	89.91	115.10
Population (millions)	2.97	3.41	4.04	4.08	4.50	5.00	5.50
TPES/GDP[10]	0.26	0.35	0.30	0.31	0.31	0.29	0.26
Energy Production/TPES	0.49	0.87	0.76	0.74	0.76	0.74	0.74
Per Capita TPES[11]	2.78	4.04	4.30	4.57	4.88	5.17	5.36
Oil Supply/GDP[10]	0.14	0.10	0.12	0.12	0.12	0.11	0.10
TFC/GDP[10]	0.19	0.25	0.23	0.23	0.22	0.20	0.18
Per Capita TFC[11]	2.04	2.88	3.29	3.34	3.38	3.57	3.71
Energy-related CO_2 Emissions (Mt CO_2)[12]	17.0	22.0	32.7	..	..	..	..
CO_2 Emissions from Bunkers (Mt CO_2)	1.6	2.4	2.7	..	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–03	03–04	04–10	10–20	20–30
TPES	1.5	3.9	1.8	7.3	2.8	1.7	1.3
Coal	–4.5	1.5	3.7	10.4	–2.5	5.0	0.7
Oil	–0.9	–0.5	4.2	9.3	1.7	1.6	1.4
Gas	20.3	14.7	–0.1	–10.4	–0.4	–1.8	2.1
Comb. Renewables & Waste	–	1.1	3.3	55.0	9.3	3.2	3.1
Nuclear	–	–	–	–	–	–	–
Hydro	4.6	2.0	0.1	14.2	–1.3	0.1	–
Geothermal	–2.2	8.1	–0.9	7.4	11.8	1.9	0.2
Solar/Wind/Other	–	12.5	14.8	–53.0	27.2	13.6	2.1
TFC	2.1	3.3	2.3	2.6	1.9	1.6	1.3
Electricity Consumption	3.0	3.5	1.6	4.9	0.4	1.3	1.2
Energy Production	4.6	7.7	0.7	4.1	3.4	1.4	1.2
Net Oil Imports	–2.5	–5.4	8.1	14.3	1.9	2.0	1.3
GDP	0.0	1.8	3.1	3.6	2.5	2.5	2.5
Growth in the TPES/GDP Ratio	1.5	2.1	–1.2	3.6	0.3	–0.8	–1.2
Growth in the TFC/GDP Ratio	2.0	1.5	–0.7	–1.0	–0.6	–0.9	–1.1

Please note: Rounding may cause totals to differ from the sum of the elements.

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

1 Includes lignite.

2 Comprises solid biomass, biogas and industrial waste. Data are often based on partial surveys and may not be comparable between countries.

3 Total net imports include combustible renewables and waste.

4 Includes non-energy use.

5 Includes less than 1% non-oil fuels.

6 Includes residential, commercial, public service and agricultural sectors.

7 Inputs to electricity generation include inputs to electricity and CHP. Output refers only to electricity generation.

8 Losses arising in the production of electricity and heat at main activity producer utilities (formerly known as public) and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 10% for geothermal and 100% for hydro.

9 Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.

10 Toe per thousand US dollars at 2000 prices and exchange rates.

11 Toe per person.

12 "Energy-related CO_2 emissions" have been estimated using the IPCC Tier I Sectoral Approach. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals.

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The 26 member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1. **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4. **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA members wish to retain and improve the nuclear

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7. **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and subsequently abbreviated, this glossary provides a quick and central reference for many of the abbreviations used.

AAU	assigned amount unit, under the Kyoto Protocol
APEC	Asian Pacific Economic Co-operation
bcm	billion cubic metres
bpd	barrels per day; 1 Mt/year is equivalent to about 20 000 bpd
CC	Commerce Commission
CH_4	methane
CHP	combined production of heat and power; sometimes when referring to industrial CHP, the term "co-generation" is used
CO_2	carbon dioxide
CO	carbon monoxide
CNG	compressed natural gas
CSLF	Carbon Sequestration Leadership Forum
EC	Electricity Commission
ECNZ	Electricity Corporation of New Zealand
EECA	Energy Efficiency and Conservation Authority
ERU	emissions reduction units
EU	European Union
EU-ETS	European Union Emissions Trading Scheme
EUR	Euro (€); EUR 1 = USD 1.24 = NZD 1.76 (average exchange rate in 2005)
FoRST	Foundation for Research, Science and Technology
FBT	fringe benefit tax
FTR	financial transmission right
GDP	gross domestic product
GHG	greenhouse gas

GIC	Gas Industry Company
GJ	gigajoule
GST	goods and services tax
GWh	gigawatt-hour = 1 gigawatt × 1 hour
HEEP	Household Energy End-use Project
HVDC	high-voltage direct current
IEA	International Energy Agency
IEP	International Energy Program
IPCC	Intergovernmental Panel on Climate Change
IT	information technology
JI	joint implementation
km	kilometre, or 1 metre × 10^3
km^2	square kilometre
kW	kilowatt, or 1 watt × 10^3
kWh	kilowatt-hour = 1 kilowatt × one hour = 1 watt × 10^3 × one hour
kV	kilo-volt, or 1 volt × 10^3
LMP	locational marginal pricing
LNG	liquefied natural gas
LTA2	Dutch long-term agreements with industry
LTNZ	Land Transport New Zealand
m	metre
mb	million barrels of oil
MEPS	minimum energy performance standard
mg/m^3	milligram per cubic metre, or 1 gram × 10^{-3} per cubic metre
MoRST	Ministry for Research, Science and Technology
Mt	million tonnes
$MtCO_2$	million tonnes of carbon dioxide
$MtCO_2$-eq	million tonnes of carbon dioxide equivalent; these values include other greenhouse gases converted to CO_2-equivalents based on their global warming potential
Mtoe	million tonnes of oil equivalent; see "toe"

MW	megawatt, or 1 watt × 10^6
MWh	megawatt-hour = 1 megawatt × one hour
NEECS	National Energy Efficiency and Conservation Strategy
NGA	negotiated greenhouse gas agreement
NIMBY	"not in my backyard"
NO_2	nitrous oxide
NZ	New Zealand
NZEM	New Zealand Electricity Market
NZD	New Zealand dollar ($); NZD 1 = USD 0.70 = EUR 0.57 (average exchange rate in 2005)
NZRC	New Zealand Refining Company
NZTS	New Zealand Transport Strategy
OECD	Organisation for Economic Co-operation and Development
PJ	petajoule; equivalent to 23 880 toe, or about 280 GWh
PJM	(Pennsylvania - New Jersey - Maryland) an independent system operator in the US
PM_{10}	particulate matter (particles less than or equal to 10 micrometres in diameter)
PMP	petroleum mining permit
ppm	parts per million
PRE	Projects to Reduce Emissions programme
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well
RAP	Refinery-to-Auckland pipeline
RLTS	regional land transport strategy
RMA	Resource Management Act
RON	research octane number
SME	small and medium-sized enterprise
SO_2	sulphur dioxide
SOE	state-owned enterprise
TFC	total final consumption of energy

toe	tonne of oil equivalent, defined as 10^7 kcal; equivalent to 4.19×10^{-5} PJ
TPA	third-party access; in some regions the term "open access" is used in place of TPA
TPES	total primary energy supply
TWh	terawatt-hour = 1 terawatt × 1 hour = 1 watt × 10^{12} × 1 hour
UK	United Kingdom
US	United States
USD	US dollar ($); USD 1 = EUR 0.81 = NZD 1.42 (average exchange rate in 2005)
WHO	World Health Organization
$\mu g/m^3$	microgram per cubic metre, or 1 gram × 10^{-6} per cubic metre

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