



International
Energy Agency

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Energy Policies of IEA Countries

New Zealand

2010 Review

New Zealand

New Zealand's strong commitment to liberalised energy markets has delivered a relatively high level of energy security and economic prosperity for consumers. Since the previous IEA review in 2006, the government has built on the success of existing policy mechanisms and implemented a number of far-reaching changes in the electricity sector and environmental policy. But progress in some sectors, such as energy efficiency, has not been as strong as anticipated.

In mid-2010, the government commenced a review of the New Zealand Energy Strategy. The result is the publication of a new energy strategy, which establishes clear long-term policy priorities and energy-savings goals. Implementing these strategies will bring many new challenges, including attainment of the government's medium-term energy-savings targets.

New Zealand enjoys the advantage of a diverse and balanced portfolio of renewable-energy resources, which contribute over 70% of electricity output – the third highest portion in IEA member countries. This resource base has the potential to deliver greater volumes of energy and the government aspires to increase this proportion to 90% of electricity generation by 2025. Meeting this target will bring many benefits but also tough challenges, such as maintaining a robust National Grid.

This review analyses the energy-policy challenges facing New Zealand and provides sectoral critiques and recommendations for further policy improvements. It is intended to help guide New Zealand towards a more sustainable energy future.



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Erratum for paragraph 6, p.49.

Four sentences in the paragraph of the previous version of this publication were omitted.

The paragraph should have read:

Nonetheless, New Zealand's energy efficiency policies and programmes face several challenges. Energy intensity has improved by approximately 1% per year between 1995 and 2007, not enough to offset the economy-wide increase in energy demand of approximately 2% each year. Energy performance varies across sectors. In 2008, transport accounted for 38% of energy consumption. From 1995 to 2007, energy consumption in the transport sector increased by 2.9% per year (freight by 3.9% per year and passenger transport by 2.1% per year). Growth in this sector, thus caused by the increasing number of vehicles on the road, appears to be the biggest energy-saving challenge.

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy.

The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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**International
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The European Commission also participates in the work of the IEA.

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

To date, New Zealand's strong commitment to undistorted and transparent liberalised energy markets has delivered a relatively high level of energy security and economic prosperity for consumers. Furthermore, in order to fully understand and analyse the challenges New Zealand policy makers face, it is important to take into account the country's geographic isolation and low population density. Within this policy-making framework, where policy changes have been needed the government has generally acted; the 2009 decision to improve electricity market performance, the two-phase reform of the Resource Management Act, the 2009 Petroleum Action Plan and the Energy Research Roadmap are relevant examples. In recent years, the government has also introduced a series of Government Policy Statements, on Gas Governance and on Land Transport Funding, and a National Policy Statement on Electricity Transmission. A National Policy Statement on Renewable Electricity Generation is currently being developed. Since the previous review in 2006, the government has built on the success of existing policy mechanisms and implemented a number of IEA recommendations. Tougher building standards have been introduced, the New Zealand Emissions Trading Scheme has been developed, a new Vehicle Exhaust Emissions Rule was introduced and the Warm Up New Zealand programme has been developed. In 2008, the national Energy Strategy was placed under detailed review and the outcome of this process was the draft New Zealand Energy Strategy, which was published alongside an updated energy efficiency strategy, in mid-2010.

The government has set two national targets for reducing greenhouse gas emissions: a medium-term responsibility target of a 10% to 20% reduction in emissions below 1990 levels by 2020 and a long-term target of a 50% reduction in net greenhouse gases from 1990 levels by 2050. In February 2010, New Zealand announced that it was joining the Copenhagen Accord on climate change. To assist in meeting the country's Kyoto targets, the government introduced a New Zealand Emissions Trading Scheme (NZ ETS), which commenced in July 2008. By 2015, the NZ ETS will cover all sectors and all gases and will be reviewed every five years, with the first review to be carried out in 2011. During a transition phase, emitters will only be liable for half their emissions, having to surrender one emission unit for every two tonnes of emissions. New Zealand is one of the first non-EU OECD member countries to introduce such a scheme; it represents a significant achievement and the ability to review the scheme in 2011 presents the government with an opportunity to make any changes necessary.

New Zealand has abundant renewable energy resources, which at present contribute over 70% of electricity output, one of the largest shares among OECD countries. The government goal is to increase this proportion to 90% of electricity generation by 2025 (in an average hydrological year) providing this does not affect security of supply. We welcome renewed government support for this target. Furthermore, New Zealand is

recognised as having one of the best wind energy resources of any OECD member country and, although underdeveloped, the industry is growing. This is despite the absence of subsidies or explicit fiscal mechanisms, which are available to developers elsewhere. Further potential for geothermal energy, where New Zealand is also a world leader, remains and the government is supporting the industry by means of a high-level overview of geothermal technologies and the preparation of an assessment of potential barriers to development. Hydropower, the principal source of electricity, contributes over 55% of capacity, continues to expand with a number of capacity additions planned or under construction. Hydro's contribution, however, as a percentage of total electricity generated, has declined in recent years as the contribution from other renewable sources of electricity such as wind and geothermal has increased. The country also has substantial bioenergy resources but their potential has yet to be realised.

Since the last review, the government has completed an assessment of the electricity market, the objective of which was to improve performance of the sector in line with government objectives. The outcome of this assessment, in the form of a government decision, was published in late 2009 and a series of changes to improve sector performance is being implemented in 2010. Among the changes being made are a reconfiguration of the state-owned enterprise generation assets, the promotion of a liquid electricity futures market, measures to improve energy security and further steps to improve electricity market governance. Regarding electricity security, where New Zealand remains vulnerable owing to a reliance on hydropower, the Electricity Commission recently developed security of supply regulations and published a security of supply policy document, an Emergency Response Plan and Outage Plan. Transpower, the owner of the electricity transmission network, is investing in a number of large upgrade projects, including the North-Island Grid Upgrade and the Inter-Island Link Project, which are under construction at present.

In April 2008, the government published a Government Policy Statement on Gas Governance. The purpose of this document was to clearly establish the objectives and outcomes of the Gas Industry Company (GIC), the approved industry body and co-regulator of the gas market. The statement provides industry with a clearer understanding of the respective roles of each party, government and the GIC, while retaining the preference for light-handed regulation which is maintained by regular reporting to the minister on progress made towards meeting the government's objectives.

New Zealand is self-reliant in natural gas but faces a decline in domestic production as output from the Taranaki Basin falls. In April 2010, the government announced a major two-year work programme aimed at promoting oil and gas exploration. Crown Minerals has contracted with the Institute of Geological and Nuclear Sciences (GNS Science) to deliver the NZD 7.6 million Petroleum Exploration and Geosciences Initiative (PEGI) project, a suite of individual projects focused on improving knowledge of New Zealand's petroleum potential. The oil industry is similarly affected as production is forecast to decline rapidly. In response, changes have been made to the tax and royalty regime, including an adjustment to the corporate tax rate and a simplified royalty regime, to make exploration more attractive to investors. Since 2007, New Zealand has met the IEA's overall minimum stockholding obligation of 90-day net imports by supplementing domestic stocks with stockholding in other IEA member countries, in the form of ticket reservation. In an IEA co-ordinated action, New Zealand would likely contribute to the collective response by releasing these public stocks and implementing a campaign for voluntary demand restraint.

New Zealand has relatively strong energy efficiency policies, including minimum energy performance standards and energy rating labelling requirements in place for appliances and equipment. The compliance monitoring programme for these policies is robust, which contributes to meeting the level of energy efficiency improvements expected from the sectors. Furthermore, New Zealand has a well-regarded energy efficiency statistics and indicators capability; the Energy End-Use Database developed by the Energy Efficiency and Conservation Authority (EECA), which contains detailed end-use energy consumption estimates based on national-level data. These estimates of national energy use are broken down into different categories, including sector, technology, end use, region and fuel type. This is essential for good policy development and should be commended. On the other hand, many New Zealand homes have poor energy efficiency performance relative to European or North American countries, for example there is little central heating. The government's response, the roll-out of the Warm Up New Zealand programme, has been well managed and will deliver long-term benefits for the government and consumers. We welcome the government contribution of NZD 324.82 million and its aim to retrofit more than 180 000 homes by 2012/13.

The Ministry of Economic Development is preparing a work programme to ensure that carbon capture and storage (CCS) remains an option for New Zealand and that the country is active in CCS research and demonstration projects at home and elsewhere. Solid Energy, a state-owned enterprise, is investigating CCS technologies and is operating a practical trial aiming to store 100 000 tonnes of CO₂ underground.

As a technology taker, investment in energy technology research and investment in New Zealand is traditionally at the lower end of the OECD scale in terms of New Zealand dollars spent per unit of gross domestic product (GDP). Nonetheless, the amount of money invested in R&D has increased in recent years, with investment generally in line with government priorities, much of the increase in funding over recent years being targeted on the biofuels and geothermal energy sectors.

New Zealand has traditionally taken a proactive approach to energy policy and many of the changes adopted in the last four years continue this position. Recent policy developments demonstrate a visible commitment to energy policy reform which has built upon previous IEA recommendations. Nonetheless a number of policy challenges remain.

ENERGY STRATEGY

In recent years, the energy policy environment has been marked by uncertainty. It is difficult to fully assess the long-term potential and effectiveness of energy policy when significant changes occur on a regular basis. Investments in energy infrastructure are long-term considerations and require some level of national consensus and regulatory certainty before informed and efficient decisions can be taken. At the time of the review team visit, in December 2009, a review of the 2007 Energy Strategy had been announced by the newly elected government in order to align government energy policy priorities and to reflect a stronger focus on economic development. In mid-2010, a revised New Zealand Energy Strategy was published in draft form, the goal of which was to assist the country to make the most of its energy potential. This document clearly identifies a number of priorities and is intended to form the basis of the strategic direction of the New Zealand energy sector and the role energy will play in the economy. The IEA welcomes the publication of the draft Energy Strategy and urges the government to move quickly and finalise this important Strategy and commence implementation in

collaboration with other relevant ministries and industry stakeholders. The Strategy should include clear priorities and identify firm actions needed to meet them.

ENERGY EFFICIENCY

The draft New Zealand Energy Efficiency and Conservation Strategy (NZECS) was published alongside the draft New Zealand Energy Strategy (NZES). The draft NZECS was prepared under the Energy Efficiency and Conservation Act 2000 to promote energy efficiency, energy conservation and renewable energy. The NZECS proposes energy-saving goals for each of the energy-consuming sectors of the economy and assigned clear, sometimes shared, responsibility for leadership within each sector. Supporting actors have been identified and governance arrangements, progress monitoring and review mechanisms included. Nonetheless, the draft proposals lack a firm commitment to actions that will contribute to achieving the energy savings goals. The government needs to assign priorities for working towards goals it can realistically achieve in order to demonstrate early effectiveness and lead to confidence building. The Strategy is missing a firm set of actions to achieve its stated goals. While the Strategy takes a high-level view, action plans complement strategies by detailing what specific actions are needed, by whom and when. Detailed action plans targeted specifically on the transport, commercial buildings and industry sectors may be needed in the form of sectoral strategies.

INVESTMENT IN ELECTRICITY INFRASTRUCTURE

The Transpower-owned national grid is a cornerstone of New Zealand's energy infrastructure and general economic well-being. Investment in the electricity transmission network peaked over thirty years ago while demand for electricity has continued to grow, by almost 300%, over the same period. The grid is highly loaded, constraints are frequent and it is increasingly difficult to take assets out of service for planned maintenance. While there was significant increase in expenditure from 2005 to 2008, it appears that this was to address constraints rather than an investment for the future. At the same time, electricity security has become more fragile; the country has faced four major droughts since 2010. There is an obvious need, therefore, to increase and maintain investment in both transmission and generation capacity. A robust grid is necessary to facilitate the forecast growth in "renewable electricity" required to meet the government's 90% target. Furthermore, there is significant potential for efficiency gains in the form of reduced losses along the grid. The low-carbon energy system of the future with more variable renewable energy, greater small-scale generating capacity, increased interruptible load and demand participation, electric vehicles, supported by a smart grid, all call for higher levels of investment. We understand that this process has commenced and we commend the government for the scale of the investment programme under way at present. We recommend that the government continue to support investment in long-term development and maintenance of the electricity transmission grid, complemented by the removal of administrative barriers in order to facilitate a competitive electricity market, secure and diverse electricity supply and, in the longer term, a low-carbon economy.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Finalise and implement the New Zealand Energy Strategy in a manner that will inform long-term strategic policy direction for the energy sector based on a co-ordinated approach to economic, environmental and consumer priorities.*
- Finalise and implement the New Zealand Energy Efficiency and Conservation Strategy and give priority to enhancing energy efficiency in the transport, commercial buildings and industry sectors by defining clear objectives for the sector supported by adequate cost-effective measures and long-term investments. The strategy should also include a detailed roadmap towards achieving the government's 90% target for renewable electricity.*
- Continue to support the long-term development and maintenance of the electricity transmission grid, in order to facilitate a competitive electricity market, to meet renewable energy targets, maintain a secure and diverse electricity supply and, in the longer term, facilitate the emergence of a low-carbon economy.*

PART I
POLICY ANALYSIS

Map 1. New Zealand



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.

2. GENERAL ENERGY POLICY

COUNTRY OVERVIEW

New Zealand is a parliamentary democracy governed by an elected House of Representatives. Parliamentary representation is through a single-house, mixed-member proportional system. The principal functions of Parliament are to enact laws, scrutinise the government's administration, and approve the government's allocation of tax income. The Constitution Act 1986 is a primary formal statement of New Zealand's system of government, in particular the executive, legislature and the judiciary. The Act recognises the Queen of New Zealand, independently of her position as Queen of the United Kingdom, as the Head of State of New Zealand and the Governor-General as her representative. New Zealand also has 85 local authorities that are responsible for certain functions at the local and regional level.

The land area is approximately 268 000 square kilometres, making it similar in land size to Japan. In June 2009, the estimated population was 4.37 million people and population growth between 1990 and 2007 was 25%.¹ The New Zealand economy has sizeable manufacturing and services sectors complementing an efficient export-oriented agricultural sector.

THE ECONOMY

Over the last twenty-five years, the New Zealand economy has emerged from being one of the most regulated in the OECD to one of the least regulated. Between 2000 and 2007, the economy expanded by an average of 3.5% each year as private consumption and residential investment grew strongly. Annual inflation averaged 2.6%, comfortably within the Reserve Bank's 1% to 3% target range, while the current account deficit averaged 5.8% of GDP over this period.²

The minority National Party government, elected in November 2008, aims to lift the long-term performance of the economy through six key policy drivers: a growth-enhancing tax system; better public services; support for science, innovation and trade; better regulation, including regulation around natural resources; investment in infrastructure; and improved education and skills.

ENERGY SUPPLY AND DEMAND

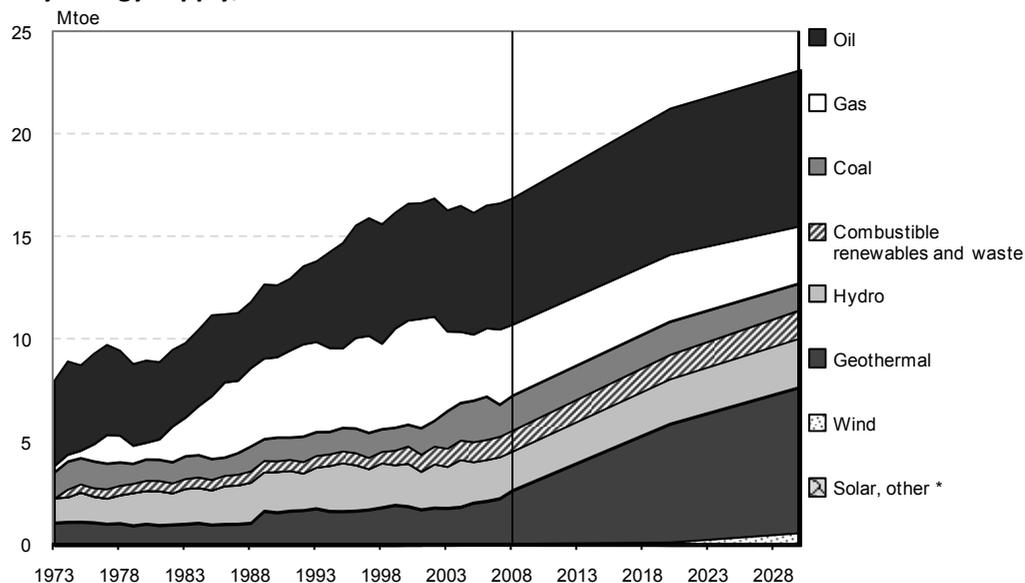
SUPPLY

New Zealand's total primary energy supply (TPES) is relatively diversified but dominated by oil and natural gas, which between them provide 57% of supply. Geothermal and hydro sources provide 15% and 11.3% respectively, while coal provides 10%. New Zealand's share of geothermal energy in TPES is the highest in the IEA and is second only to Iceland among OECD countries.

1. Statistics New Zealand.

2. *New Zealand Economic and Financial Overview 2010*, New Zealand Treasury, 2010.

Figure 1. Total primary energy supply, 1973 to 2030

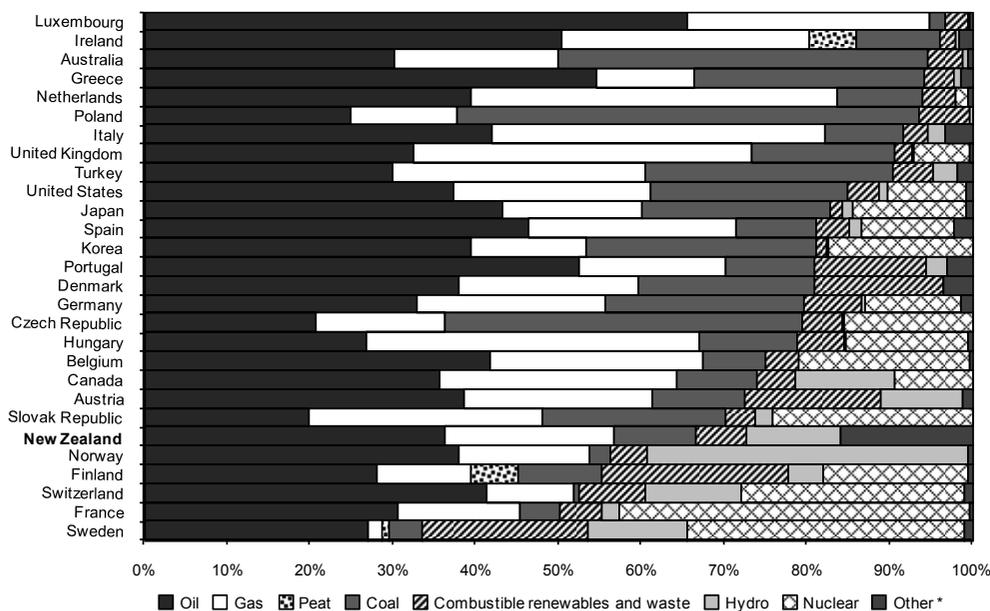


* Other includes ambient heat used in heat pumps (negligible).

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: Energy Balances of OECD Countries, IEA/OECD Paris, 2009 and country submission.

Figure 2. Breakdown of total primary energy supply in IEA member countries, 2008



* Other includes geothermal, solar, wind, and ambient heat production.

Source: Energy Balances of OECD Countries, IEA/OECD Paris, 2009.

Total primary energy supply was 16.94 million tonnes of oil equivalent (Mtoe) in 2008. This is slightly higher (1.5%) than the previous year and marginally higher than consumption in 2000. Since 2005, TPES has increased at an average of 1% per year and is expected to grow in the medium term: by at least 2% per year to 2020 and less than 1% per year thereafter to 2030. The share of geothermal energy and oil in supply is

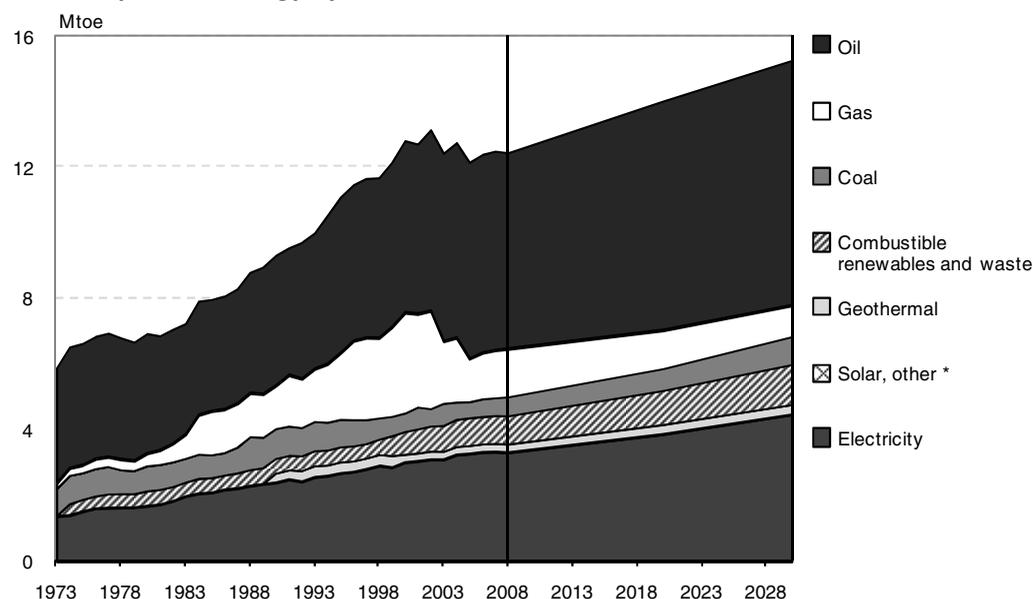
expected to account for most incremental growth in energy to 2020 while the share of natural gas is expected to fall as local production declines.

New Zealand produces much of the oil, natural gas and coal it consumes. Natural gas and oil production is limited to the Taranaki region where production is transitioning to a number of smaller gas fields following the decline of the Maui field. Most of the oil produced is exported and the country is reliant on imports for domestic transport. Oil production has increased in recent years following the commissioning of the Tui and Maari fields. New Zealand also has large high-quality coal reserves – high quality coal is exported and used domestically – and extensive lignite deposits in the South Island, which are largely undeveloped.

DEMAND

In 2008, total final consumption (TFC) of energy was 12.42 million tonnes of oil equivalent (Mtoe). This represents a small decrease on the previous year but is consistent with a fall in GDP. TFC was 3% lower than in 2000, showing significant efficiency gains, given that GDP in 2008 was 25% higher than in 2000. New Zealand is a net exporter of coal, is self-sufficient in natural gas and produces over a third of its oil consumption. The transport sector is the largest consumer of energy (4.75 Mtoe) ahead of the industrial sector (4.46 Mtoe). The residential sector is the largest consumer of electricity while the industrial sector consumes the largest amount of natural gas. Consumption is expected to increase at an average of 1% per year to 2020 driven by increased use of oil in the transport sector and growing demand for electricity.

Figure 3. Total final consumption of energy by source, 1973 to 2030



* *Other* includes ambient heat used in heat pumps (negligible).

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: Energy Balances of OECD Countries, IEA/OECD Paris, 2009 and country submission.

ENERGY ADMINISTRATION AND INSTITUTIONS

The Ministry of Economic Development has primary responsibility for energy policy advice. However, other ministries have an interest in energy policy such as: the Ministry for the Environment and the Ministry of Transport. In addition, the Ministry of Research, Science and Technology (MoRST) directs energy-related R&D policy. The Treasury is responsible for the oversight of state-owned enterprises (SOEs), a number of which are large players in the energy sector. SOEs are owned by the Crown but operate as commercial businesses and provide services directly to the public through market transactions. SOEs in the energy sector include Meridian Energy, Genesis Power, Mighty River Power, Solid Energy and Transpower.

Within the Ministry of Economic Development (MED), the Energy and Communications Branch is the policy lead on energy policy, including minerals and petroleum, energy efficiency, renewable energy, and energy conservation policy. The ministry is also responsible for the management of the New Zealand Emission Unit Register, research into carbon capture and storage, energy information and modelling, and exploring the use of oil, natural gas, geothermal and alternative fuels. It provides advice to ministers on a number of Crown entities and statutory boards, including the Commerce Commission, the Energy Efficiency and Conservation Authority, the Electricity Commission, the Gas Industry Company and the Electricity and Gas Complaints Commission.

The Commerce Commission is New Zealand's competition enforcement and regulatory agency and it is responsible for the enforcement of the Electricity Industry Reform Act and price regulation of electricity and natural gas networks. The Energy Efficiency and Conservation Authority was established to encourage, support and promote energy efficiency, energy conservation, and the use of renewable sources of energy.

The Electricity Commission is a Crown entity set up under the Electricity Act to oversee New Zealand's electricity industry and markets. It regulates the operation of the electricity industry and markets, to ensure electricity is produced and delivered to all consumers in an efficient, fair, reliable and environmentally sustainable manner. The Commission also promotes and facilitates the efficient use of electricity. In October 2010, the Electricity Commission was replaced with an Electricity Authority (EA) as an Independent Crown entity. The objective of the EA is to promote competition, reliable supply and efficient operation of the electricity market for the long-term benefit of consumers.

The Ministry for the Environment is the government's principal adviser on the environment in New Zealand and on international matters that affect the environment. It is responsible for leading the development of the emissions trading legislation and for the development of allocation plans and regulations under the scheme. The ministry is also responsible for reporting under the United Nations Framework Convention on Climate Change (the Convention) and the Kyoto Protocol.

The role of the Ministry of Research, Science and Technology is to provide ministerial advice and oversee the government's investment in research, science and technology, which includes energy research and development. The ministry oversees a number of Crown Research Institutes including the Institute of Geological and Nuclear Sciences (GNS Science), the New Zealand Crown-owned research institute that focuses on geological resources, environmental and industrial isotopes, and natural hazards. The ministry also oversees the Foundation for Research, Science and Technology, a Crown entity which delivers the government's research and development programmes.

In the natural gas sector, the Gas Industry Company is an industry-owned entity established to fulfil the role of the industry body under the Gas Act 1992. As the co-regulator of the gas industry, it can make recommendations to the Minister of Energy and Resources 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.

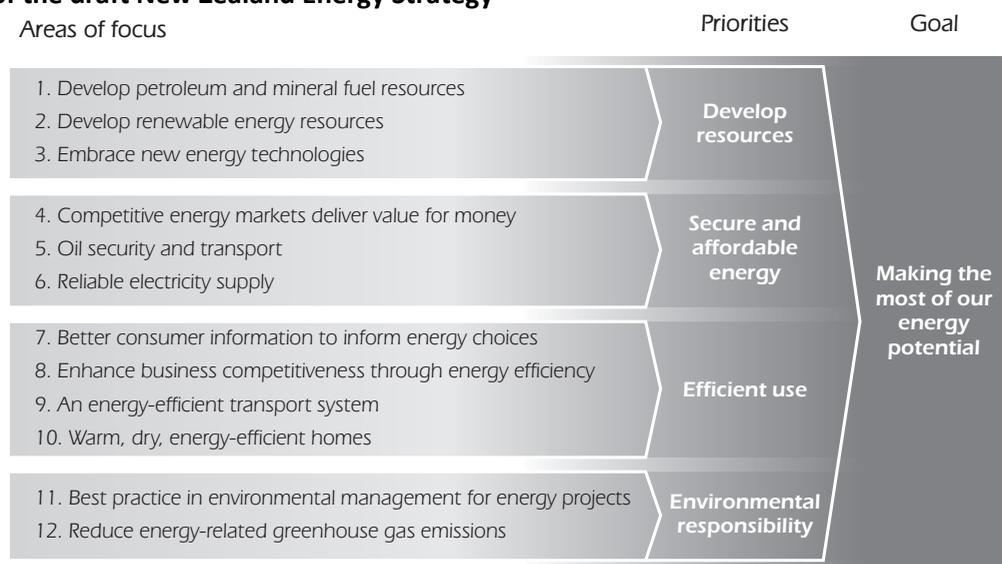
Local authorities (regional, district and unitary authorities) have the primary responsibility for regulating resource use in New Zealand and for promoting the environmental, social, cultural and economic well-being of communities. Many local authorities are active in promoting emissions reduction policies and measures in their respective regions.

ENERGY POLICIES

The Ministry of Economic Development is responsible for developing and implementing energy policy in New Zealand. During 2010, the ministry is updating the government's high-level statement of energy policy, the New Zealand Energy Strategy (NZES). The first New Zealand Energy Strategy was published in October 2007 alongside the second five-year New Zealand Energy Efficiency and Conservation Strategy but, following the election of the National Party government in 2008, both of these documents were placed under review. The purpose of the review was to present more clearly the link between energy policies and economic growth.

In July 2010, a draft NZES, which outlines the strategic direction of the energy sector and the role of energy in the national economy, was published for public consultation. The draft New Zealand Energy Efficiency and Conservation Strategy (NZEECS), a companion strategy which focuses on the promotion of energy efficiency, energy conservation and renewable energy, was also published in July 2010.

Figure 4. Structure of the draft New Zealand Energy Strategy



Source: Ministry of Economic Development.

The draft 2010 NZES sets out four priorities and twelve areas of focus, which are intended to support New Zealand to make the most of its energy potential. The NZES identified four key priorities: to develop resources; a high level of secure and affordable energy;

improving the efficiency of energy use; and integrating responsible environmental management into the development and efficient use of energy resources. The structure of the draft Strategy is outlined in Figure 4.

The draft 2010 NZECS was prepared under the Energy Efficiency and Conservation Act 2000 and published alongside the NZES. Its purpose is to promote energy efficiency, energy conservation and renewable energy. The Strategy proposes policies, objectives, and targets for the period to 2015, and the means by which these can be achieved. The energy efficiency target for the NZECS is to deliver 55 petajoules (PJ) or 1.3 Mtoe of energy savings across the economy by 2015. The NZECS also proposes that by 2025, 90% of electricity will be generated from renewable sources, providing supply security is maintained.

The energy savings from these efficiency improvements equate to approximately a 9% improvement (reduction) in New Zealand's economy-wide energy intensity level by 2015, an improvement which would increase New Zealand's rate of energy intensity improvement from 1% to 1.2% per year from 2008 levels.

The government's principal policy response to managing climate change is the New Zealand Emissions Trading Scheme (NZ ETS). This Scheme covers emissions of the following six greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆).

NZ ETS was legislated by means of the Climate Change Response Act (2002) in September 2008 and amended in November 2009. In July 2010, the stationary energy and industrial processes sector and liquid fossil fuels sector joined the forestry sector in being directly affected by the NZ ETS. The Scheme will include all sectors of the economy and all greenhouse gases (GHGs) by 2015. In November 2009, the Scheme was amended and a transitional phase introduced. The transitional phase will apply between 1 July 2010 and 31 December 2012. During this period, participants will be able to buy emission units from the government for a fixed price of NZD 25 and participants in the energy, industrial and liquid fossil fuels sectors will have to surrender only one emission unit for every two tonnes of emissions they produce.

RESOURCE MANAGEMENT ACT

The Resource Management Act 1991 (RMA) promotes the sustainable management of natural and physical resources in New Zealand by means of a framework based on environmental effects and devolves decision making. All energy infrastructure projects must obtain regulatory approval (resource consents) as defined by the Resource Management Act. Under the RMA, regional councils are charged with ensuring the sustainable management of the environment via regional policy statements, regional plans and resource consents. The RMA has undergone several reviews and been amended regularly since its enactment in 1991.

A two-phase reform of the RMA is under way, led by the Minister for the Environment. The purpose of the reforms is to reflect the government's priority to support economic growth and productivity. Phase One introduced the Resource Management (Simplifying and Streamlining) Amendment Act 2009 enacted in October 2009. This Act was intended to reform the objections process, streamline decision-making processes for projects of national significance and create an Environmental Protection Agency. Compliance measures were also strengthened.

In April 2009, the government agreed that the primary objective of Phase Two of the RMA reform is to achieve least-cost delivery of good environmental outcomes, including

the promotion of central government direction on resource management using more National Policy Statements and National Environmental Standards. National Policy Statements and National Environmental Standards affect regional policy statements, regional plans and resource consents and so the outcomes of the devolved environmental management process by regional and local councils.

National Policy Statements (NPS) are promulgated by the government after detailed inquiry and public consultation. They allow the government to provide more detailed policy guidance for local authorities in executing their responsibilities under the RMA. The development of a NPS will usually follow four stages: scoping, drafting, consultation and implementation. In most cases, reference groups will be set up with representatives from key stakeholders and agencies. Reporting back to ministers occurs after scoping has been completed and before formal consultation. The National Policy Statement on Electricity Transmission came into effect in early 2008.

National Environmental Standards (NES) are regulations issued under sections 43 and 44 of the Resource Management Act and apply nationally. This means that each regional, city or district council must enforce the same standard or, when appropriate, impose a stricter standard. A NES for electricity transmission came into effect on 14 January 2010.

MARKET REFORM

New Zealand was one of the first OECD members to reform its energy markets. In the 1980s, motivated by concerns relating to overall economic performance, the government undertook wide-ranging micro- and macro-economic reforms that liberalised much of the energy sector. This process of reform continues today albeit at a slower pace.

In April 2009, the Minister of Energy and Resources announced a Ministerial Review into Electricity Market Performance in light of concerns about the market's performance and governance arrangements. The minister appointed a Technical Advisory Group of six independent experts to assist officials. On 9 December 2009, the minister announced the outcome of the review: 29 new measures to improve electricity market performance, which will be implemented by 1 October 2010. These proposals are discussed in greater detail in Chapter 9.

ENERGY SECURITY

ELECTRICITY

The Electricity Act requires the Electricity Commission to use reasonable endeavours to ensure the security of electricity supply, without the need for emergency conservation campaigns, while minimising any distortions to the operation of the electricity market. To do so, the Commission forecasts supply and demand, develops and publishes guideline on hydro levels for security of supply, contracts for reserve energy, and works to improve the ability of consumers to manage price risks in the market.

Since 2004, the Commission has been advised by a Security Advisory Group, comprising market stakeholders. In 2008, the Commission published a security of supply policy document and, in 2009, published an Emergency Response Plan and an Outage Plan. The Emergency Response Plan defines several phases covering different levels of security risk and outlines the steps that the Commission will take during each phase.

NATURAL GAS

In 2006, the Gas Industry Company carried out a review of gas emergency arrangements.³ The review concluded with a recommendation that mandatory arrangements should be put in place. A statement of proposal was issued in August 2007 which outlined a replacement to existing arrangements in the form of regulations under the Gas Act. Two further consultation papers were published in December 2007 and May 2008. The outcome of the consultation process was a recommendation to the Minister of Energy and Resources to approve the Gas Governance (Critical Contingency Management) Regulations 2008 and associated amendments to the Gas Governance (Compliance) Regulations 2008.

In accordance with the new regulations, Vector was appointed by the Gas Industry Company to act as the critical contingency operator (CCO) – a role which vests the CCO with the power to direct pipeline users to take specific actions during a national gas supply emergency. Depending on the severity of an emergency event, pipeline users may be directed to instruct their customers to reduce or cut consumption of natural gas. This will be done following formal industry curtailment notifications which will outline the order in which the curtailments must occur.

OIL

The Ministry of Economic Development is responsible for oil supply security and, in an international disruption, would chair the National Emergency Sharing Organisation (NESO) and take the lead in developing a plan of action. In July 2008, MED released an Oil Emergency Response Strategy in consultation with other agencies and stakeholders. The Strategy sets out the broad policy and operational aspects that underpin the government's response to a disruption of oil supplies. The Strategy outlines roles and responsibilities for action in a supply disruption and the response measures available to government.

The objectives of the Strategy are to ensure that the effects of an oil supply disruption on the economy are minimised; and that New Zealand is able to effectively meet its obligations during an IEA declared emergency. The measures contained in the Strategy would only be considered in a severe oil supply disruption and only when an industry response is considered insufficient. Determining whether government intervention is required in the event of an oil supply disruption will be on the basis of industry consultation.

LONG-TERM FORECASTS AND SCENARIOS

Each year, the Ministry of Economic Development undertakes energy supply and demand modelling and produces long-term projections of future energy supply, demand, prices and emissions under various scenarios. The outcome of this process is the *New Zealand Energy Outlook*, which is published on an annual basis. One of the purposes of the work is to support the development of energy and environmental policies, as well as meeting New Zealand's reporting obligations under the Kyoto Protocol and informing broader public debate. More recently, the work has taken the form of a number of short topic-specific articles supported by detailed data tables rather than a single publication as would have been the case in the past. The most recent edition, *New Zealand's Energy Outlook 2009/2010*, was released in two stages; the first set of articles presented forecasts to 2040 for a Reference Scenario and a range of key

3. *Discussion Paper: Review of Gas Emergency Arrangements*, Gas Industry Company, 2006.

macroeconomic sensitivities: oil price, emissions price and economic growth (GDP). The second set of articles presented alternative energy scenarios.

ENERGY PRICES AND TAXES

Taxes and levies in the form of fuel excise duty (petrol tax), charges on diesel and heavy vehicles (road-user charges) and vehicle registration and licensing fees, are collected and paid into the National Land Transport Fund (NLTF) for investment in maintaining and improving land transport networks and services.

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) powered by fuel other than petrol, compressed natural gas or liquefied petroleum gas. The charges range from NZD 31.41 to NZD 40.28 per 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.

Levies on reticulated natural gas and electricity finance safety-related regulatory activities. New Zealand does not provide any direct subsidies for domestic energy consumption, including subsidies for low-income consumers.

CRITIQUE

New Zealand is endowed with a diverse range of energy resources, including oil, natural gas, coal and numerous sources of renewable energy. The country is unique in terms of its location, low population density, the profile of its greenhouse gas emissions, and the absence of subsidies for renewable energy. These factors help shape energy policy and places New Zealand in an unusual context relative to other IEA member countries regarding energy security and access to international markets.

The IEA commends New Zealand for its continuing commitment to light-handed regulation, to ongoing government monitoring and review, and to market liberalisation. Since the last in-depth review in 2006, arrangements have been developed to strengthen energy security and new policies have been implemented in the electricity, natural gas and oil sectors. The government has made good use of tools to provide detailed policy guidance in some sectors. Relevant examples include Government Policy Statements on Gas Governance and Land Transport Funding; and the National Policy Statement on Electricity Transmission, and the proposed National Policy Statement on Renewable Electricity Generation. The *Energy Research Roadmap*, published in December 2006 and updated in June 2008, sets out the national and international context for energy research, identifies the broad range of research capabilities New Zealand needs to develop and gives direction on how to maintain and improve those capabilities. Amendments to the Resource Management Act, which is undergoing detailed reform at present, have been introduced in order to improve the quality of decision making and to reduce associated costs, mainly by shortening the consenting processes timeframe.

We also laud the ongoing commitment to the transparent development, monitoring and updating of energy supply-demand forecasts, the availability of timely, consistent and high-quality energy data, and the close co-ordination among various ministries and central/local government. We also note the high-level debate on energy policy, which has ensured that the New Zealand public shares an informed understanding of the national energy situation and future challenges.

Nonetheless, responding to the complex challenges of climate change, energy security and economic development that New Zealand faces involves combining a complex set of interrelated measures together into a comprehensive, well-analysed strategy that incorporates all of the key policy strands. In this regard, the IEA commends the New Zealand government on the publication of a long-term Energy Strategy for public consultation in mid-2010. Two draft policy documents comprise the New Zealand Energy Strategy and the New Zealand Energy Efficiency and Conservation Strategy, which replace previous policy documents. While the publication of the two documents represents a positive development, how they will be implemented remains to be seen. There have been a number of changes in energy policy and regulations in the recent past making it difficult to assess the effectiveness and efficiency of policy. This has been further complicated by revisions of climate change, biofuels and transport policies. Successful energy policies require a stable energy strategy and regulatory certainty. Investments in energy infrastructure require, in most cases, long-term capital investments, and a stable policy environment will facilitate an increase in the attractiveness of New Zealand as an investment opportunity and deliver multiple benefits across the entire economy. We urge the government to finalise both strategy documents as soon as possible.

In the IEA's *World Energy Outlook 2009*, the 450 ppm (parts per million) Scenario, demonstrates in detail how a global temperature rise can be limited to two degrees Celsius should we collectively take the right policy decisions between now and 2030; it highlights that end-use energy efficiency is the largest contributor to CO₂ emissions abatement to 2030. Energy efficiency investments in buildings, industry and transport usually have short pay-back periods and negative net abatement costs, as the fuel-cost savings over the lifetime of the capital stock often outweigh the additional capital cost of the efficiency measure, even when future savings are discounted. The draft New Zealand Energy Efficiency and Conservation Strategy is consistent with the 450 Scenario and has identified explicit targets for each of these sectors. As the Strategy is finalised, we look forward to learning more about the detailed action plans, which will complement the Strategy by detailing what specific actions are needed, by whom and when. Detailed action plans targeted specifically on the transport, commercial buildings and industry sectors are needed.

We welcome the retention of the aspirational target that 90% of electricity generation be from renewable sources by 2025 (in an average hydrological year) providing this does not affect security of supply. We also note the commitment from government to remove any unnecessary regulatory barriers (particularly in the bioenergy and geothermal sectors) to renewable energy development, and to promote small-scale generation and to continue funding for ocean energy. Nonetheless, the Strategy lacks a detailed roadmap guiding New Zealand towards this key strand of energy policy. We recommend that this roadmap form part of the finalised Energy Strategy.

Within the context of international efforts to reduce greenhouse gas emissions, and set against a background of significant renewable energy potential, New Zealand is one of the few OECD member countries that can make extensive use of renewable energy and to a large extent without the use of subsidies. While the already extensive contribution of renewables to electricity generation means it will be difficult to substantially reduce CO₂ emissions from this sector, the IEA welcomes the introduction of the New Zealand Emissions Trading Scheme. Notwithstanding the finalisation of the energy strategies, we encourage the government to maintain its commitment to reviewing the Scheme on

a regular basis and also to ensure that administrative and technical barriers to the growth in renewable energy are minimised.

The IEA 450 Scenario notes that fossil fuels continue to account for the lion's share of primary energy demand, although by 2030 their share will have declined. The indigenous production of oil and natural gas is forecast to decline unless offset by substantial new discoveries, thereby increasing import demands. The government wants New Zealand to remain a highly attractive global destination for petroleum exploration and production investment and develop the potential of the vast Exclusive Economic Zone and Continental Shelf. This strategy is supported by the release of the Petroleum Action Plan in November 2009. Upstream oil and gas exploration is a resource-intensive activity and New Zealand needs to act swiftly to maintain its place as an investment destination.

Concerning the regulatory responsibilities within the energy sector, the country has a number of overlapping regulatory bodies in the energy sector, which contribute to a sometimes cumbersome and unpredictable regulatory environment for market participants. In this regard, we welcome the government decision to replace the Electricity Commission with an Electricity Authority, which was implemented in October 2010. We understand that the new body will have fewer objectives and functions than the previous commission and this represents a positive development. Further rationalisation should be considered, for example the government should examine the effectiveness of the existing regulatory models in the natural gas and electricity sectors. At present, market participants have to deal with a number of agencies rather than with one single energy regulator as is sometimes the case elsewhere.

The energy technology research and development sector also requires leadership and vision. The announcement that the government is to amalgamate the roles and functions of the Ministry of Research, Science and Technology and the Foundation for Research, Science and Technology into a new Ministry of Science and Innovation is another positive step. Energy technologies, and in particular low-carbon technologies, are also a prerequisite for the long-term sustainable economic prosperity and development of a low-carbon economy. Investment in energy technology research and development in New Zealand is at the lower end of the OECD scale in terms of dollars spent per unit of GDP. Long-term energy research and development funding needs to be increased to the levels of competing economies while at the same time remaining aligned to the government's greater economic and energy goals.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Finalise and implement the New Zealand Energy Strategy and New Zealand Energy Efficiency and Conservation Strategy in a manner that will inform the long-term strategic policy direction for the energy sector.*
- Increase public-sector investment in research and development to enhance its contribution towards long-term sustainable economic growth and consistent with the priorities established by the finalised New Zealand Energy Strategy.*

3. CLIMATE CHANGE

OVERVIEW

New Zealand's primary climate change objectives are to secure an effective long-term global agreement to meet the goal of the United Nations Framework Convention on Climate Change (UNFCCC) to stabilise greenhouse gas concentrations in the atmosphere at a level that prevents dangerous human-induced climate change, and to ensure that New Zealand does its fair share as part of the global effort.

Under the first commitment period of The Kyoto Protocol (2008-2012), New Zealand is committed to reducing its greenhouse gas emissions to 1990 levels, on average, over the period, or to take responsibility for any emissions above this level if it cannot meet this target. New Zealand is forecast to be in surplus by 9.6 million Kyoto Protocol units over the first commitment period, on a net basis. On a gross basis (excluding land use, land use change and forestry), emissions in 2008 were 23% above 1990 levels.

In 1990, New Zealand's total emissions were 60.8 million tonnes of carbon dioxide equivalent (Mt CO₂-eq). In 2008, this total had increased by 13.9 Mt CO₂-eq (22.8%) to 74.7 Mt CO₂-eq. This is largely due to growth in energy sector emissions.⁴ Uniquely among OECD member countries, the agriculture sector dominates New Zealand's emissions profile in that 46.6% of total emissions in 2008 were produced by the sector. The energy sector was the second-largest emitter (45.3%), followed by the industrial processes (5.7%) and waste sectors (2.2%).

The government has set two national targets for reducing New Zealand's greenhouse gas emissions. The first is a medium-term responsibility target of a 10% to 20% reduction in emissions below 1990 levels by 2020; and the second, a long-term target of a 50% reduction in net greenhouse gases from 1990 levels by 2050. Subsequently, in February 2010, New Zealand announced that it was joining the Copenhagen Accord on climate change and is submitting its existing conditional 2020 target range of 10% to 20% below 1990 levels by 2020. As net emissions are forecast to increase to 2020, it is expected that a substantial proportion of the 2020 target will be met through international purchases.

INSTITUTIONS

New Zealand initiated its response to climate change in 1988 with the establishment of the New Zealand Climate Change Programme, co-ordinated by the *Ministry for the Environment*. The programme has steadily evolved and now spans several government departments and agencies. A group comprised of the relevant government agencies' chief executives (the Natural Resources Sector Group) provides governance for the co-ordination of environmental policy, including climate change.

4. *New Zealand's Greenhouse Gas Inventory 1990–2008, Environmental Snapshot April 2010*, Ministry for the Environment, 2010.

During 2008–2009, the government undertook a comprehensive review of climate change policies, in particular the New Zealand Emissions Trading Scheme (NZ ETS). The aim of the review was to ensure that the government's policy response to climate change is appropriate, given national circumstances. During this time, the government also announced emissions reduction targets for 2020 and 2050.

The Ministry for the Environment is the lead policy agency on climate change issues and is responsible for leading the development of emissions trading legislation and for the development of allocation plans and regulations under the scheme. The ministry is also responsible for reporting under the United Nations Framework Convention on Climate Change (the Convention) and the Kyoto Protocol and has a climate change adaptation work programme.

Implementation of climate change policy as it relates to energy is led by the *Ministry of Economic Development*. Implementation of energy efficiency policy is carried out by the *Energy Efficiency and Conservation Authority*. The *Ministry of Transport* leads on transport-related policy matters.

The *Ministry of Agriculture and Forestry* leads agricultural- and forestry-related policy. The *Ministry of Foreign Affairs and Trade* is responsible for leading New Zealand's international climate change negotiations.

The *Treasury* provides fiscal and economic advice to the government on climate change. The *Ministry of Research, Science and Technology* has a role in the New Zealand Innovation System; it provides science and technology policy advice and related services to the government. The *Foundation for Research, Science and Technology* invests money in science and research on behalf of the government, seeking benefits to New Zealand's economy, environment and society.

The *Department of Conservation* conserves the natural and historic heritage of New Zealand that may be affected by climate change. *Local authorities* (regional, district and unitary authorities) have primary responsibility for regulating the use of resources in New Zealand and for promoting the environmental, social, cultural and economic well-being of communities.

GREENHOUSE GAS INVENTORY

New Zealand's *Greenhouse Gas Inventory 1990–2008*, published by the Ministry for the Environment, is the official annual report of all human-caused emissions and removals of greenhouse gases in New Zealand and is a Tier 1 statistic. The inventory measures New Zealand's progress against its obligations under the Kyoto Protocol as well as the United Nations Framework Convention on Climate Change (UNFCCC).

In 2008, New Zealand's total greenhouse gas emissions were 74.7 Mt CO₂-eq, which means total emissions are now 13.9 Mt CO₂-eq (22.8%) higher than the 1990 level of 60.8 Mt CO₂-eq. In 2008, net removals from afforestation, reforestation and deforestation under the Kyoto Protocol were -14.4 Mt CO₂-eq, including deforestation emissions of 2.9 Mt CO₂-eq, primarily from the conversion of forest land to grassland for dairy farming.

Between 2007 and 2008, total emissions decreased by 0.1 Mt CO₂-eq (0.1%) while agricultural emissions decreased by 0.7 Mt CO₂-eq (2.1%), largely because of a widespread drought reducing livestock numbers. In the energy sector, road transport emissions decreased for the first time as a result of high fuel prices and the onset of the

global recession. However, this was offset by an increase in stationary energy emissions because of greater use of coal in electricity generation, a consequence of the impact of drought on hydro inflows.

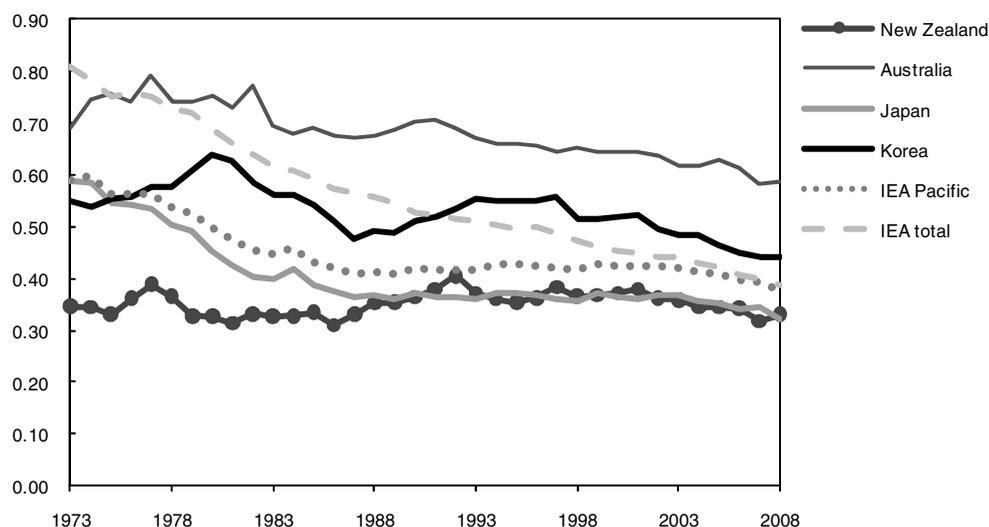
In 2008, the energy sector produced 33.8 Mt CO₂-eq (45%) of New Zealand's total greenhouse gas emissions.⁵ These emissions were 47% above the 1990 level (23.0 Mt CO₂-eq). The sources contributing most to this increase were public electricity and heat production combined, with an increase of 4.2 Mt CO₂-eq (122%), and road transportation, with an increase of 5.2 Mt CO₂-eq (69%). Emissions from the manufacture of solid fuels and the other energy industries have decreased by 1.4 Mt CO₂-eq (81%) from 1990. This decrease is mainly due to the ending of synthetic petrol production in New Zealand in 1997.

CO₂ EMISSIONS FROM FUEL COMBUSTION

In 2007, total emissions from fuel combustion were 35.47 Mt CO₂-eq. Oil was the largest emitter by fuel, 18.12 Mt CO₂-eq or 51%, followed by coal and natural gas at 26% and 23% respectively. The transport sector was the largest emitting sector, 13.89 Mt CO₂-eq, of which 91% were from the road transport subsector. Since 1990, CO₂ emissions from the transport sector increased by 60%. The electricity generation sector, including autoproducers, contributed 11.61 Mt CO₂-eq emissions and manufacturing industry was the source of 5.33 Mt CO₂-eq emissions.

Figure 5. Energy-related CO₂ emissions per GDP in New Zealand and in other selected IEA member countries, 1973 to 2008

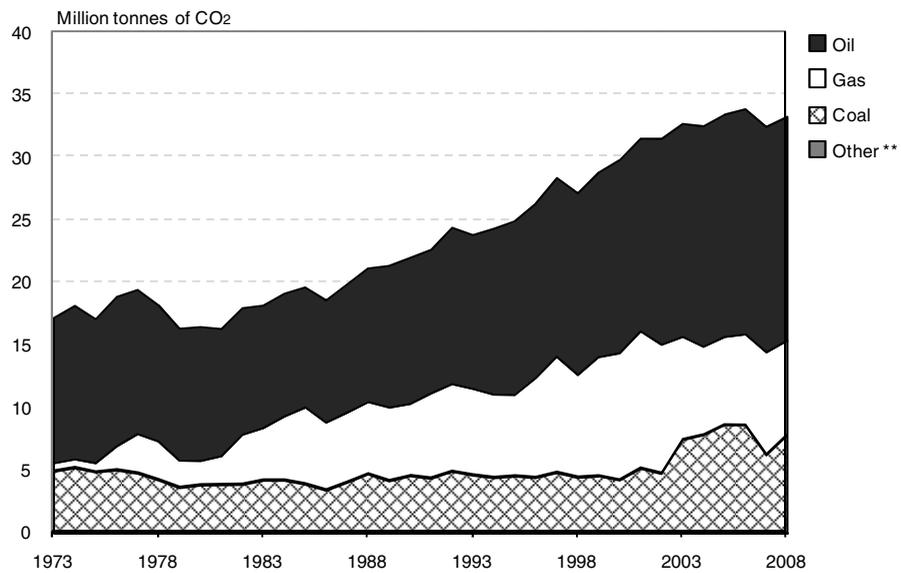
(Tonnes of CO₂ emissions per thousand USD GDP using 2000 prices and purchasing power parities.)



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and *National Accounts of OECD Countries*, OECD Paris, 2009.

5. *New Zealand's Greenhouse Gas Inventory 1990–2008*, Ministry for the Environment, 2010.

Figure 6. CO₂ emissions by fuel*, 1973 to 2008

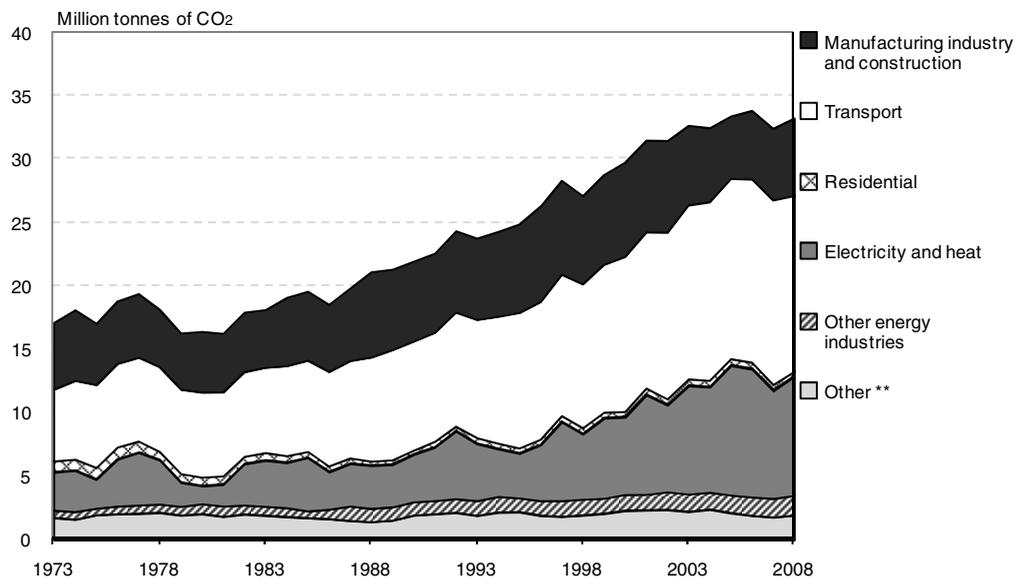


* Estimated using the IPCC Sectoral Approach.

** Other includes industrial waste and non-renewable municipal waste (negligible).

Source: CO₂ Emissions from Fuel Combustion, IEA/OECD Paris, 2009.

Figure 7. CO₂ emissions by sector*, 1973 to 2008



* Estimated using the IPCC Sectoral Approach.

** Other includes emissions from commercial and public services, agriculture/forestry and fishing.

Source: CO₂ Emissions from Fuel Combustion, IEA/OECD Paris, 2009.

FORECAST EMISSIONS

The introduction of the Emissions Trading Scheme is forecast to halt the increase in New Zealand's total emissions (excluding land use, land use change and forestry), with emissions expected to plateau at around current levels to 2020. However, net emissions (including forestry) are expected to rise sharply after 2020, when relatively large areas of forest planted in the 1990s are harvested.⁶ In addition to these long-term trends, New Zealand's emissions have significant year-to-year fluctuations. These fluctuations are largely due to two factors. The first is the change in the proportion of non-renewable electricity generation depending on annual rainfall, affecting CO₂ emissions. Owing to the large proportion of agriculture-related emissions in the New Zealand emissions profile, the second is the effect of droughts on agricultural productivity and livestock numbers, leading to changes in nitrous oxide and methane emissions.

By April 2009, the net position is projected to be a surplus of 9.6 million Kyoto Protocol units during the first commitment period. The April 2009 update compares with a projected deficit reported in May 2008 of 21.7 million Kyoto Protocol units.⁷ The change from previous projections is explained mainly by lower projected emissions from the agriculture sector and increased net removals from planted forests.

Emissions from the energy sector are expected to be 6% higher than 1990 levels by 2020. The energy sector includes electricity generation, other stationary energy, industrial and commercial use of energy, and fugitive emissions, but excludes emissions from transport. The projections for these sectors were produced by the Ministry of Economic Development and published in the New Zealand Energy Outlook in September 2009.⁸

POLICIES AND MEASURES

The most important change in energy policy relating to climate change since the publication of the last in-depth review in 2006 is the government decision not to proceed with the previously planned carbon tax. Instead, the previous and current governments support an Emissions Trading Scheme as the primary policy instrument in the area of climate change. The Scheme includes all gases covered by the Kyoto Protocol, and deals with all emitting sectors, with different sectors entering at different times.

In addition, the government has added two further broad-based targets, namely a carbon-equivalent net emissions target of 50% below 1990 levels by 2050, and a conditional target of 10% to 20% below 1990 emissions by 2020. Another government target is that 90% of electricity will be generated from renewable sources by 2025. Energy efficiency is also a priority, and the New Zealand Energy Efficiency and Conservation Strategy sits under the New Zealand Energy Strategy.

Developing our Energy Potential - Draft New Zealand Energy Strategy, and Draft New Zealand Energy Efficiency and Conservation Strategy consultation documents were published in July 2010. In the former, the government confirmed its commitment to an economy-wide target for a 50% reduction in New Zealand's carbon-equivalent net

6. New Zealand's Fifth National Communication under the United Nations Framework Convention on Climate Change (Including the Report on the Global Climate Observing System), Ministry for the Environment, 2009.

7. *Net Position Report 2009: New Zealand's projected balance of Kyoto Protocol units during the first commitment period*, Ministry for the Environment, 2009.

8. Table 5.1 in New Zealand's Fifth National Communication.

emissions, compared to 1990 levels, by 2050. In joining the Copenhagen Accord on climate change, New Zealand is prepared to accept a target for greenhouse gas emissions reductions of between 10% and 20% below 1990 levels by 2020, if there is a comprehensive global agreement and if certain conditions are met.

The Draft New Zealand Energy Strategy also identifies a number of policies that will contribute to reducing energy-related greenhouse gas emissions. The most significant of these include the New Zealand Emissions Trading Scheme, the facilitation of greater investment in renewable energy by streamlining regulatory processes, and continued investment in energy efficiency and conservation.

THE NEW ZEALAND EMISSIONS TRADING SCHEME

The government's principal policy response to climate change is the New Zealand Emissions Trading Scheme (NZ ETS). The Scheme was legislated through the Climate Change Response Act (2002) in September 2008 and amended in November 2009. The first sector (forestry) entered the Scheme retrospectively on 1 January 2008. The purpose of the amendments in November 2009 was to ease the effect of the Scheme on the economy, particularly in the transition period as the Scheme takes effect.

Under the Scheme, participants (aside from forestry) will have to surrender one emission unit to the government for every two tonnes of greenhouse gas they emit until 2013. This obligation will rise to one emission unit for each tonne of emissions from 2013. By 2015, the NZ ETS will cover all sectors and all gases. Trade-exposed industries will receive an allocation of free emission units, linked to levels of production, which will phase down slowly over time. The NZ ETS will be reviewed every five years, with the first review to be carried out in 2011.

On 1 July 2010 the stationary energy and industrial processes sector and liquid fossil fuels sector joined the forestry sector in being direct participants in the NZ ETS. The Scheme will include all sectors of the economy and all greenhouse gases covered by the Kyoto Protocol by 2015. Key entry dates for the NZ ETS are:

- 1 January 2008 for the forestry sector;
- 1 July 2010 for the transport (liquid fossil fuels), stationary energy and industrial processes sectors;
- 1 January 2013 for the waste and synthetic gas sectors; and
- 1 January 2015 for the agriculture sector.

Some sectors will be required to start reporting their emissions before they enter the Scheme. From 1 July 2010 to 31 December 2012 a progressive obligation applies, with participants required to surrender one emission unit for every two tonnes of emissions.⁹ During this transition phase there is also a NZD 25 fixed price option for meeting surrender obligations. This provides some relief and certainty for businesses facing a price on emissions for the first time. Free allocation to emissions-intensive, trade-exposed industry will be provided on an intensity basis. The number of units allocated to emissions-intensive, trade-exposed industry will be reduced by 50% during the transition phase when the progressive obligation is in place.

9. Except for deforestation emissions.

TRANSPORT POLICIES

Emissions from the transport sector are projected to rise to 15.65 Mt CO₂-eq (80% above 1990 levels) by 2020. Road transport accounts for 91% of New Zealand's transport emissions, and over 95% of the growth in transport emissions between 1990 and 2007. Emissions are expected to continue rising to 2020, even with inclusion of transport fuels in the NZ ETS - the government's principal policy to address transport emissions.

A Government Policy Statement on Land Transport is produced every three years by the Ministry of Transport. This Statement identifies short- to medium-term impacts the government wishes to achieve as well as the funding levels allocated to different areas of the transport system. Many of the specific actions that will deliver land transport impacts in the Statement will be set out in regional land transport strategies and regional land transport programmes implemented by regional councils. The government has made a commitment to develop a forward plan for transport that will complement the Government Policy Statement on Land Transport funding by providing further guidance on overall longer-term transport policy.

The New Zealand Transport Strategy 2008, a non-statutory document, was developed to give a long-term perspective and direction to the transport sector. It established a series of aspirational targets for the year 2040. Since the election of the present government, the NZ ETS is now seen as the principal policy tool.

FORESTRY

Forestry was the first sector included in the Emissions Trading Scheme, from 1 January 2008. This reflects the potential for forestry to act as a carbon "sink" to absorb greenhouse gas emissions and to help New Zealand meet international emissions obligations.

In addition, the Ministry of Agriculture and Forestry (MAF) is responsible for developing forestry-related policy. MAF administers two major schemes (other than the NZ ETS) that promote afforestation and provide incentives to maintain forests: the Permanent Forest Sink Initiative, and the East Coast Forestry Project. MAF also administers a range of programmes aimed at increasing the use of wood as a construction material. New Zealand also advocates the development of a mechanism which would encourage developing countries to reduce emissions from deforestation and forest degradation (REDD).

WASTE

The government is reviewing the New Zealand Waste Strategy, which was originally launched in 2002. A revised Strategy will be released by the end of 2010. The major piece of legislation that governs waste management in New Zealand is the Waste Minimisation Act 2008. The Ministry for the Environment is responsible for developing waste policy in the country alongside local councils. Waste emissions have reduced since 1990 by 31.8% mainly thanks to the accelerating use of landfill gas collection and destructions systems.

ENERGY SUPPLY AND RENEWABLE ENERGY

The government has an aspirational target for the energy sector that 90% of New Zealand's electricity will be generated from renewable sources by 2025. Putting a price on emissions through the NZ ETS is the principal policy to encourage investment in renewable energy.

THE ENERGY EFFICIENCY AND CONSERVATION AUTHORITY

The EECA is responsible for encouraging more efficient use of energy. The agency runs programmes in various sectors to improve energy efficiency and to promote the use and development of renewable sources of energy. The Electricity Commission also runs programmes specifically to promote efficient use of electricity.

INTERNATIONAL MEASURES

The Kyoto Protocol flexibility mechanisms are market mechanisms designed to help developed countries reduce the costs of meeting their emissions targets by achieving emissions reductions at lower costs through projects in other countries. These means include the clean development mechanism and joint implementation projects (including projects to reduce emissions).

JOINT IMPLEMENTATION

The Projects to Reduce Emissions (PRE) programme ran tenders in 2003 and 2004 to support initiatives that reduce greenhouse gas emissions. The resulting 33 PREs are largely renewable energy initiatives. Some projects produce renewable energy by using natural resources such as water, wind or steam from geothermal activity. Others turn waste into energy. Projects earn emission units which are internationally tradable and add to the financial value of the project. All PREs are eligible to become joint implementation (JI) initiatives and receive "emissions reduction units" (ERUs).

Six PREs have applied to become JI projects, and will produce emissions reductions of 2.11 Mt CO₂-eq. The remaining projects from the PRE programme will produce emissions reductions of 7.19 Mt CO₂-eq and will receive "assigned amount units" (AAUs).

CLEAN DEVELOPMENT MECHANISM

New Zealand has guidelines for organisations that wish to invest in a clean development mechanism (CDM) project and transfer the resulting certified emissions reductions (CERs) into the New Zealand Emission Unit Register. The New Zealand government has not invested in any CDM projects directly.

CRITIQUE

Climate change and, to a lesser extent air pollution are among the primary energy-sector environmental challenges for New Zealand. As is the case globally, the energy sector is a major source of greenhouse gas emissions. New Zealand's emissions profile, however, is unique in relation to its OECD peers in that almost half its emissions come from the agriculture sector. Furthermore, it has a relatively high proportion of power generation from low-emitting sources such as hydro, geothermal energy and natural gas.

The energy sector is also vulnerable to the impacts of climate change. Changing rainfall patterns have the potential to affect the frequency and duration of “dry years” when shortfalls in hydro generation must be compensated with fossil fuel-powered generation in the absence of alternative sources of energy. Energy supply infrastructure in coastal zones could also be affected by a rise in sea levels and the increased frequency and severity of extreme weather events such as high winds and coastal storms.

Within the energy sector, emissions from power generation and transportation have increased by 123% and 63% since 1990, respectively. These subsectors represent the greatest opportunities for mitigation in the energy sector.

At a carbon price of over NZD 25 per tonne, MED modelling assumes that New Zealand’s single coal-fired power generation plant will become uneconomic and be decommissioned by 2021, with gas-fired and renewable generation providing full electricity supply. The modelling shows demand growth being met primarily by geothermal and wind generation, made economic by the carbon price.

In the transport sector, biofuels - including ethanol and biodiesel - present mitigation opportunities by displacing liquid fuels derived from imported crude oil. New Zealand has favourable weather conditions and much marginal agricultural land that could be utilised to produce biofuel feedstock, including the potential for second-generation biofuels from forestry biomass. It is commonly understood that the most promising option to meet liquid fuel demand is in energy from biomass. This also has the co-benefit of increasing energy security by shifting from imported to domestic energy sources.

New Zealand has no domestic motor vehicle production; therefore it is a technology taker in the transport sector. As such, global vehicle production trends will dictate the availability of vehicle types in New Zealand, although the country sets fleet entry regulations and import standards on safety and harmful emissions. As global manufacturers shift towards increased production of hybrid and fully electric vehicles, New Zealand will likely see an increased market share for these vehicles. Combining efficient electric vehicles with New Zealand’s competitive advantage in renewable electricity generation is expected to reduce transport-sector greenhouse gas emissions.

New Zealand’s climate change response relies on the principle that emissions reductions are achieved at least cost through an emissions trading scheme. In 2009, New Zealand passed legislation for an Emissions Trading Scheme (NZ ETS), modifying the previous design. The NZ ETS places an obligation on upstream energy suppliers to surrender emission rights equivalent to either the emissions from electricity generation or emissions from liquid and solid fossil fuels. The system is uncapped, meaning that the government can issue as many units of emission rights as end-users emit, at a maximum price of NZD 25 per tonne until 2013. If the government issues more units than it has assigned amount units (AAUs) or removal units (RMUs) under the Kyoto Protocol, it must purchase more on the international market as part of its Kyoto “true up”. This system is designed to ensure that allocation within the ETS reflects the caps and restrictions placed on New Zealand through its international obligations. The government will issue free allocations to trade-exposed and emissions-intensive industrial activities, linked to their level of production. There are restrictions on the levels of allocation to emitters laid down in legislation. For example: a maximum of 60% for moderately emissions-intensive sectors, 90% for highly-intensive sectors including agriculture. This rate declines year on year. Firms must pass strict emissions-intensity thresholds in order to qualify for allocation. Some sectors (such as electricity generators) and emission sources do not qualify for allocation at all.

By issuing free allocations at market prices, industries can offset increased energy costs, passed on by upstream suppliers, who are ultimately required to hold the emission credits. This is, in effect, a subsidy to industry to moderate the effect of higher energy input costs. Owing to these allocations, there is no guarantee that the NZ ETS, with all its administrative burdens, will result in absolute emissions reductions. Previously, the government allocated more units than it has AAUs and RMUs (and therefore more than its cap) owing to one-off allocations to pre-1990 forestry (in compensation for a loss in land values - prescribed in legislation) and the 50% obligation that applies to emitters to the end of 2013. To the end of 2012, emitters will also have access to the price cap mechanism.

From 2013, the existing allocation rules prescribed in legislation mean that the level of free allocation will be less than what end-users within the scheme emit, though the volumes in the system will vary. According to projections of industrial and agricultural growth, the level of allocation will also be substantially less than that implied by any international obligation New Zealand would face under its conditional 10% to 20% reduction target for 2020 – and therefore substantially less than its cap.

At international climate change negotiations, New Zealand has committed to take responsibility for emissions reductions of 10% to 20% below 1990 levels by 2020. The upper limit is conditional on other major emitters taking on comparable commitments. Following the recent emissions reduction proposals announced by China, India and South Africa, international pressure will mount for New Zealand to commit to the upper range of its target. If so, implications for the energy sector should be assessed. If a high target is adopted and the ETS does not deliver sufficient domestic emissions reductions, the government will have to meet the shortfall by purchasing international offset credits. With high international demand for offsets, high credit prices will have major implications for the energy sector. It may be wiser for the government to clearly establish an emissions cap on the sectors covered by the NZ ETS in order to deliver great levels of certainty and set emissions on a path towards meeting long-term reduction targets for 2050. Specifying emissions caps over a long timeframe provides greater certainty to scheme participants, and providing an indicative pathway for the scheme cap to 2050 would be useful. Similarly, the number of units that can be freely allocated to trade-exposed or emissions-intensive activities should be capped, and the end date for full elimination of free allocations should be specified.

Current projections show total emissions relatively flat to 2020, with net emissions (including forestry) increasing. Although compliance with New Zealand's 2020 emissions target can be achieved through the purchase of international offsets, a trajectory of increasing emissions will make it significantly more difficult to achieve the long-term target of a 50% reduction in net emissions by 2050.

The aspirational policy target of 90% of electricity generation from renewable sources by 2025 is commendable; however, it is unclear whether the NZ ETS alone is sufficient to deliver this objective. Although modelling shows that renewable options are likely to be cost-effective in meeting demand growth, investment decisions are sensitive to policy uncertainty (both domestic and international). This could lead to further expansion of gas-fired generation, putting the 90% goal out of reach. The government should also consider what grid investments (such as smart grid technology) or what electricity market modifications may be required to support a system with such a high share of renewable generation.

In the transport sector, the road user charge (RUC) for non-petrol vehicles is a sound policy that sends a direct price signal to users for distances travelled. The pump price of

petrol (gasoline) includes excise taxes whereas for other liquid fuels, namely diesel, excise taxes are not included. The road user charge is therefore applied to vehicles not fuelled by petrol to compensate for the absence of excise tax. The RUC is calculated on the basis of distance travelled and vehicle type. For example, an average diesel vehicle is charged NZD 36 to NZD 40 per 1 000 kilometres travelled. Nonetheless, these charges are among the lowest in the OECD countries that tend to rely on strong fuel standards and higher excise duties, and are unlikely to deliver any meaningful reduction in transport emissions. The transport sector needs explicit emissions reduction targets in the medium term. These targets can be met using a variety of means, including vehicle-fuel import standards, greater use of biofuels and greater levels of support for public transport infrastructure.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Monitor investment decisions in electricity generation, and implement additional policies to support delivery of the 90% renewables target if the NZ ETS alone is insufficient.*
- Establish an explicit target for emissions reductions in the transport sector, developing an appropriate mix of policy tools and an action plan for implementation.*

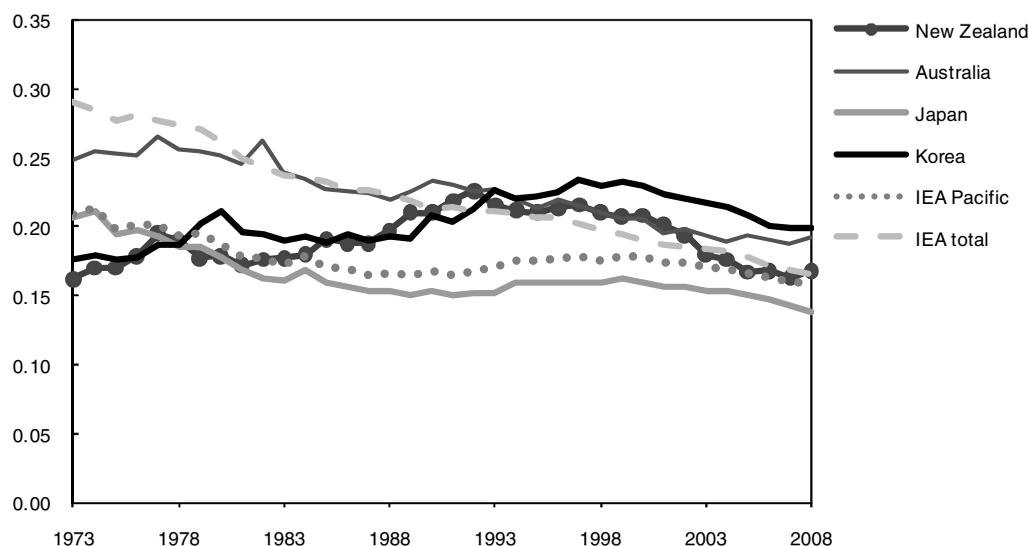
4. ENERGY EFFICIENCY

OVERVIEW

New Zealand's final energy intensity, adjusted for purchasing power parity (PPP), has declined relatively consistently since 1990 at an average of 1% per year. Despite this consistent improvement, New Zealand's energy intensity in 2007 was higher than the IEA average, mainly because of the large proportion of energy-intensive sectors in its economy.

Figure 8. Energy intensity in New Zealand and in other selected IEA member countries, 1973 to 2008

(Toe per thousand USD at 2000 prices and purchasing power parities)

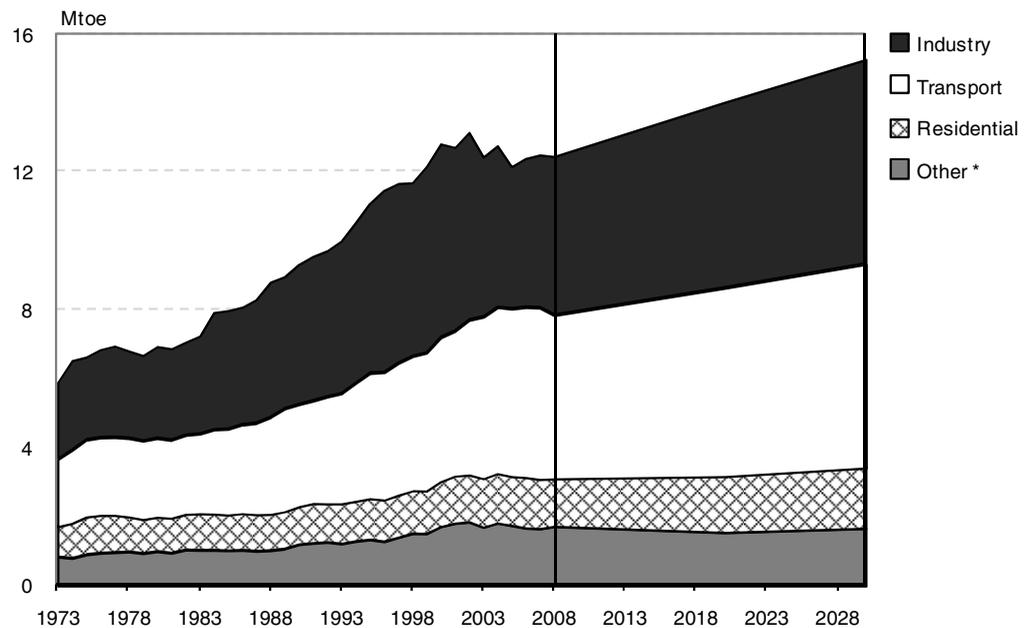


Sources: Energy Balances of OECD Countries, IEA/OECD Paris, 2009 and National Accounts of OECD Countries, OECD Paris, 2009.

A contributing factor to this improvement in final energy intensity has been improvements in energy efficiency. According to the Energy Efficiency and Conservation Authority (EECA), between 2001 and 2007, overall energy efficiency improvements saved New Zealand the equivalent of almost 10 TWh of energy (40% of the growth in demand for energy services).

Total final consumption of energy (TFC) in New Zealand was 12.42 Mtoe in 2008 compared to 9.3 Mtoe in 1990. The transport sector was the largest consumer of energy (4.75 Mtoe) followed by the industrial sector (4.56 Mtoe) and the residential sector (1.42 Mtoe). While energy consumption in the industrial sector was slightly higher than in 2007, consumption in the transport sector was almost 5% lower than the previous year.

Figure 9. Total final consumption by sector, 1973 to 2030



* Other includes commercial, public service, agricultural, fishing and other non-specified sectors.

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

INSTITUTIONS

As in many countries, responsibility for energy efficiency policy development, implementation and evaluation is spread across several institutions spanning different sectors of the economy, including energy, transport, and residential and commercial buildings.

The *Ministry of Economic Development* (MED) has primary responsibility for energy policy advice to the *Minister of Energy and Resources*. This responsibility spans supply- and demand-side responses, and so includes the provision of advice on energy efficiency policy and practice. MED also has responsibility for monitoring the Energy Efficiency and Conservation Authority (EECA).

EECA is the government's primary energy efficiency delivery agency. It is a Crown (government) entity established under the Energy Efficiency and Conservation Act 2000. EECA's role as defined in its enabling legislation is "to encourage, promote, and support energy efficiency, energy conservation, and the use of renewable sources of energy."

The Authority develops and administers government programmes in various sectors to improve energy efficiency as well as promoting the use and development of renewable sources of energy. It also provides advice to the Minister of Energy and Resources on operationally linked policy issues affecting the uptake of energy efficiency and renewables. EECA works closely with other government policy and operational agencies to design, implement and monitor policies and programmes. It is governed by a board of between six and eight members which reports directly to the Minister of Energy and Resources.

At the time of the review, the *Electricity Commission* (EC) also administered programmes specifically to promote and facilitate the efficient use of electricity. The EC was a Crown entity established in 2003 under the Electricity Act. Its aim was to oversee and regulate

New Zealand's electricity industry and markets. It also promoted and facilitated electricity efficiency and conservation in the areas of lighting, industry and commercial buildings. The EC was disestablished in October 2010 and replaced by the *Electricity Authority*, responsible for the technical regulation of the electricity market. The EC's electricity efficiency programmes were transferred to EECA at this time.

The *Ministry of Transport* and its land-based service-delivery partner, the *New Zealand Transport Agency*, are responsible for transport policy, including energy efficiency policy and most energy efficiency programmes in the sector with the exception of fuel economy labelling for motor vehicles for which EECA takes responsibility.

The *Department of Building and Housing* is the government body responsible for administering the Building Act and the New Zealand Building Code for residential and commercial buildings, incorporating energy efficiency measures that provide cost-effective whole-of-building performance. The Department also works with industry on research and other initiatives contributing to energy efficiency.

POLICIES AND MEASURES

New Zealand has a long history of promoting energy efficiency policies. The country has a strong legislative and institutional base for its energy efficiency policies. New Zealand's Energy Efficiency and Conservation Act (2000) provides the basis for promoting energy efficiency. The Act established the Energy Efficiency and Conservation Authority (EECA) as a stand-alone entity with an enduring role to promote energy efficiency across all sectors of the economy. The Act also empowers the preparation of regulations implementing product energy efficiency standards and labelling, as well as the disclosure of information to compile statistics on energy efficiency, energy conservation and renewable energy.

The government's primary statement of energy policy is the July 2010 draft New Zealand Energy Strategy (NZES). A companion strategy, the draft New Zealand Energy Efficiency and Conservation Strategy (NZECS), was released by the government at the same time. The draft NZECS is prepared under the Energy Efficiency and Conservation Act 2000 to promote energy efficiency, energy conservation and renewable energy in New Zealand.

The NZECS proposes government policies, objectives and targets to 2015, and the means by which these will be achieved. The July 2010 draft was issued for public consultation through to September 2010. Following consideration of public submissions, a new version of the NZECS will be in force once a final version is publicly notified and issued by the Minister of Energy and Resources, for a period of five years.

The draft NZECS builds on achievements to date and focuses on five-year targets and objectives to 2015, to provide consistency and certainty for investment. The government's proposed energy efficiency target is for the NZECS to deliver 15.3 TWh (55 petajoules, PJ) of energy saving across the economy by 2015. This equates to cumulative savings of 150 PJ between 2008 and 2015. The energy saving from these efficiency improvements equates to approximately a 9% improvement (reduction) in New Zealand's economy-wide energy intensity level by 2015. This improvement would increase New Zealand's rate of energy intensity improvement from 1% to 1.2% per annum (from 2008 levels).

The NZECS is a government strategy, and as such, the means by which the policies, objectives and targets in this draft are proposed to be achieved relate to a number of

ministerial portfolios and public-sector agencies. The Minister of Energy and Resources, supported by the Ministry of Economic Development and the Senior Energy Officials Group (comprising representatives from identified agencies) will oversee the NZEECS's delivery across portfolios. Specific policy measures will also be recorded in annual Output Agreements with respective ministers and in statements of Intent presented to Parliament.

Table 1. Energy efficiency sector objectives and targets specified in the draft NZEECS 2010

Objectives	Targets
Transport: A more energy-efficient transport system, with a greater diversity of fuels and renewable energy technologies.	8 TWh of savings. A 4% improvement from 2008 levels in MWh/kilometres travelled on land.
Business: Enhanced business growth and competitiveness from energy productivity investment.	5.83 TWh of savings (4.44 TWh of savings in industry and 1.39 TWh in the commercial sector). 14% improvement in the commercial and industrial sector energy intensity level. An additional 2.64 TWh of energy used for heat and/or fuel from biomass and/or geothermal sources per year by 2025.
Homes: Warm, dry and energy-efficient homes with improved air quality to avoid ill-health and lost productivity.	1.11 TWh of savings. Historical trends of increasing energy use by households levelling off.
Products: Greater business and consumer uptake of energy-efficient products.	Extend minimum energy performance standards (MEPS), labelling and EnergyStar product coverage to remain in line with major trading partners.
Electricity system: An efficient renewable electricity system supporting New Zealand's global competitiveness.	90% of electricity will be generated from renewable sources by 2025, providing supply security is maintained.
Public sector: Greater value for money from the sector through increased energy efficiency.	10% reduction in energy use per full-time staff equivalent compared with 2008/09 baseline.

Source: Draft New Zealand Energy Efficiency and Conservation Strategy 2010, Ministry of Economic Development, July 2010.

CROSS-SECTORAL ACTIVITIES

Through EECA, New Zealand has developed a world-class energy efficiency indicators and monitoring system. EECA's Energy End Use Database contains allocations of national energy use broken down into different categories, including territorial jurisdictions, sectors, technology, end use, region, and fuel type.

Buildings

Building codes

All new building work in New Zealand must comply with the Building Code. It is a performance-based code, which means it states how a building and its components must perform as opposed to describing how the building must be designed and constructed. Compliance documents are prepared by the Department of Building and Housing in accordance with section 22 of the Building Act 2004. A compliance document is for use in establishing compliance with the code.

While the existing code contains a number of provisions in relation to energy efficiency, a number of changes have been implemented that will strengthen the energy efficiency of both commercial buildings and the new housing stock.

From 1 February 2009, new Building Code (NZBC) provisions for hot water and heating, ventilation and air-conditioning (HVAC) systems came into force. Hot water energy efficiency provisions of the Building Code now include a new requirement for systems to “be constructed to facilitate the efficient use of hot water”. This new provision only applies to buildings that are classified as housing. From January 2009, all HVAC systems must be located, constructed and installed to limit energy use, consistent with the intended use of space; and enable them to be maintained to ensure their use of energy remains limited, consistent with the intended use of space. This change applies only to buildings that are classified as commercial.

From October 2007, the New Zealand Building Code was changed to require improved thermal performance (insulation) in all new houses, non-residential buildings smaller than 300 square metres, and in alterations to both. New houses and major extensions to existing houses need to use 30% less heating energy to achieve healthy indoor temperatures than previously. The changes have become effective progressively throughout New Zealand since that time.

Further amendments relating to the installation of solar water heaters and the energy efficiency of commercial lighting in new and retrofitted buildings became law in late 2007.

Warm up New Zealand: Heat Smart

Warm Up New Zealand: Heat Smart, is the principal energy efficiency programme for the residential sector. The aim of the programme is to deliver grants for the installation of energy efficiency measures and clean heating devices in homes built before 2000. In total, the scheme has NZD 324.82 million dedicated to it by the government (excluding administration costs) through to 2012. It aims to retrofit more than 180 000 homes by 2012/13.

The grant targets two income levels: general income and those on lower incomes. For the general income group, the grant provides 33% off the cost of insulation up to NZD 1 300, and a flat NZD 500 off the cost of a clean heating device. Low-income owner-occupiers or landlords with low-income tenants are eligible for 60% off the cost of insulation, estimated to average NZD 1 800, and a flat NZD 1 200 off the cost of a clean heating device.

In addition, the low-income group (including landlords with low-income tenants) may be able to access top-up funding provided by community groups and private-sector companies. Subject to availability and eligibility criteria set by third-party funders, many low-income households receive heavily discounted or free insulation.

The programme started on 1 July 2009 and by June 2010:

- 57 908 homes had insulation installed, a clean heating device installed, or both;
- over 51 000 homes having only insulation installed exceeded the revised target of 50 000;
- particularly high demand was recorded from low-income households, with over 32 000 houses being insulated or having clean heating installed (both owner-occupied and rented);
- 9 000 rentals had been insulated or had clean heating devices installed;

- NZD 13 million of community and private funding had been raised and channelled to Community Services Card holders for installations. There is a further NZD 15 million pledged for 2010/11.

Box 1. The KEMA Electric Energy Efficiency Potentials Study

New Zealand Electric Energy Efficiency Potentials Study of September 2007 assessed the electricity potential in New Zealand's residential, commercial and industrial sectors. The goals of the study were to determine levels of electricity efficiency available in the economy and to estimate the cost-effectiveness of programmes to achieve these potentials. The report identified lighting as having considerable economic potential in the residential and commercial sectors and, to date, the Electricity Commission's programmes have focused strongly on this area. By 2016, KEMA estimates a total of 1 750 GWh per annum of economic potential from efficient lighting across New Zealand's residential and commercial sectors which the estimate equals 40% of all other energy efficiency measures. The report also highlighted the contribution that lighting makes to peak demand; in the residential sector it is estimated that 50% of lighting electricity use is consumed over the peak period.

Efficient Lighting Programme

The Electricity Commission (the Commission) estimates that lighting New Zealand homes consumes around 8% of the total energy consumed in homes while lighting in businesses and public areas consumes over 14% of the energy consumed in those buildings. With these numbers in mind, the Commission developed the Efficient Lighting Programme using analysis from a specially commissioned study.¹⁰

The Commissions also drew upon research and feedback from representatives of the lighting industry through its own Efficient Lighting Stakeholder Group (ELG) and other lighting industry representatives. To date the Commission has provided funding that has resulted in the installation of around five million efficient lamps which, the Commissions estimates, contribute to energy savings of around 400 GWh per year.

Efficient Lighting Strategy

The Commission, in partnership with the EECA and the Lighting Council of New Zealand (LCNZ), established the Efficient Lighting Group (ELG). The ELG comprises representatives from the Commission, the EECA, the Department of Building and Housing (DBH), the LCNZ and other lighting industry representatives. The key objective set out in the Efficient Lighting Strategy developed by the ELG is to "strengthen naturally occurring, market-delivered efficiency through interventions that remove barriers to technologically and economically viable efficient lighting options". In order to help achieve the key objective, the Efficient Lighting Strategy sets out six strategic goals:

- eliminate inefficient incandescent lighting;
- eliminate inefficient halogen lighting;
- eliminate inefficient fluorescent lighting;
- eliminate inefficient mercury vapour lighting;
- increase use of efficient lighting design and controls; and
- eliminate inefficient street lighting.

10. *New Zealand Electric Energy-Efficiency Potentials Study* – September 2007, KEMA and the Electricity Commission, 2007.

These goals were developed by the ELG taking into account the outputs from the KEMA Potentials Study and broad stakeholder knowledge and experience of ELG members. These six goals provide the focus for the Commission's interventions in the lighting market to improve the efficiency of lighting in New Zealand.

Since the time of the review, the Commission has made four changes to the RightLight Programme (information, training, promotion of efficient lighting across all sectors of the economy). This programme has adopted a much greater focus on information and training, *i.e.* building knowledge, awareness and capability among consumers and businesses on energy-efficient lighting options.

Appliances

Efficient products programmes

New Zealand and Australia co-operate on a joint programme known as the Equipment Energy Efficiency (E3) Programme. The E3 Programme measures are jointly funded and developed under the leadership of the E3 Committee, comprising officials from the New Zealand government and the Australian State, Territory and Commonwealth governments. Minimum energy performance standards (MEPS) and energy-rating labelling requirements are tools which the E3 Programme uses to improve product efficiency.

Since 2006, this programme has been developing energy-rating labelling requirements and mandatory MEPS for a range of commonly used residential, commercial and industrial electrical products. The programme allows both countries to set consistent standards and measures for energy efficiency. It enables consumers to assess and compare the energy efficiency of a product when purchasing appliances. Compliance with the programme requirements is monitored and actions are taken to remove non-compliant products.

New Zealand also operates a voluntary product endorsement scheme (ENERGY STAR) to encourage consumers to purchase more efficient products.

Minimum energy performance standards

Minimum energy performance standards (MEPS) ensure that the most inefficient products are not available for sale. Under the standards, products must be tested and shown to meet a minimum standard for energy efficiency before they can be sold. MEPS are currently in place for eight product classes in New Zealand: air conditioners/heat pumps, distribution transformers, domestic fridges and freezers, electric hot water cylinders, fluorescent lamps, ballasts for fluorescent lamps, refrigerated display cabinets, and three-phase electric motors.

Compulsory product labelling

Product labelling regulations require retailers of all white goods and heat pumps to provide energy efficiency information to consumers at the point of sale. The labels assess how much electricity the appliance is likely to use in a year (on average) and provide a star rating that compares the appliance's efficiency to other appliances of its kind.

As with MEPS, mandatory labels in New Zealand align with those set by the Australian government. Products covered by MEPS and/or labelling, and the relevant standards, are

listed in schedules 1 and 2 of the Energy Efficiency (Energy Using Products) Regulations 2002. Regulations in both Australia and New Zealand specify the general requirements for MEPS and labelling, including offences and the penalties if a party does not comply with the requirements.

Voluntary product labelling

ENERGY STAR® is an independent, international programme that awards labels to only the most energy (efficient) products on the market. The EECA is responsible for implementing the programme in New Zealand. Established in the United States by the Environmental Protection Agency and the United States Department of Energy, the ENERGY STAR® programme takes into account a range of environmental standards when assessing the appliances. These labels make it easier for consumers to identify and purchase the most energy-efficient products and reduce their electricity use.

Industry

The Electricity Commission's industrial sector electricity efficiency programme focuses on motorised systems efficiency. The Electric Motors Bounty Scheme provides a direct incentive to motor users to upgrade their electric motors. Under the Bounty Scheme, motor users are paid for the removal (and permanent disabling) of lower-efficiency, three-phase motors that are replaced with MEPS 2006-compliant motors. The scheme is for three-phase motors with capacities of 22 kW to 185 kW.

The Commission is also running a pilot Compressed Air Systems Programme. Under this programme, subsidies are available for audits of compressed air systems for their energy efficiency. The Commission is also working to train and accredit auditors to enhance industry capacity to undertake energy audits of compressed air systems.

The Commission offers financial assistance to businesses in the commercial sector to improve their electricity efficiency. The programmes allow businesses to apply for part-funding for electricity efficiency projects where there is a current barrier preventing such projects from proceeding. These programmes include efficiency projects for commercial buildings, of which 75 projects were established by June 2009. Projects funded so far include electricity efficiency enhancements in several hospitals, office buildings, a tertiary educational institute, and retail outlets. These projects target efficiency measures such as upgrades of building management systems, lighting replacements, replacement of inefficient chilling systems, and installation of monitoring and targeting systems.

Since the time of the review, the Commission has also rolled out new training programmes in the commercial sector (targeting energy specialists, facilities managers, refrigeration/HVAC engineers and maintenance staff, etc.) and the Motor Rewind Quality Workshop Scheme (targeting quality repair /rewind of electric motors).

EECA also runs several programmes to support businesses to become more energy (efficient). It provides information on new technologies and energy management, grants for energy audits and demonstrations of new technology, and one-on-one support for energy-intensive businesses. Grant funding is available for energy and design audits. Energy audits analyse a business's current energy use and pinpoint where savings can be made. Design audits analyse the energy efficiency of premises or facilities yet to be constructed and propose design changes to make them more efficient. Grant funding is also available for new or under-utilised technology improvements. Up to 40% of the

total project cost is available (up to NZD 100 000), or up to 75% of the cost of a feasibility study (up to NZD 10 000) for new technologies. Examples of technologies recently funded include fans and boiler controls, bio-digesters and heat recovery systems. EECA works directly with energy-intensive businesses on their energy management and works with industry associations in energy-intensive industries to promote best practice in energy management.

EECA provides support for central and local government entities to implement energy efficiency initiatives within their own operations. Under the Crown Energy Efficiency Loans Scheme, government entities can access funding for energy efficiency and renewable energy projects. Priority is given to projects that are cost-effective and can be easily replicated.

Transport

Total final consumption of energy in New Zealand in 2008 was 12.42 Mtoe, of which the transport sector consumed 4.75 Mtoe (38%). The road transport sector is the primary user of this energy, most of which is imported oil. In 2008, the government published a set of defined targets for the transport sector and actions to achieve these targets over the next 30 years. The targets are set out in two key documents: the 2009 Government Policy Statement on Land Transport Funding (GPS) and the New Zealand Transport Strategy 2008 (NZTS).

Strategic-level transport initiatives

Government Policy Statement on Land Transport Funding

The Government Policy Statement (GPS) on Land Transport Funding sets out the government's priorities for expenditure from the National Land Transport Fund over the next 10 years. It sets out how funding is allocated between activities such as road safety policies, state highways, local roads and public transport. It details the government's desired outcomes and funding priorities for the use of the National Land Transport Fund to support activities in the land transport sector. The GPS covers the impacts the government wishes to achieve from its investment in land transport, how it will achieve these impacts through funding certain activity classes, how much funding will be provided, and how this funding will be raised.

The present GPS covers the financial period 2009/10 to 2014/15 and provides indicative figures from 2015 to 2019. It will be in effect from July 2009 to July 2012. Another GPS must be released before July 2012.

The incoming government took the opportunity in the GPS to refine the New Zealand Transport Strategy 2008 (NZTS):

“The government in general terms supports the overall intent of the NZTS, but considers that moving too quickly on modal shift will have a negative impact on environmental and economic efficiency. The government expects carbon mitigation primarily to occur via new fuels (*e.g.* biofuels and electric cars) encouraged via an emissions trading scheme, plus some modal shift actions particularly in our major cities of Wellington, Auckland and Christchurch.”

Vehicle Fuel Economy Labelling Scheme

In December 2007, the government introduced the Vehicle Fuel Economy Labelling Scheme making it compulsory for vehicle traders and online sellers to display information about the fuel economy of their vehicles. The scheme came into effect in April 2008. The aim of the programme is to allow consumers to make a more informed choice when purchasing a vehicle and to place an appropriate value on fuel economy. This should encourage consumers to buy more fuel-efficient vehicles and thus reduce greenhouse gas emissions from New Zealand's transport sector. The label provides information about the relative fuel economy of that make and model of vehicle. It displays the information as a star rating out of six stars, the number of litres of fuel per 100 kilometres travelled, as well as an estimate of the fuel costs per year. Fuel economy information must be displayed for all light vehicles (*i.e.* motor cars, utilities and vans under 3.5 tonnes) whenever it is available. It is not required for motorcycles or vehicles over 3.5 tonnes.

Electric vehicles

In June 2009, the government passed legislation to provide an exemption from road-user charges for electric vehicles from October 2009 until July 2013. This was done in recognition of the role electric vehicles will play in assisting with the reduction of greenhouse gas emissions from the transport sector.

Fleet Best-Practice Programme

Two reports on commercial vehicle fleet fuel efficiency were published during 2008: the Fleet Commitment Initial Work Programme Trial, by the Transport Engineering Research New Zealand Limited, and the Survey on Fleet Fuel Efficiency in the Heavy and Light Commercial Vehicle Fleet, by Kissling Consulting Limited (NZ) and Imise Limited (United Kingdom).

The research recommended that a New Zealand Fleet Best Practice Programme be developed. As the first stage, the Ministry of Transport, in conjunction with the New Zealand Transport Agency, has converted the United Kingdom Safe and Fuel Efficient Driver training programme to a New Zealand-based curriculum for heavy and light commercial vehicle fleets. Other activities include the development of tip booklets and videos, additional New Zealand-based research to tailor driver training and fuel-efficient driving techniques for the New Zealand fleet, greater training for driver trainers and driver training.

Public transport

The government has committed to continuing public transport funding and has provided NZD 500 million for the electrification of the Auckland rail network. The purchase of electric trains to run on the new network will also be supported by the government. Including this project, the government will invest a total of NZD one billion in Auckland's rail network.

The Ministry of Transport is also examining ways to increase the productivity and efficiency of the public transport system. The main focus is to look at how to remove barriers to greater efficiency, *e.g.* delays in the renewal of passenger-class driver licences and buses losing time when re-entering heavy traffic from bus stops.

CRITIQUE

Energy efficiency, defined in the New Zealand Energy Efficiency and Conservation Act 2000 as “a change to energy use that results in an increase in net benefits per unit of energy used” not only reduces end-user costs and benefits the wider economy, but is also environmentally more responsible and leads to greater energy security by reducing the dependence on imported sources of energy.

New Zealand has relatively strong minimum energy performance standards and energy-rating labelling requirements in place for appliances and equipment. Furthermore, the compliance monitoring programme for these requirements is robust, which means that New Zealand can be sure it is achieving the level of energy efficiency improvements expected from these regulations.

Furthermore, New Zealand has a well-regarded energy efficiency statistics and indicators capability. The Energy End-Use Database developed by the EECA contains detailed end-use energy consumption estimates based on national-level data. It contains estimates of national energy use broken down into different categories, including sector, technology, end use, region, and fuel type. This is essential for good policy development and should be commended.

A rolling set of surveys of energy end use within economic sectors has also been implemented through Statistics New Zealand. This will further improve the quality of information on energy use in New Zealand to supplement (and replace) the existing data sources.

The roll-out of Warm Up New Zealand: Heat Smart has been managed well and appears to be delivering good results nationwide. Nearly 60 000 homes were retrofitted with insulation or equipped with a clean heating device or both during the first year of the scheme.

Nonetheless, New Zealand’s energy efficiency policies and programmes face several challenges. Energy intensity has improved by approximately 1% per year between 1995 and 2007, not enough to offset the economy-wide increase in energy demand of approximately 2% each year. Energy performance varies across sectors. In 2008, transport accounted for 38% of energy consumption. From 1995 to 2007, energy consumption in the transport sector increased by 2.9% per year (freight by 3.9% per year and passenger transport by 2.1% per year). Growth in this sector, thus caused by the increasing number of vehicles on the road, appears to be the biggest energy-saving challenge.

The development of new EECA programmes, or substantial changes to existing schemes, generally require approval from the government. That said, EECA retains a good degree of authority to develop initiatives within existing baseline funding and make operational modifications to improve existing programmes (based on implementation experience). Funding linked to a specific programme by Cabinet may not be allocated to other areas without specific Cabinet approval. The leeway of EECA to shift funding between programmes in order to adapt the portfolio according to changing needs is therefore limited to some extent.

EECA periodically receives specific and detailed directions from government ministers with respect to the development and implementation of programmes and measures. The government’s Warm Up New Zealand: Heat Smart initiative is one such example.

At the time of the review, energy efficiency programmes, actions and schemes were not only administered by the EECA. The Electricity Commission is responsible for programmes to promote efficiency in the electricity sector (lighting, industrial motor systems, and commercial buildings). Sharing the responsibility for energy efficiency programmes between two government entities can sometimes lead to sub-optimal results.

The December 2009 decision of the Minister of Economic Development to concentrate the function in one entity seems a pragmatic solution. At present, energy efficiency activities are funded by means of a mix of direct budget allocation to EECA, through the annual government budget process, and the Electricity Commission's levy on electricity consumption. With the reorganisation of responsibilities for programme delivery, it is important that the levy-funding continues to flow to where it is required.

Notwithstanding recent changes, there remains considerable duplication of effort across government agencies responsible for energy efficiency (and renewable energy) policy and practice. The legislative basis for EECA requires it to maintain policy, information and monitoring capability, which appears to duplicate work in other agencies and government departments. International experience, however, suggests that technical energy efficiency agencies can bring significant expertise to energy efficiency policy development. The government should ensure that the policy work of EECA and MED is co-ordinated and complementary.

In 2007, the government launched the New Zealand Energy Strategy (NZES). The Energy Efficiency and Conservation Strategy (NZECS), a subset of the NZES, was promulgated in the same year. The NZECS contained efficiency targets for the transportation, business, residential, renewable energy, and government sectors. A change of government in 2008 led to a review of both the NZES and the NZECS and revised draft strategy documents were released for consultation in mid-2010. The draft NZECS notes that the greatest potential for efficiency savings is found in the transport, industrial and commercial sectors and, to a lesser extent, in the residential sector. For example, over half the savings are expected to come from the transport sector; yet the mix of policies and instruments proposed for the sector are vague and explicit targets for its constituent parts are absent. Previous IEA studies have demonstrated that substantially changing transport trends will require both the widespread adoption of current best available technology, and the longer-term development and deployment of a range of new technologies supported by strong policies to ensure rapid uptake and full utilisation of these technologies, and to encourage sensible changes in travel patterns. It needs to involve industry, governments and consumers.

Improving energy efficiency in the transport sector is challenging in all countries. In New Zealand, two issues make addressing transport-sector energy efficiency particularly difficult. It is unclear, under present policy conditions, how the demonstrated potential for energy efficiency gains in the transport sector will be realised. The lack of clarity is also impacted by frequent policy changes and regulatory uncertainty, for example changes in biofuels policies.

Amendments to the Building Code in 2007 imposed tougher minimum energy performance standards (MEPS) for new buildings and major renovations. This has led to an effective increase in insulation requirements for residential homes and smaller commercial buildings. Given the significance of energy use in the commercial sector, it is critical that the regulation on the energy performance of buildings be extended to commercial buildings larger than 300 square metres.

At 7.5%, the level of losses incurred in the transmission and distribution of electricity is relatively high. Reducing these losses would lead to a reduction in the amount of future capacity additions needed. While Transpower is making a number of investments to reduce losses in the transmissions system, which account for up to 4% of annual losses, stronger actions need to be taken in the distribution system. The draft NZEES expects the regulator, system operator and lines companies to minimise lines losses and make efficiency gains in the operation of the system, and to plan ahead so as to ensure the system can securely support a greater proportion of renewable generation in the future, but a clear vision as to how this can happen is lacking.

KEY RECOMMENDATIONS

The Government of New Zealand should:

- Within the constraints of existing legislation, provide EECA with greater flexibility regarding how to spend the funding on the design, development, implementation and possible modification of energy efficiency programmes, schemes and actions;*
- Extend the Warm Up New Zealand: Heat Smart scheme to retrofit insufficiently insulated residential buildings beyond the life of the present programme;*
- Develop and implement the new Building Code regulations and expand minimum energy performance standards to commercial buildings larger than 300 square metres.*
- Develop and implement programmes to improve the fuel efficiency of fossil fuel-powered vehicles and examine the possibility of making fuel-efficient driving part of the driving licence training and testing.*
- Define clear roles for policy development and implementation in the transport sector and, if possible, vest policy in one agency or ministry.*
- Ensure that responsibility for energy efficiency policy development, data gathering and energy efficiency indicators analysis and programme delivery is clearly allocated to relevant government agencies. Such an allocation of responsibility should recognise the need for technical expertise in both policy development and implementation, and seek to avoid duplication of effort.*
- Set a target to reduce losses in the transmission and distribution of electricity and apply penalties for non-fulfilment via regulatory mechanisms.*

G8 ENERGY EFFICIENCY RECOMMENDATIONS

At the 2009 IEA Ministerial Meeting, the IEA recommended the adoption of a broad range of specific energy efficiency policy measures. The recommendations (in Box 2) cover 25 fields of action across seven priority areas and were originally developed by the IEA in 2007 under the G8 Gleneagles Plan of Action. The 25 recommendations are considered by the IEA Secretariat and member countries as a useful compilation of best-practice policies. To improve energy efficiency, the IEA encourages New Zealand to continue to implement these recommendations and similar measures where appropriate to national circumstances.

Box 2. IEA G8 Energy Efficiency Recommendations

At the Group of Eight* (G8) Summit in 2005 in Gleneagles, Scotland, the G8 countries asked the IEA to assist in developing and implementing energy efficiency policies. Responding to this request, the IEA subsequently prepared a set of energy efficiency policy recommendations covering 25 fields of action across seven priority areas: cross-sectoral activity, buildings, appliances, lighting, transport, industry and power utilities. These 25 recommendations were presented to the Summit of the G8 in Hokkaido, Japan in July 2008. The fields of action are outlined below.

1. The IEA recommends action on *energy efficiency* across sectors. In particular, the IEA calls for action on:

- Measures for increasing investment in energy efficiency.
- National energy efficiency strategies and goals.
- Compliance, monitoring, enforcement and evaluation of energy efficiency measures.
- Energy efficiency indicators.
- Monitoring and reporting progress with the IEA energy efficiency recommendations themselves.

2. *Buildings* account for about 40% of energy used in most countries. To save a significant portion of this energy, the IEA recommends action on:

- Building codes for new buildings.
- Passive energy houses and zero-energy buildings.
- Policy packages to promote energy efficiency in existing buildings.
- Building certification schemes.
- Energy efficiency improvements in glazed areas.

3. *Appliances and equipment* represent one of the fastest growing energy loads in most countries. The IEA recommends action on:

- Mandatory energy performance requirements or labels.
- Low-power modes, including stand-by power, for electronic and networked equipment.
- Televisions and set-top boxes.
- Energy performance test standards and measurement protocols.

4. Saving energy by adopting efficient *lighting technology* is very cost-effective. The IEA recommends action on:

- Best-practice lighting and the phase-out of incandescent bulbs.
- Ensuring least-cost lighting in non-residential buildings and the phase-out of inefficient fuel-based lighting.

5. About 60% of world oil is consumed in the *transport sector*. To achieve significant savings in this sector, the IEA recommends action on:

- Fuel-efficient tyres.
- Mandatory fuel efficiency standards for light-duty vehicles.
- Fuel economy of heavy-duty vehicles.
- Eco-driving.

6. In order to improve energy efficiency in *industry*, action is needed on:

- Collection of high-quality energy efficiency data for industry.
- Energy performance of electric motors.
- Assistance in developing energy management capability.
- Policy packages to promote energy efficiency in small and medium-sized enterprises.

Box 2. IEA G8 Energy Efficiency Recommendations (continued)

7. *Energy utilities* can play an important role in promoting energy efficiency. Action is needed to promote utility end-use energy efficiency schemes.

Implementation of IEA energy efficiency recommendations can lead to huge cost-effective energy and CO₂ savings. The IEA estimates that, if implemented globally without delay, the proposed actions could save around 8.2 Gt CO₂/yr by 2030. This is equivalent to one-fifth of global energy-related CO₂ emissions in 2030 under the IEA Reference Scenario, in which no new policies are adopted or implemented. Taken together, these measures set out an ambitious road-map for improving energy efficiency on a global scale.

* The Group of Eight is an international forum for the governments of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.

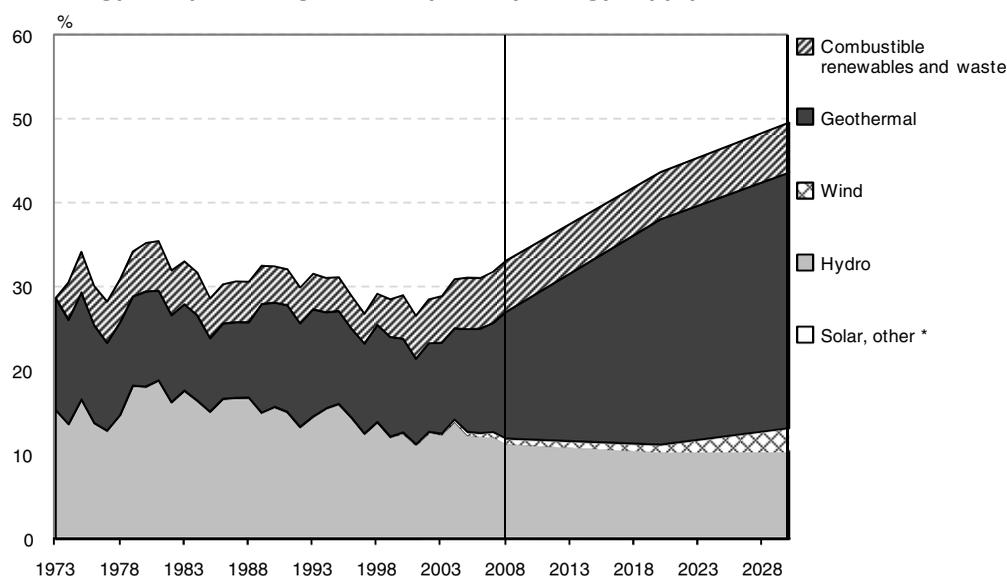
PART II
SECTOR ANALYSIS

5. RENEWABLE ENERGY

OVERVIEW

In 2008, renewable sources of energy provided 33% (5.6 M toe) of total primary energy supply (TPES) a share that has changed little over the past 10 years. The relatively high share of renewables is owed to plentiful hydropower and geothermal resources and shares of each in TPES are among the highest in the OECD.¹¹ Wind energy and geothermal energy capacity additions are forecast to provide most of the incremental growth in renewable energy in the medium term. MED projections based on known upcoming generation projects and assumed costs of electricity generation indicate that renewable electricity generation is likely to reach 83% of generation by 2025, assuming business as usual with a target in place for 90%.

Figure 10. Renewable energy as a percentage of total primary energy supply, 1973 to 2030



* *Other* includes ambient heat used in heat pumps (negligible).

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

INSTITUTIONS

In addition to the *Ministry of Economic Development* (MED), which provides advice on all energy policy, including renewables, the following institutions are active in the renewables sector:

11. Geothermal power plants operating at low temperatures have low efficiency, often less than 10%, therefore the share of geothermal energy in primary supply tends to be misleading.

The *Energy Efficiency and Conservation Authority* (EECA), a Crown entity established under the Energy Efficiency and Conservation Act 2000, is the primary government agency providing information, advice, public awareness, research into renewables and incentives such as grants schemes, to promote renewable energy. Its statutory function is to encourage, promote and support energy efficiency, energy conservation and the use of renewable sources of energy.

The *Ministry for the Environment* administers the Resource Management Act 1991 (RMA) and provides advice on the preparation and administration of national policy statements and regulations (national environmental standards) under that Act. At present, a proposed national policy statement for renewable electricity generation is being developed.

The *Ministry of Transport* is responsible for policy in relation to supporting electric vehicle uptake while the *Ministry of Research, Science and Technology* (MoRST) and the *Foundation for Research, Science and Technology* (FRST) support energy research policy and administration of research funding, including funding for renewables research. The *Ministry of Agriculture and Forestry* (MAF) is responsible for the development of policy in relation to the production of bioenergy.

Local government is responsible for the management of natural and physical resources under the RMA. The RMA requires local government to have particular regard to the benefits to be derived from the use and development of renewable energy resources when formulating local plans and when considering applications for renewable energy developments.

Local government can also produce non-statutory strategies, which include consideration of regional-level policies to support the development of renewable energy. Four local authorities have received financial support from EECA to develop these regional energy strategies.

Industry associations also work to promote renewable energy on behalf of the wind, geothermal and small renewable energy industries.

POLICIES AND SUPPORT MEASURES

Explicit support schemes for renewable energies are minimal in New Zealand, unlike many other OECD member countries, as renewable energies are already competitive with fossil-fuelled equivalents. Most renewable electricity projects rely on existing market mechanisms while some sectors, such as solar water heating, are in receipt of low levels of support.

Some projects, such as the Te Apiti wind farm and the Palmerston North landfill gas project, have benefited from selling the related carbon credits (to the Netherlands and Austria respectively but also to Toyota New Zealand and other local organisations).

POLICY

The Energy Efficiency and Conservation Act 2000 determined that there must be a national energy efficiency and conservation strategy in force at all times. Accordingly, the New Zealand Energy Strategy (NZES), which built on existing policies and incentives promoting renewable energy, was first published in 2007, along with a second five-year

New Zealand Energy Efficiency and Conservation Strategy (NZECS). The NZECS is the action plan for energy efficiency and conservation along with the use of renewable sources of energy. It sets out who is responsible for delivering each action and the work of the Energy Efficiency and Conservation Authority is guided by the NZECS.

Following a November 2008 election, the new government announced that both of these policy documents were to be reviewed for the purpose of aligning policy with present government energy policy priorities and to place a renewed emphasis on economic development. Accordingly, revised drafts were published for consultation in July 2010. The draft New Zealand Energy Strategy retains the previous government target of 90% of electricity generated from renewable sources by 2025 (in an average hydrological year) providing this does not affect security of supply. The Strategy notes that the achievement of this target must not be at the expense of the security and reliability of electricity supply and recognises that some fossil fuel thermal generation (mainly natural gas) will be required to support supply security for the medium term.

The draft Strategy also indicates that the government seeks the environmentally responsible development and efficient use of the country's diverse energy resources, so that the economy grows, powered by secure, competitively priced energy and increasing energy exports; and so that the environment is recognised for its importance to New Zealand's way of life. It confirms that the government expects to see considerably more investment in renewable electricity generation, particularly from geothermal and wind resources.

The draft Strategy also indicates that the government will take greater steps to encourage biomass-to-energy development, support the development of new applications using geothermal energy, continue to work with relevant parties to remove unnecessary barriers to the uptake of medium- and smaller-scale renewable technologies, and continue to maintain the Marine Energy Deployment Fund to 2011. This fund is supporting several research and demonstration projects on wave and tidal energy along New Zealand's 15 000 km coastline.

The draft NZECS sets out the government's policies, objectives and targets to 2015, and the means by which these will be achieved. The principal focus is energy efficiency but the document sets out the government's approach to increasing renewable electricity output to 90% by 2025, including:

- removing unnecessary barriers to investment in large-scale renewable electricity generation;
- building on recent changes to streamline and simplify consenting processes under the Resource Management Act;
- incorporating the cost of greenhouse gas emissions into electricity investment decisions through the Emissions Trading Scheme that has been in place for stationary energy since 1 July 2010;
- investigating and removing unnecessary barriers to deployment of smaller-scale distributed electricity generation and to the modernisation of electricity networks;
- fostering the deployment of new renewable sources such as marine and solar sources of energy;
- ensuring the electricity sector has an appropriate focus on electricity demand management tools; and
- monitoring industry roll-out of smart meter, smart network and smart appliance technologies, to promote consumer choice and a more efficient electricity system.

The draft Strategy notes that expected changes to the Electricity Act 1992 will aim to provide local network lines companies with the option of developing smaller-scale electricity generation, as long as the total capacity of the lines companies' generation portfolio is within specified limits.

With regard to climate change commitments, the draft Strategy confirms that the government has adopted an economy-wide target for a 50% reduction in New Zealand's carbon-equivalent net emissions, compared to 1990 levels, by 2050. It confirms that New Zealand is prepared to take on a responsibility for a reduction in greenhouse gas emissions of between 10% and 20% below 1990 levels by 2020 if there is a comprehensive global agreement and if certain conditions are met.

Resource Management Act

The Resource Management Act 1991 (RMA) is the legislative framework governing resource management planning and development in New Zealand. Since its introduction, the RMA has replaced or amended more than fifty other laws relating to planning and environmental management. The RMA sets out who has what responsibilities in local and central government, and the rules for carrying out the planning process. The RMA is a national act monitored by the Ministry for the Environment but decision making is largely devolved to regional and local councils. All energy infrastructure projects must obtain regulatory approval (known as "resource consents") as defined by the RMA. Obtaining consent under the RMA to develop a site for renewable generation is often a challenge faced by developers.

Generally, the RMA has functioned well but in recent years there have been criticisms of its ability to effectively manage complex environmental issues. Complaints about slow and costly plan preparation and consenting processes are common. Furthermore, many projects have faced significant delays owing to the inconsistent approach taken by different consenting authorities in managing the process and by the varying level of resources each authority can apply to the process.

In November 2008, the newly elected government promised to introduce legislation for the purpose of amending the RMA without delay. Accordingly, the first reform phase, the Resource Management (Simplifying and Streamlining) Amendment Act commenced on 1 October 2009. The key features of the amendments are:

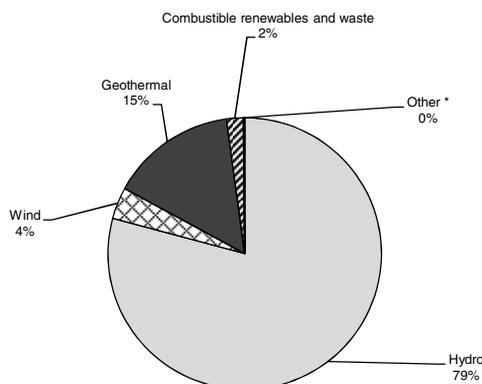
- removal of frivolous, vexatious and anti-competitive objections;
- streamlined processes for proposals of national significance;
- creation of an Environmental Protection Authority (EPA);
- improved plan development and plan change processes;
- improved resource consent processes;
- improved national instruments;
- streamlined decision making; and
- improved workability and compliance.

Notably, one of the roles of the EPA is to process called-in applications for projects of national significance. Consenting delays for generation are often caused by lengthy merits-based appeals. Decisions on these projects are taken by independent Boards of Inquiry, with appeals only permitted on points of law. Decisions must be taken within nine months. Many generation projects are now being referred to the EPA, resulting in considerable time savings.

RENEWABLE ELECTRICITY GENERATION

Approximately 64% of New Zealand's electricity production in 2008 was from renewable sources, rising to 73% in 2009, the third-highest share among OECD members. Renewable electricity generation capacity in 2008 was 6.29 GW out of a total of 9.05 GW or 69% of generating capacity. This represents an increase of 3% over the previous year, which can be attributed to growing amounts of geothermal capacity. Over the next decade the government expects substantial growth in geothermal and wind generation along with hydro.

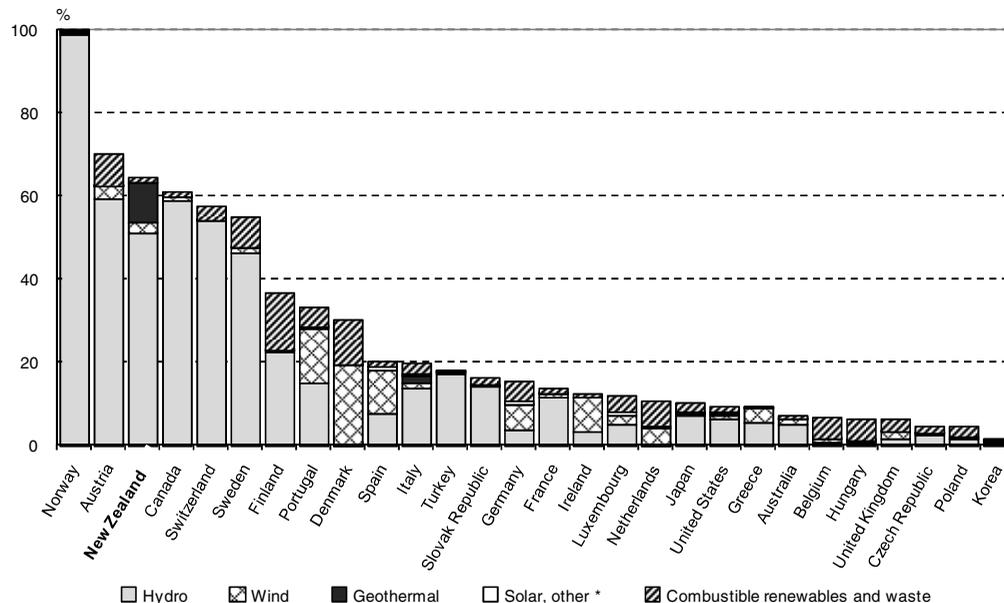
Figure 11. Renewable electricity generation by energy source, 2008



* Other includes tide and wave and ambient heat used in heat pumps.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

Figure 12. Electricity generation from renewable energy as a percentage of all generation in IEA member countries, 2008



* Other includes tide and wave and ambient heat used in heat pumps.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009.

HYDROPOWER

The use of hydropower to produce electricity has a long history in New Zealand and it remains the principal source of electricity generating capacity. By the mid-1990s, hydro capacity had reached 5 000 MW where it has remained since. Nonetheless, there are a number of medium-scale hydro projects under consideration at present.

One of three state-owned generators, Meridian Energy, has received water-only resource consent for its proposed hydro generation tunnel concept on the north bank of the Waitaki River in South Canterbury on the South Island. The North Bank Tunnel Concept proposes to take water from Lake Waitaki and discharge it back into the Waitaki River about 34 km downstream. The project will have a capacity of approximately 200 MW. Meridian has also received resource consent for its 85 MW Mokihinui hydro proposal for the construction of a hydro dam and power station north of Westport on the South Island to produce between 310 and 360 GWh per year of electricity.¹²

A privately owned generator, TrustPower, has also proposed a number of small-scale hydro developments. The most significant is the Arnold River project on South Island west coast. The 46 MW scheme was granted a resource consent by the Grey District and Westland Regional Councils in November 2008. Earlier in 2008, the company was also granted consents for a 72 MW project on the Wairau River in Marlborough.¹³

Another privately owned generator, Contact Energy, is considering reviewing old plans for a number of possible future large-scale hydro developments on the Clutha River in the Central Otago region where they have a number of existing generation facilities.

WIND

Wind energy is an underdeveloped but growing resource in New Zealand. With its narrow islands and geographic location, New Zealand has a good exposure to coastal winds and its ranges and areas of elevated terrain give localised wind speed accelerations. New Zealand has one of the most consistent wind energy resources in the world, and at some sites wind farms can operate at net capacity factors of 45% to 50%.¹⁴ hence no dependence is needed from government subsidies.

New Zealand has eleven operating wind farms and installed wind capacity is approximately 490 MW, with a further 82 MW under construction. When construction of wind farms at Te Rere Hau, Te Uku, and Mahinerangi is complete, total installed capacity will rise to 614 MW. Investment in wind capacity has been impacted by earlier uncertainty surrounding the New Zealand Emissions Trading Scheme and the low level of the NZD 12.50 per tonne price cap (for the first three years of the Scheme), as well as by implications of the ongoing reform of the Resource Management Act.

12. This project has been appealed and its future is uncertain. The project is also on conservation land, and separate approvals are required from the Minister of Conservation under the Conservation Act.

13. Subject to appeal; although a favourable decision has been given, the conditions are still being refined.

14. *Transmission to Enable Renewables - Economic Wind Resource Study*, Electricity Commission, 2008.

Table 2. Wind farms operating in New Zealand

Wind farm	Operator	Region	Capacity (MW)	Date commissioned
Brooklyn	Meridian	Wellington	0.225	1993
Gebbies Pass	Windflow	Canterbury	0.5	2003
Hau Nui	Genesis	Wairarapa	8.7	1996 to 2004
Southbridge	Energy3	Canterbury	0.1	2005
Tararua	TrustPower	Manawatu	161	1999 to 2007
Te Apiti	Meridian	Manawatu	90.8	2004
Te Rere Hau	NZ Windfarms	Manawatu	32.5	2006 to 2009
White Hill	Meridian	Southland	58	2007
West Wind	Meridian	Wellington	142.6	2009
Horseshoe Bend	Pioneer Generation	Central Otago	2.25	2009
Weld Cone	Energy3	Marlborough	0.75	2010

Source: New Zealand Wind Energy Association, September 2008.

The backbone of the New Zealand wind power industry is formed by a relatively small number of large-scale wind farms. The Meridian Energy's Te Apiti project was the first wind farm to supply electricity into the national grid. Its 55 turbines of 1.65 MW each have a total capacity of 90 MW.

TrustPower's Tararua wind farm, near Palmerston North, is recognised internationally as one of the world's top performing wind farms, producing 46% of its rated capacity on an annual basis since the first 32 MW-phase was completed in 1999. Following the completion of Stage 3 of the project in 2007, total capacity at the site is 161 MW, giving an average annual output of 620 GWh.

Project West Wind is a Meridian Energy project currently located close to Terawhiti station and Makara farm to the west of Wellington in the south of the North Island. The facility, which was commissioned in 2009, consists of 62 turbines with a total capacity of 143 MW.

NZ Windfarms operates a 48.5 MW wind farm situated on the Tararua Ranges near Palmerston North. The project is notable for its use of the two-bladed New Zealand designed and manufactured Windflow 500 turbines. The project received resource consent in May 2005 for up to 97 turbines which are being installed in stages on the site.

BIOENERGY

The potential for energy from biogas using existing sources of organic waste is estimated to be of the order of 1.4 PJ or 0.033 Mtoe (0.3%) of New Zealand's energy demand. Approximately 80 to 200 cubic metres of landfill gas is produced per tonne of municipal solid waste. In addition, New Zealand has a relatively large primary agricultural industry with many opportunities for producing biogas from animal manure.¹⁵

15. *Biogas and Landfill Gas Fact Sheet*, Energy Efficiency and Conservation Authority, 2005.

In 2009, Scion (a Crown Research Institute) published a detailed report outlining New Zealand's bioenergy potential.¹⁶ The purpose of the study was to consider whether the large-scale bioenergy forest concept was worth pursuing, considering the productivity, cost, economic, environmental and land-use impacts. The study found that there are significant areas of low-productivity hill country in New Zealand that are suitable for forestry activities, and which could be highly productive. The report identified potential production from a series of scenarios and determined the potential amount of energy delivered was in the range of 2 094 PJ (or 50 Mtoe) to 19 200 PJ (or 459 Mtoe) of stored energy.

In August 2010, a *New Zealand Bioenergy Strategy* was published by the Bioenergy Association of New Zealand (BANZ) and the Forest Owners Association (NZFOA). The Strategy notes that approximately 8.5% of energy use is derived from biomass sources, most of it used in the production of heat for industry or homes. The Strategy identifies bioenergy potentially supplying more than 25% of New Zealand's projected energy needs by 2040, including 30% of the country's transport fuels and up to a 60% increase in biomass used to produce heat (excluding that provided by black liquor). The *New Zealand Bioenergy Strategy* is designed to achieve: "Economic growth and employment built on New Zealand's capability and expertise in growing and processing wood-crops and converting organic by-products to energy, leading to new business opportunities which by 2040 supply more than 25% of the country's energy needs, including 30% of the country's transport fuels."

A companion document, *A Picture of Bioenergy Opportunities for New Zealand*, was published concurrently. The purpose of this paper was to provide extensive background information on biomass, bioenergy, and associated conversion processes and products as the basis for the Strategy.

OCEAN ENERGY

New Zealand enjoys a large coastal resource with world-class wave and tidal stream potential. In August 2006, the government published its *Energy Outlook to 2030*, which suggested that, in some scenarios, marine energies have the potential to contribute up to 1% of primary energy supply by 2030 (1 850 GWh). The Aotearoa Wave and Tidal Energy Association estimates that marine energy has the potential to contribute 2000 MW of electricity generating capacity.

The most significant government marine energy initiative is the Marine Energy Deployment Fund, which EECA administers on behalf of the government. The fund, established in 2007, provides grants to deploy energy devices in the New Zealand marine environment and has a budget of NZD 8 million.¹⁷ Grants for the fund are being allocated in four rounds, from 2008 to 2012, and will provide up to 40% of the costs of new projects. The first marine energy deployment fund grant of NZD 1.85 million was awarded to Crest Energy in 2008 for a tidal stream generator project at the entrance to Kaipara harbour, north of Auckland. In the second round, funding of NZD 760 000 was awarded to Wave Energy Technology-New Zealand (WET-NZ) in 2009 for a 100 kW ocean-scale point absorber wave device deployed in Wellington harbour.

16. *Bioenergy Options for New Zealand, Analysis of Large-Scale Bioenergy from Forestry, Productivity, Land Use and Environmental & Economic Implications*, Scion, 2009.

17. Since the programme was announced? NZD 1.85 million has been reallocated to other programmes.

In the third phase, a proposal put forward by Chatham Islands Marine Energy Ltd (CHIME) to install a shore-based device to capture wave energy was awarded NZD 2.16 million in 2010. The project will see the construction of an oscillating water column to power two 110-kilowatt Wells turbines. The device will be installed on the south-west coast of Chatham Island, and will supply electricity into the island's electricity network, which is currently dependent on expensive diesel-fuelled generation.

GEOHERMAL ENERGY

In the 1950s, New Zealand was the first country in the world to develop large-scale geothermal electricity generation. Geothermal energy is currently the second-largest source of renewable electricity generation since the country has an abundant supply of geothermal resources in both the North and South Islands. The major development to date has been in the Taupo volcanic zone and at Ngawha, both on the North Island. Moderate to low and very low temperature systems are more widely dispersed: in Northland, Hauraki Plains, and on the coastal Bay of Plenty. Of New Zealand's 129 identified geothermal areas, fourteen are in the 70 to 140 degrees Celsius range, seven in the 140 to 220 degrees Celsius range and fifteen in the over 220 degrees Celsius range.

While high-temperature geothermal resources have been utilised for electricity generation for almost fifty years, low-temperature geothermal energy (commonly defined as less than 150 degrees Celsius) has been used directly in New Zealand for centuries for cooking, washing, bathing, and heating. Low-temperature geothermal resources can also be used indirectly for heating using ground-source heat pumps in many parts of New Zealand but very few examples exist because of the relatively high capital investment compared with the common air-to-air heat pumps used for space heating. New technologies are also being developed to utilise low-temperature geothermal resources for electricity generation.

Significant potential for expansion of geothermal energy remains. It has been estimated that there is approximately another 1000 MW of geothermal potential that could be used for generating electricity. There is also significant potential for the direct use of geothermal heat, for example in industrial use, or in “cascading” uses.

Geothermal heat direct use

Direct use applications of geothermal energy are found across both the North and South Islands. Close to the higher-temperature resource found in the Taupo volcanic zone, uses include greenhouse and glasshouse heating, shellfish farming and kiln drying. Geothermal direct use is dominated by the major industrial supply for the forest pulping plant at Kawerau, in the eastern Bay of Plenty on the North Island, which represents the largest single geothermal industrial use in the world.¹⁸

Geothermal electricity generating capacity

Total geothermal electricity capacity stands at approximately 782 MW, one of the highest among OECD members. This number is expected to increase as plans for generating capacity expand in existing known fields and at standard depths up to hundreds of

18. Institute of Geological and Nuclear Sciences (GSN Science).

metres. Direct use of geothermal electricity has been of a similar magnitude in terms of energy produced, and will continue to grow, albeit at a lower rate than electricity.

New Zealand's first geothermal power station, at Wairakei on the North Island, was commissioned in 1958. The present capacity of the Contact Energy-owned facility is 176 MW and it is New Zealand's largest geothermal power station. The company also operates the nearby Ohaaki geothermal power station, which was commissioned in 1989. Owing to geothermal limitations based on early designs that did not reinject the spent hot water, the field's capacity has been progressively scaled down to 50 MW from a peak of 104 MW. Since 2000, Contact Energy has also operated the Poihipi Road geothermal power station, which was commissioned in 1997. It is supplied with steam from the Wairakei geothermal system and has a capacity of approximately 38 MW. Commissioned in 2010, the Te Huka plant delivers around 23 MW of capacity to the grid. The electricity is generated by means of a binary (organic rankine cycle) process and reinjection occurs. It is the first power station to be built on the Tauhara geothermal steam field.

Contact Energy has plans to invest in two new geothermal power stations in the Taupo region where the Wairakei plant is located. The plans involve replacing the 50 year old Wairakei power station with a new 220 MW power station located at Te Mihi, which will be powered with steam from the Wairakei steam field. This will gradually replace the Wairakei power station which will be phased out of production. The same company has also filed a resource consent application for a 250 MW geothermal power station on the Tauhara geothermal steam field, north east of Taupo, and near the recently commissioned 23 MW Te Huka geothermal power station.

Other significant geothermal generators include the Tuaropaki Power Company, Mighty River Power and Top Energy. The Tuaropaki Power Company commissioned the 55 MW Mokai geothermal plant in 2000. Following a number of capacity increases it now has a total capacity of 110 MW. Rotokawa, owned by Mighty River Power in a joint venture with the Tauhara No. 2 Trust, has expanded its capacity to 33 MW. The Ngawha plant owned by distribution company Top Energy has a capacity of 25 MW. These plants are all in the north of the North Island.

The 140 MW Nga Awa Puroa project, the second development by Mighty River Power in partnership with the Tauhara North No 2 Trust, was commissioned in 2010 and is believed to be the world's largest geothermal steam turbine.

In addition to the above, there are 23 other projects at various stages of development or deployment in New Zealand but in the absence of a feed-in tariff or other form of financial support, it is unlikely that many of these projects will be commercially viable at current power prices, even with a carbon price on thermal systems.

OTHER HEAT SOURCES

Previously, a short-term funding initiative, the Innovation Fund, was introduced to support a wide range of solar and heat pump water heating initiatives, to provide useful information and resources to businesses, government and the industry.

In mid-2010 the government announced a new efficient water-heating programme, which will commence in September 2010. The previous programme continued until 31 August 2010. Under the scheme, EECA provides a grant to home-owners for buying systems that meet the necessary eligibility criteria. The level of grant will depend on the

energy savings performance of the installed system. The grant will be NZD 1 000 for those systems which meet ENERGY STAR® criteria for large and medium-sized households, and NZD 500 for all other systems.

EECA also supports the development of the wood energy sector by providing advice and support on both the supply and demand sides. Previously, EECA provided funding for a number of wood energy demonstration projects. The emphasis is now on sharing the findings of these projects and the agency no longer provides grants for wood energy investments. EECA is also preparing guidance for local authorities on particular regulations to support the use of wood as an energy source.

BIOFUELS IN TRANSPORT

There are significant uncertainties over the long-term fiscal and legislative regime surrounding biofuels in New Zealand. The previous government announced a biofuels sales obligation in 2005, which was implemented in October 2008, with a motor fuels blending target of 3.4% by 2012. The newly-elected government repealed this obligation to encourage biodiesel production. Under the scheme, which started on 1 July 2009, a grant of up to NZD 0.425 per litre for biodiesel or biodiesel content of a biodiesel blend is available to biodiesel producers. The grant will be payable monthly in arrears to producers whose product sales amount to, or are in excess of, 10 000 litres, B100 content (100% biodiesel) per month. The Engine Fuel Specification Regulations limit the retail sale of biodiesel to a blend of 5% biodiesel in mineral diesel, which can be used in all diesel engines. Five biodiesel producers signed or were offered contracts to participate in the Biodiesel Grants Scheme, only one of which produces bioethanol. Five biodiesel producers signed contracts to participate in the Biodiesel Grants Scheme.

In March 2007, the Ministry of Transport published an analysis of electric vehicle potential in New Zealand.¹⁹ The study noted the potential of plug-in electric hybrids, which, if affordable, could find widespread application in New Zealand. The study also noted the attractiveness of plug-in hybrids as a means of reducing total emissions from the transport sector if there is a large uptake of these vehicles and technology without restricting mobility. The principal conclusion of the report was that a work programme be established to formulate an electric vehicle policy that will remove barriers and encourage uptake. Subsequently, in April 2009, the Ministry of Transport announced that the government will exempt light electric vehicles from paying road user charges for four years, valued at about NZD 400 per vehicle annually until 2013, as an initial step towards encouraging their uptake.

The City of Wellington has also undertaken initiatives to promote electric vehicles and is developing a pilot project to that effect with a focus on featuring electric vehicles in selected company fleets and making them visible in prominent tourist localities, such as Wellington Airport and cruise ship terminals. The city is also investigating electric vehicle technology for the local bus network.

19. *Electric Vehicles in New Zealand: Identifying Potential Barriers and Future Considerations*, Ministry of Transport, 2007.

CRITIQUE

Renewable electricity production in New Zealand has experienced significant development and growth in recent years despite the absence of explicit support schemes for its production. Geothermal electricity production has increased considerably and contributed 9% of electricity production in 2008 while wind power contributed 2.5% in the same year.

Significant potential for further development of renewable energies has been identified. Potential for development of low-temperature geothermal electricity capacity is estimated to be 1 000 MW. New Zealand has unique conditions for maritime energy, including wave and tidal energy. Biomass is widely used already and, along with biofuels, has large potential to make greater contributions. Solar heating can also increase considerably.

An efficient environmental and planning process is an important step for the development of economically viable projects. Resource allocation and management of the effects of development are regulated by means of the Resource Management Act. The Act encompasses all natural resources and provides a national framework for decision making by local councils. Amendments have recently been made in order to improve the quality of decision making and to reduce associated costs, mainly by shortening the consenting processes timeframe. A National Policy Statement (NPS) on Electricity Transmission came into force at the beginning of 2009 and another NPS for Renewable Electricity Generation is currently being developed. NPSs are intended to provide local councils with guidance when drafting local plans and when deciding on consenting applications.

Each of these NPSs may have an impact on the development of renewable electricity and are highly commendable since they may remove administrative barriers to the development of renewable energy. It will be important, however, to closely follow their implementation and to assess whether further amendments are needed. In this regard, we understand that the Ministry for the Environment will be undertaking reviews of the national policy statements every five years and it is envisaged that the effectiveness of the NPSs will be ascertained when these reviews occur.

The government goal is to increase this proportion to 90% of electricity generation by 2025 (in an average hydrological year) providing this does not affect security of supply. According to the Ministry of Economic Development's Energy Outlook 2009 reference scenario, renewable electricity penetration is forecast to reach 83% by 2025, which means that the 90% target is out of reach under present policy conditions. Therefore, the 2010 draft New Zealand Energy Efficiency and Conservation Strategy, with clear renewable energy targets, should be implemented as soon as possible and should include a detailed renewable electricity roadmap, one that bridges the gap between 83% and 90%.

Renewable direct heat use has increased slightly during the last years from 12.72 TWh per year in 2007 to 12.88 TWh in 2008 owing to increased use of wood heat. There have been several programmes administrated by EECA promoting switching from coal to wood, natural gas and heat pumps, the increase of wood production and demand, and solar water heating. Despite this, New Zealand does not collect comprehensive energy use statistics relating to direct heat generation and use. A tool has been developed for the assessment of the different programmes. The use of that assessment tool is necessary in order to increase cost-effectiveness.

In 2008, a Biofuels Sales Obligation system was put in place but was recently abolished. Instead, a three-year Biodiesel Grant Scheme was implemented in July 2009 to encourage domestic biofuels production. The scheme provides NZD 36 million in support over three years; NZD 9 million in the first year, NZD 12 million in the second year and NZD 15 million in the third. Commercialisation of demonstration projects takes time, five to 10 years, which means that a long-term policy is necessary in order to make projects viable.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Closely follow the implementation of the NPS on Electricity Transmission and the NPS on Renewable Electricity Generation and assess whether further amendments to the Resource Management Act are needed in order to remove non-economical barriers to the development of renewable energy.*
- Put in place the revised New Zealand Energy Strategy and revised New Zealand Energy Efficiency and Conservation Strategy, and include detailed policies and roadmaps to assist New Zealand in meeting the 90% government target.*
- Continue its efforts to improve the availability of comprehensive statistics on direct heat use and generation and also to assess possible support programmes and implement them if appropriate.*
- Provide a stable regulatory framework for the development of biofuels that are deemed to be produced in a sustainable manner and shorten the timeframes for commercialisation of demonstration projects.*
- Create a stable and predictable legislative framework for the implementation of biofuel blending regulations and ensure that the oil industry is given sufficient time to adapt to potential targets, thereby allowing for long-term planning.*

6. COAL

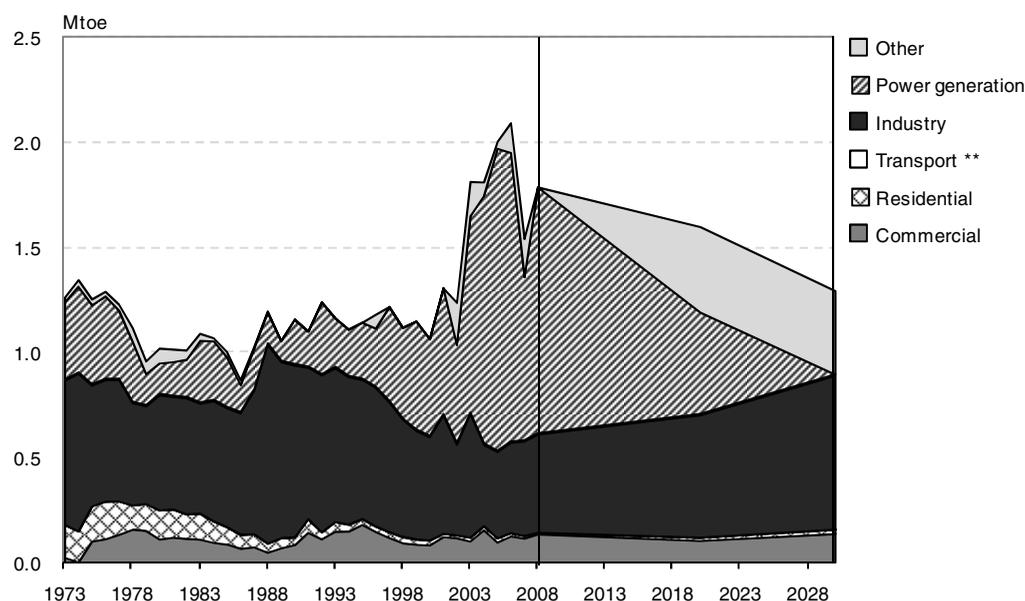
OVERVIEW

In 2009, coal accounted for approximately 8% of New Zealand's total primary energy supply. The largest domestic consumers were a coal-fired power station and a steel mill. The cement and dairy industries also consume relatively large amounts of coal.

New Zealand produced approximately 4.6 million tonnes (Mt) of coal in 2009. Of this, approximately 2.1 Mt of bituminous coal and 2.2 Mt of sub-bituminous coal were produced with the remaining 0.3 Mt being lignite.

In 2009 there were four underground and 18 opencast coal mines in operation. Most production is in the Waikato region (mainly for industrial users and the Huntly power station), the west coast (mainly for export) and Otago/Southland (mainly for local industrial markets).

Figure 13. Coal supply by sector*, 1973 to 2030



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes residential, commercial, public services, agriculture/forestry, fishing and other final consumption.

** Negligible.

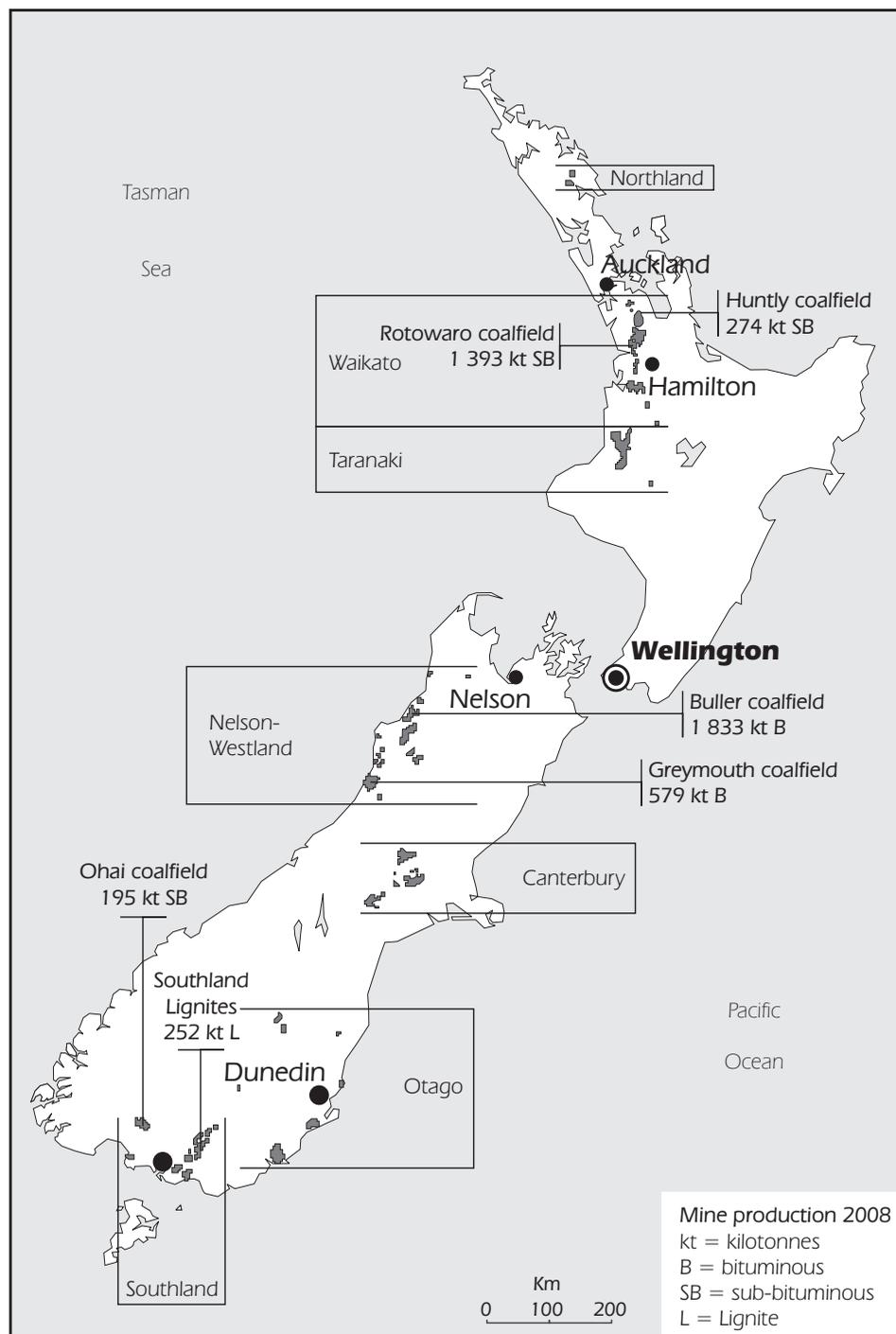
Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

RESERVES

New Zealand has extensive coal resources, largely located in the Waikato and Taranaki regions of the North Island, and the west coast, Otago and Southland regions of the South Island. National in-ground resources of all coals are over 15 billion tonnes, of which 80% are South Island lignites.

Map 2. Location of coalfields and resources



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.
 Source: IEA.

North Island coals are all sub-bituminous. All of New Zealand's bituminous resources are on the west coast of the South Island, which also has some sub-bituminous deposits. Otago and Southland also have sub-bituminous deposits, but principally host New Zealand's extensive lignite resource.

New Zealand's coal resources are generally well explored. A major government-funded coal exploration programme explored almost all of New Zealand's realistic coal prospects between 1975 and 1989. More than 1 800 holes were drilled and extensive resource evaluation, geotechnical, geophysical, utilisation, environmental and mining feasibility studies were carried out. The discovery of very large resources of lignite in Otago and Southland also led to a series of investigations in the 1980s by the Liquid Fuels Trust Board to evaluate the potential of the lignites for conversion to transport fuels.

Lignite is New Zealand's largest known fossil fuel energy resource. The main deposits are well known, with technically and economically recoverable quantities in the ten largest deposits established at over 6 billion tonnes.

Sub-bituminous and bituminous in-ground resources are approximately 3.5 billion tonnes, but recoverable quantities of these coals are uncertain. The most recent published inventory of coal resources (1994) needs extensive revision because of recent production, new exploration, and assumptions made in 1994 on technical, economic and environmentally acceptable recoverability that may no longer be applicable. Many recent reserve estimates are commercially sensitive.²⁰

LEGISLATION AND REGULATION

The Crown Minerals Act 1991 sets the broad legislative framework for prospecting, exploring and mining of Crown-owned resources, including Crown-owned coal.²¹ All functions related to the management of the Crown estate are managed by Crown Minerals, part of the Business Services Branch of the Ministry of Economic Development.

Coal mines operating under licences granted before 1991 are managed via the legislation of the day, the Coal Mines Act 1979.

MINING REGULATIONS

The "Minerals Programme for Minerals (Excluding Petroleum) 2008", which sits below the Crown Minerals Act 1991, establishes the policies, procedures and provisions to be applied in respect of the management of minerals and coal. Its intentions are to:

- promote good exploration and mining practice;

20. The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code) was established as a joint initiative of the Australasian Institute of Mining and Metallurgy, the Minerals Council of Australia and the Australian Institute of Geoscientists through the Joint Ore Reserves Committee. It establishes standards for public reporting, emphasising principles of transparency and materiality. All companies listed on the Australian or New Zealand Stock Exchanges are required to comply with the JORC Code. The code has also formed the basis for comparable reporting standards introduced internationally in recent years.

21. The Crown has nationalised the following minerals – petroleum, gold, silver and uranium – and as such ensures these are governed under the CMA. Coal that is owned by the Crown (either through existing land title or through historical purchase) is also managed through this manner. Coal that is not under Crown control is only subject to certain legislative and regulatory constraints (such as resource management approval, but not permitting or royalty requirements as specified under the CMA).

- provide for the efficient allocation of permits;
- provide for the Crown to obtain a fair financial return from its minerals;
- have regard to the principles of the Treaty of Waitangi (Te Tiriti o Waitangi); and
- have regard to any relevant international obligations.

How these intentions are expected to be achieved is prescribed in the Crown Minerals (Minerals and Coal) Regulations 2008, which sets out the application and reporting requirements for coal exploration and mining.

REGULATED FINANCIAL COSTS

Where Crown-owned coal is being mined on Crown-owned land, the specific royalty rates for coal in New Zealand depend on the regime under which the right to extract coal was granted – the Coal Mines Act 1979 (repealed) or the Crown Minerals Act 1991 (via the Minerals Programme for Minerals (Excluding Petroleum) 2008).²² For example, the royalty rates for Crown-owned coal as defined in the Minerals Programme for Minerals (Excluding Petroleum) 2008 are presented in Table 3.

Table 3. Coal royalty rates

Mineral	Rate per tonne sold
Coal (hard and semi coking coal)	NZD 1.40
Coal (thermal and semi soft coking)	NZD 0.80
Coal (lignite)	NZD 0.30
Peat	NZD 0.30 per cubic metre sold

Source: Ministry of Economic Development.

Where a coal mining licence was granted before 1991 (*i.e.* under the Coal Mines Act 1979) the specific royalty rate will be prescribed in the licence conditions, and is generally NZD 0.50 for opencast coal and NZD 0.25 for underground coal.

The Energy Resource Levy Act 1976 prescribes that all coal won by opencast methods, whether under Crown ownership or otherwise, is subject to an Energy Resource Levy of NZD 2.00 per tonne, except for South Island lignite which is levied at NZD 1.50 per tonne. Coal mining companies are also required to pay standard company tax, defined as 30% of gross profit (reducing to 28% from 1 April 2011).

ENVIRONMENTAL MANAGEMENT AND LAND ACCESS

Environmental and social matters are managed via the Resource Management Act 1991. Specifically, local government authorities manage resource consents required under this Act. This process is separate from obtaining a permit for mineral rights under the Crown Minerals Act 1991. The purpose of the Resource Management Act 1991 is to promote sustainable management of natural and physical resources, including use and development.

22. Note that previous versions of these pieces of legislation may prescribe different royalty rates.

Neither a permit under the Crown Minerals Act 1991, nor a consent under the Resource Management Act 1991, gives an unobstructed right of access to land. Land access is ultimately determined by direct negotiation with landowners and occupiers.

EMISSIONS TRADING

With the passing of the Climate Change Response Act 2002 and the subsequent Climate Change (Emissions Trading) Amendment Act 2008, coal mining companies will be obliged to pay for the carbon emissions associated with the combustion of coal.²³

INDUSTRY STRUCTURE

Solid Energy New Zealand Limited (Solid Energy), a state-owned enterprise, is New Zealand's largest producer of coal. In 2009, Solid Energy was responsible for mining 80% of total national production. Of New Zealand's total coal production, over 55% is produced at two large opencast mines operated by Solid Energy: Stockton on the west coast of the South Island and Rotowaro in the Waikato region in the North Island. The remainder is produced at other Solid Energy-operated mines and by a number of smaller private-sector coal operators via both underground and opencast mining methods.²⁴

There are two major coal consumers in New Zealand, namely Genesis Power that operates the Huntly power station and New Zealand Steel that operates the Glenbrook steel mill.

Sub-bituminous coal produced in the Waikato region feeds the Huntly power station and the Glenbrook steel mill, whereas bituminous coal produced on the west coast of the South Island is valued overseas and is generally exported to foreign markets. Lignite produced in the South Island is in relatively small quantities and largely used for space heating and industrial processes.

The original Huntly power station was built between 1973 and 1985 and was designed to operate on either natural gas or on Waikato coal, and purchases coal from Solid Energy and other producers. The 1 000 MW steam power plant is made up of four identical 250 MW units, which have an assumed power plant efficiency rating of 37%.

In recent years of high electricity demand, Genesis Power imported sub-bituminous coals from a range of Indonesian mines to supplement supply to the Huntly power station. To this effect, Genesis invested in coal handling facilities at the Port of Tauranga in 2003 together with transport facilities to Huntly.

At Glenbrook steel mill, NZ Steel uses a direct reduction kiln for its steel-making process unlike the vast majority of steel-making processes around the world that utilise coking coals in their blast furnaces. Other medium-sized consumers include: Holcim cement plant at Westport which uses bituminous coal from a variety of sources; Golden Bay cement plant in Whangarei, which imports bituminous coal. Dairy processors in Clondeboy in South Canterbury and Edendale in Southland also consume large amounts of coal. Smaller consumers include residential users, the transport sector, commercial users and smaller industrial sites.

23. The exact entry date of participants in the Stationary Energy and Industrial Processes sector has been altered several times. As it currently stands, the SEIP sector will enter the scheme (*i.e.* will have to pay for emissions) on 1 July 2010. For a full list of entry dates, see www.national.org.nz/Article.aspx?ArticleId=30852.

24. Other smaller mine operators include: Pike River Coal Company Ltd, Glencoal Energy Ltd, O'Reillys Opencast Ltd, Cascade Coal Ltd, New Creek Mining, Rockie Mining, Francis Mining, RJ Banks, Birchfield Coal, LLW Heaphy, Canterbury Coal, Kai Point Coal, Harliwich Carrying Company and Rochfort Coal.

TRADE

Most of New Zealand's premium bituminous coal production is exported. These coals are valued internationally for their low ash and sulphur content. Exports of bituminous coal produced in the west coast were 2.0 Mt in 2009.

Solid Energy produces about 90% of this exported coal with the remainder produced by Francis Mining from the Roa mine (exported partly in conjunction with Solid Energy). Solid Energy's Annual Report to June 2009 shows 87% of its exports were for coking coal, 13% for thermal coal and semi-soft coal and less than 1% for specialist uses (such as activated carbon and silicon metal processes). The company stated that its main customers were in India, Japan, China, South Africa and Chile.

New Zealand exports of coal are set to increase as the Pike River coal mine became operational in late 2009. The Pike River coal mine expects to produce 1 Mt of bituminous coal per year, all of which will be exported. In 2009, Pike River coal mine produced approximately 20 kilotonnes of bituminous coal.

In 2009, 0.7 Mt of sub-bituminous coal was imported, primarily for consumption at the Huntly power station.

PRICES AND SUBSIDIES

Coal prices are determined by the market. Domestic prices are influenced by international prices to some extent but the effects differ by region. Within New Zealand there are three main regional markets:

- lower South Island (below Timaru) served mainly from Southland with lignite and/or sub-bituminous;
- upper South Island served mainly from the west coast with bituminous/sub-bituminous blends; and
- North Island sub-bituminous.

The lower South Island is dominated by lignite coals that are not traded internationally. Prices are determined locally and are largely driven by extraction costs.

West coast coals are exported and receive international benchmark prices, generally free on board (FOB) in Lyttelton; coking, thermal and semi-soft coals are exported. The export value of thermal coals sets a lower limit on the local price for thermal coals. Import costs for coal are not a significant determinant of prices in the South Island as, with the exception of two large dairy plants and Holcim cement, no individual user is large enough to import coal given the size of ships used for international coal trade (typically 40 000-tonne vessels).²⁵

In the North Island, there are several large users of coal including NZ Steel, Genesis Power's Huntly coal-fired electricity plant, Golden Bay cement plant (located at Portland, near Whangarei) and McDonald lime. Both Genesis Power and Golden Bay Cement import coal, from Indonesia and Australia respectively. Genesis Power also purchases coal from Waikato. Prices differ markedly between these firms, depending on the scale of order and the rank of coal ordered.

25. There is the possibility for a wholesaler to import coal to supply local markets, but this has not occurred yet.

There are no specific production policies or subsidies that promote the extraction of coal. Production is determined by market forces. There is however a robust set of regulatory requirements that coal mining companies have to abide by when mining for coal.

TRANSPORT AND FREIGHT COSTS

Exports of coal from New Zealand face an internal cost for transport to the deepwater port at Lyttelton. The cost of transport is approximately NZD 35 to 40 per tonne from the west coast.

Freight costs to New Zealand for coal imports have varied considerably in recent years owing to the price of oil and availability of vessels. When oil prices and Chinese demand were high, prices approximated USD 25 per tonne for shipments. Currently (and historically) prices are closer to USD 17.50 per tonne.

CARBON CAPTURE AND STORAGE

The New Zealand Government is supportive of the international development of CCS as it recognises that CCS could potentially be an important climate change mitigation mechanism. Domestically, New Zealand does not have particularly capturable point sources of emissions and therefore CCS in New Zealand is more likely to be pertinent to any future development of fossil fuel resources, particularly any development of New Zealand's significant lignite resources.

In order to be able to identify international best practice, New Zealand is engaging in a number of international CCS forums, including the Carbon Sequestration Leadership Forum, the Global Carbon Capture and Storage Institute and the International Energy Agency Greenhouse Gas programme. Involvement in such international forums will assist the Government in achieving its medium-term goal of establishing an enabling legislative framework for CCS. No firm timeline has been set for the development of this framework.

CRITIQUE

New Zealand has extensive coal resources of over 15 billion tonnes. Some 80% of this resource is lignite on the South Island, but lignite has historically counted for around 5% of total coal production as it has been difficult so far to find appropriate uses for this resource. According to a study completed in 1994, sub-bituminous reserves on the North Island and bituminous resources on the South Island are about 3.5 billion tonnes in total. Recoverable quantities are uncertain, as mining technology and environmental circumstances have changed since then.

New Zealand produced approximately 4.6 Mt of coal in 2009: approximately 2.2 Mt of bituminous coal, mainly for export, 2.2 Mt of sub-bituminous coal mainly for power generation and industrial use, and 0.3 Mt of lignite.

In 2009, there were four underground and 18 opencast coal mines in operation. Solid Energy New Zealand Limited, a state-owned enterprise, is New Zealand's largest producer of coal, responsible for over 80% of national coal production. Over 55% of New Zealand's total coal production is produced at two large opencast mines.

There are two major coal consumers in New Zealand: the 1 000 MW Huntly Power station, which imports about half of its coal needs of some 2 Mt a year, and the Glenbrook steel mill. As Huntly power station also can run on natural gas, the use of coal

in recent years is a good indication of the competitiveness of coal. Coal is also intensively used in the agricultural sector. The new Emissions Trading Scheme will increase the cost of coal, which may impact on its competitiveness when compared to other energy feed stocks. Significant uncertainty surrounds the extent to which this scheme will impact the level of production and consumption of coal. Such uncertainty includes factors such as the carbon price after 2012, the extent to which producers can pass on the costs to consumers and the longevity of such a scheme given the diverse range of political views in New Zealand.

Given its significance, South Island lignite is continually being evaluated for its potential as a feedstock for large-scale petrochemical processing into a range of possible energy products, including diesel, jet fuel, methanol and fertilisers. Lignite-to-liquids conversion offers a long-term option to use the vast amounts of this resource, and to achieve a secure supply of transport fuels upon which New Zealand is heavily reliant. Sub-bituminous coal resources are increasingly difficult to mine, and as such New Zealand companies have recently begun investigating alternative energy sources, including imported sub-bituminous coal and the potential to produce economic flows of coal-seam gas (coal-bed methane) and to produce gas by underground coal gasification.

Coal companies in New Zealand are active in carbon dioxide sequestration research and demonstration projects abroad. Whether CCS can be implemented in New Zealand remains uncertain. The government is working on an enabling framework for CSS but no firm timeline is set for the development of this framework.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Promote the development of New Zealand's internationally significant lignite resources for coal-to-liquids and other use and the implementation of coal-bed methane technology through research and development and the streamlining of permitting procedures.*
- Create a long-lasting climate change policy and clarify the impact of the Emissions Trading Scheme vis-à-vis the use of coal, in order to facilitate investment decision making by the coal industry.*
- Clarify the prospects of large-scale use of carbon capture and storage in New Zealand, in order to enable the use of coal as an energy source in the future, within the limits of an Emissions Trading Scheme.*

7. NATURAL GAS

OVERVIEW

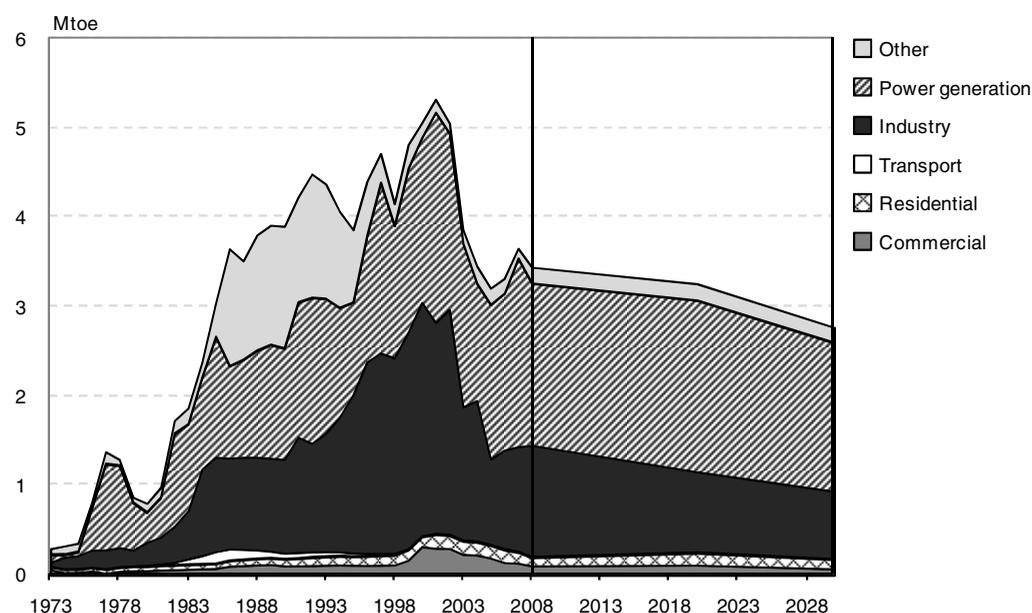
To date, New Zealand has been fully self-sufficient in natural gas supply, but domestic fields are in decline. Owing to New Zealand's inability to import gas, gas consumption has declined somewhat in recent years, in line with declining production.

SUPPLY AND DEMAND

SUPPLY

Natural gas production in 2009 was 7.1% higher than in 2006, but 34.2% lower than the historical peak recorded in 2001. Domestic production satisfies all demand for natural gas in New Zealand. In 2009, natural gas production represented 3.8 Mtoe (21% of TPES), the second-highest share after oil (36% of TPES).

Figure 14. Natural gas supply by sector*, 1973 to 2030



* TPES by consuming sector. Other includes other transformation and energy sector consumption. Industry includes non-energy use. Commercial includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

** Negligible.

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

A liquefied natural gas (LNG) import terminal was considered at Port Taranaki, which planned to import around 40% of New Zealand's total annual gas requirements (approximately 1.4 billion cubic metres). This project was abandoned in July 2009. In recent years, several new gas sources have been brought to market – primarily Pohokura, Turangi, further Maui gas and Kupe – which have pushed out to 2019 the projected date where demand is expected to exceed supply, and it is expected that further discoveries and upside potential from existing producing fields will continue to extend New Zealand's gas supply outlook.

DEMAND

The energy transformation sector which comprises electricity generation and combined heat and power (CHP) plants consumes about half of domestic production (or 48%). The petrochemical industry accounts for much of the remainder (25%). The residential sector (4%) and commercial sector (4%) consume only very small volumes of gas.

Demand from the petrochemical sector is strong, although it has declined from its peak of 2.2 bcm in 2000 (where it exceeded total gas demand for energy transformation), to account for 1.1 bcm in 2009. Notably, the petrochemical industry has proved to be flexible in the face of decreases in domestic production, in effect acting as a price-taker.

Gas demand in the residential, commercial and industrial sectors has declined in recent years. Annual residential gas demand has declined by 5.8% between 2001 and 2009, from 183 million cubic metres to 173 mcm, commercial gas demand has declined by 55% from 345 mcm to 154 mcm and industrial demand has declined by 18% from 1 381 mcm to 1 128 mcm.

Historically, the Maui field has been flexible, in terms of production flows, and could be modulated in order to meet fluctuating demand. With the decline in production rates, however, the Maui field is progressively losing flexibility. This has made the New Zealand gas market tighter at moments of peak demand, and has created a need for the construction of gas storage capacity.

RESERVES

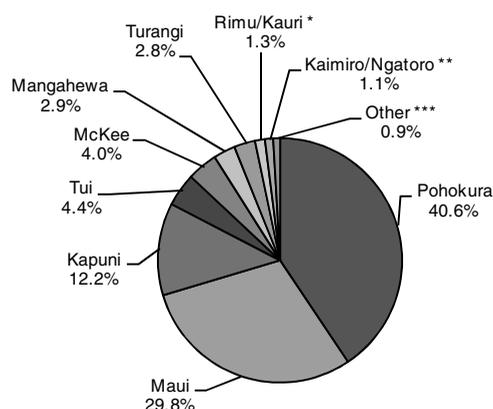
Estimates of proven natural gas reserves vary at between 34 bcm and 68 bcm.²⁶ The Ministry of Economic Development estimates reserves at January 2010 at 53 bcm. Gas reserves, like production, are concentrated between a few major players. In 2009, Shell, Todd Energy, OMV and Greymouth Petroleum control 81% of the country's gas reserves (99% of production).

In November 2009, the government announced a public consultation process on its proposed Action Plan to maximise the potential gains from New Zealand's petroleum resources. An important objective of the Action Plan is to maintain New Zealand as an attractive location for investment in petroleum and natural gas exploration and production, thereby developing the full potential of petroleum resources.

26. *Natural Gas Information*, IEA, Paris, 2009.

The government has also published a number of other studies, including a series of reports related to potential undiscovered oil and gas resources of New Zealand and another relating to potential options for realising New Zealand's methane hydrate potential.²⁷

Figure 15. Gross gas production per field, 2008



* Includes Manutahi well.

** Includes Goldie and Moturoa wells.

*** Includes Tariki/Ahuroa, Waihapa/Ngaere and Cheal fields, and Surrey well.

Source: Ministry of Economic Development

NATURAL GAS EXPLORATION

Production of natural gas is concentrated in the Taranaki region, where there are 20 fields and wells in production. Output is dominated by the Pohokura field (41%) and the Maui field (30%). The Pohokura gas field operated by Shell, with OMV and Todd Energy as partners, has overtaken Maui as the largest source of gas and now meets over a third of the country's needs. The Kupe gas field, offshore south Taranaki, was commissioned in late 2009 and has added greater diversity to supply.

Additional supply is being provided by the onshore Kowhai field, which is being developed by Greymouth Gas. While deliverability of Kowhai remains uncertain, it is likely that annual supply will be relatively small compared to national supply.

The development of the coal-bed methane (CBM)/coal-seam gas (CSG) industry is in its infancy, and production is negligible. However, as of 31 December 2009 there were 15 petroleum permits granted which include the exploration of CSG/CBM, and one permit granted solely for commercial mining of CSG/CBM.

New Zealand also has large reserves of gas hydrates, located off the east coast of the North Island, and situated relatively close to the shore. Preliminary studies are extremely promising, with estimated volumes standing in the trillions of cubic feet (tcf). However, economically viable technology is not yet available for the exploitation of these reserves.

27. *Potential Undiscovered Oil and Gas Resources of New Zealand*, GNS Science, 20 February 2009 and 23 April 2009 and *An Options Analysis for the Commercial and Economic Development of Offshore Methane Hydrates as a Future Energy Option for New Zealand*, New Zealand Centre for Advanced Engineering; June 2009.

EXPLORATION INCENTIVES: TAX AND ROYALTY POLICIES

To counteract the long-term differential between supply and demand for both oil and natural gas, the New Zealand government has been promoting exploration activities, notably by providing basic seismic data for potential investors. Partly as a result, exploration activities have increased somewhat in recent years.

The main focus remains on Taranaki, but there has also been activity in other areas, including: the east coast of the North Island; off the east coast of the South Island; and in the lower South Island. The government accepted bids in July 2007 for exploration in the Great South Basin (off the bottom of the South Island), which is seen as the most likely location for a major oil/gas find. The government has indicated that seismic surveys have yielded very positive results, particularly for green field acreage off the South Island although it is generally understood that future discoveries will not necessarily serve the domestic market, depending on their location.

In April 2010, the government announced a major two-year work programme aimed at promoting oil and gas exploration. Crown Minerals has contracted with GNS Science to deliver the NZD 7.6 million Petroleum Exploration and Geosciences Initiative (PEGI) Project, a suite of individual projects focused on improving knowledge of New Zealand's petroleum potential.²⁸ The initiative is funded by the Crown Minerals Data Acquisition Fund and builds upon GNS Science's research funded by the Foundation for Research, Science and Technology.

NATURAL GAS INFRASTRUCTURE

TRANSMISSION

New Zealand's North Island has a network of over 2 500 km of high-pressure gas transmission pipelines (including the Maui pipeline). Connected to these are more than 16 000 km of intermediate-, medium-, and low-pressure gas distribution pipeline networks. The original natural gas transmission system was constructed by the Natural Gas Corporation (NGC, now Vector) in the late 1960s to take modest quantities of Kapuni gas in Taranaki north to Auckland and south to Wellington, using 200 mm diameter pipelines. The much larger 750/850 mm diameter Maui pipeline was constructed in the late 1970s to carry Maui gas to new power stations in New Plymouth and Huntly, and also to provide additional gas to the NGC pipelines and onwards to the expanding distribution sector. During the 1980s, NGC extended its pipelines to Northland, Bay of Plenty and Hawke's Bay, and added a further 350 mm pipeline from Huntly to Auckland. The Vector distribution system is divided into five separate transmission systems:

- the Central pipeline – running from Kapuni to Huntly alongside the Maui pipeline. It is the largest of the Vector systems in terms of capacity and the backbone from which all the other sub-systems radiate;
- the North pipeline – running from Huntly north, to Auckland and on to Whangarei;
- the Bay of Plenty pipeline – running from Pokuru to the Bay of Plenty and Gisborne;

28. GNS Science is a research institute owned by the New Zealand government and incorporated on 1 July 1992.

- the Frankley Road system – a short arterial running from the Maui pipeline at Frankley Road and the Kapuni production station; and
- the South pipeline – running from Kapuni south to Wellington and across to Hawke’s Bay.

At present, natural gas enters the transmission system in the Taranaki region, from both offshore and onshore production. The Maui and Pohokura fields are the largest producing fields and are connected to the Maui pipeline. Other producers are connected to the Maui or Vector pipelines at various locations in the Taranaki area. The Maui and Vector systems are interconnected within Taranaki at the Frankley Road interchange.

The Maui pipeline runs from Oaonui, and dominates capacity north as far as Rotowaro (near the Huntly power plant), although the smaller Vector pipeline runs in parallel. The transmission pipelines north of Rotowaro (through Auckland and up to the refinery), east into the Bay of Plenty and Gisborne, and south of Taranaki (to Wellington and east to Hastings) are all part of the Vector system and are small pipelines relative to the Maui pipeline, typically in the 100 to 300 mm diameter range.

Because of its significantly larger size, balancing across the system is conducted on the Maui pipeline. The Maui pipeline is owned by Maui Development Limited (MDL), which is in turn owned by Shell (83.75%), OMV (10%) and Todd (6.25%). MDL is a bare nominee company which holds the Maui assets on behalf of the Maui Mining Companies (these have the same shareholding structure as shown for MDL).

There are no gas production facilities or pipelines in the South Island, and no infrastructure linking the two islands.

The Vector system opened for third-party access in the mid-1990s when deregulation of the energy sector encouraged the unbundling of the gas utility companies served by its pipelines. The Maui pipeline was opened to third-party access in 2005.

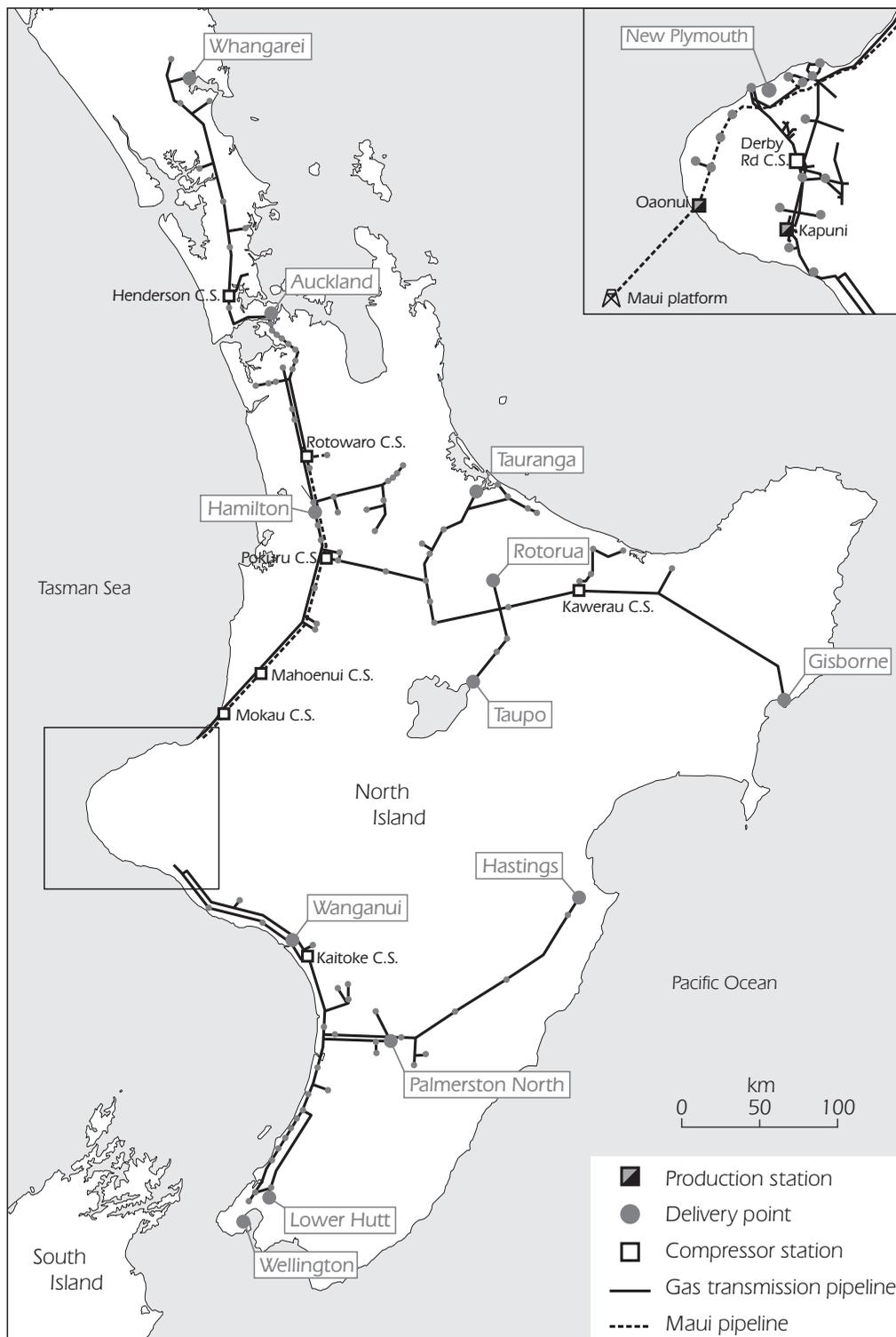
PORTS AND STORAGE

At present, New Zealand does not have any LNG import facilities or any underground gas storage.

The potential for imported LNG gained impetus with the formation of Gasbridge, a 50/50 joint venture between Contact Energy and Genesis Power in 2003. Since then, new gas supplies have been brought to market or are nearing production: namely Pohokura, Turangi, further Maui gas and lately Kupe and Kowhai. In July 2009, Gasbridge partners decided not to progress. However, the possibility remains open and can be revisited if and when gas supply and demand indicate the need for a backstop LNG option.

There is one gas storage facility being developed at present. Located at the depleted onshore Tariki/Ahuroa gas field, the facility will be owned by Contact Energy but managed by Origin Energy, which has a 51% shareholding in Contact Energy. Gas started to be injected in December 2008 and Contact Energy plans to have the gas storage facility operational by late-2010. As of end-June 2010, 132 mcm of gas had been injected. Extraction capacity is estimated to be 1.1 mcm per day from four wells.

Map 3. Natural gas transmission system



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.
 Source: Vector Ltd.

WHOLESALE, PROCESSING AND TRANSPORT ACTIVITIES

There are eleven gas processing plants in New Zealand. Total natural gas processing capacity of the eleven plants will stand at 340 PJ (8 083 mcm) in 2010 with throughput in 2009 standing at 52%. All of New Zealand's domestically produced liquefied petroleum gas (LPG) comes from the gas processing facilities of Maui, Kapuni, Rimu and Kupe. With the exception of the Kapuni gas treatment plant owned by Vector, all of the gas processing facilities are owned by the upstream producers.

One requirement of the 2008 Government Policy Statement on Gas Governance is that gas industry participants and new entrants are able to access third-party gas processing facilities on reasonable terms and conditions. Gas Industry Co. (the industry co-regulator in New Zealand) investigated market access arrangements and concluded that there were no major efficiency concerns, with companies seeking access able to either negotiate access directly with facility owners along commercial lines or able to construct new processing facilities if access to a third-party facility was neither practicable nor desired.

DISTRIBUTION AND RETAIL ACTIVITIES

There are four distribution companies at present; Vector, Powerco, Wanganui Gas and Nova Gas (a subsidiary of Todd Energy). Vector has the largest distribution system with six separate distribution networks located north of Te Kuiti to Whangarei and east to Gisborne, with a small distribution network in Kapiti. Wanganui Gas operates a small distribution network in and around Wanganui. Powerco operates in the Taranaki, Manawatu, Hutt Valley, Porirua, Wellington, Horowhenua and Hawke's Bay regions. Nova Gas operates bypass networks in Wellington, Petone, South Auckland, Hawera and Hastings.

REGULATION

GAS INDUSTRY COMPANY

Gas Industry Company Limited (GIC) is an industry-owned body established to fulfil the role of the industry body under the Gas Act 1992. It is the co-regulator of the gas industry, working with both government and industry to develop outcomes that meet the policy objectives as stated in the April 2008 Government Policy Statement on Gas Governance.

As a co-regulatory body, GIC is able to make recommendations to the Minister of Energy and Resources on a wide range of industrial matters, including the development of rules and regulations in relation to the wholesaling, processing, transmission, distribution and retailing of gas. These recommendations are made on approval by its board. The board consists of seven members, four of whom (including the chairman) must be independent. Shareholders of GIC, all of whom are gas industry participants, elect board members.

The Gas Act states that gas governance regulations (or rules) recommended to the governor-general or made by the minister in relation to the wholesale gas market, processing, transmission or distribution must implement the effect of a recommendation from GIC. The minister may only accept, reject or refer the recommendation back to GIC; the minister cannot amend the recommendation.

It is also important that the constraints on the minister's powers under the Gas Act do not apply to other decisions required to be taken by the minister in relation to the governance of the gas industry and GIC itself, and in relation to recommendations about prescribing reasonable terms and conditions of access to the Maui pipeline and consumer-oriented regulations and rules. In these areas, the minister may recommend regulations but only after having provided GIC with a reasonable opportunity to make a recommendation.

COMMERCE COMMISSION

The Commerce Commission, established under Section 8 of the Commerce Act 1986, is New Zealand's primary competition regulatory agency. The Commission is an independent Crown entity and is not subject to direction from the government in carrying out its enforcement and regulatory control activities. The governor-general, on the recommendation of the Minister of Commerce, appoints Commission members for their knowledge of, and experience in, areas relevant to the Commission's interests. At least one Commission member must be a barrister or solicitor.

EMERGENCY PREPAREDNESS

OVERVIEW

The Gas (Critical Contingency Management) Regulations 2008 determine the framework within which New Zealand gas emergencies are managed. The government has vested the implementation of the country's emergency policy to a privately owned utility, Vector, under terms specified in the regulations. In line with its responsibilities for decision making in a crisis, Vector has developed a robust set of protocols and guidelines (approved by the GIC) by which industry must abide in an emergency. Vector runs training sessions for industry participants, and tests communication exercises to ensure that the appropriate people are informed and contactable in an emergency.

In theory, the government retains control at a policy level for emergencies, in that it sets the prescribed limits within which Vector can operate as the critical contingency operator. However, the minister can only accept or reject a recommendation from GIC on a wide range of issues, which include emergency policy as it relates to gas transmission and distribution.

There are no government-mandated requirements on industry participants to hold minimum reserves of natural gas. However, pipeline operators are required to maintain operating pressure in the reticulated network and therefore they will hold a certain amount of "reserve gas" as line pack in this respect.

In the event of a critical contingency, a key component of the Critical Contingency Management Regulations is to begin load curtailment. Load is curtailed according to curtailment bands set out in the Gas Governance (Critical Contingency Management) Regulations 2008.

In recent years, the largest consumer of gas in New Zealand has been the electricity sector (48% in 2009). Electricity retailers will be among the first users to have their gas curtailed in an emergency. It is therefore important that the electricity sector is able to cope with any disruption of gas.

EMERGENCY RESPONSE MEASURES, STORAGE, FUEL SWITCHING

There is currently no gas storage in New Zealand, and there is no means of importing gas supplies from abroad. Therefore, in a gas supply crisis, all emergency measures will seek to control supplies and reduce demand for gas.

INTERRUPTIBLE CUSTOMERS

In the event of a serious natural gas crisis, the first customers to be cut off will be the Huntly power plant (which has fuel-switching abilities to coal) and the Methanex industrial plant (a swing producer of methanol for the Asia-Pacific region).

New Zealand's largest electricity generator, the 1 000 MW Huntly power station, can run on both coal and natural gas. When a gas disruption occurs, Huntly power station can be run solely on coal. It has a stockpile of coal on site which it can draw from if needed. This stockpiled coal – as well as domestic coal and imports from Indonesia – could supply this plant in the short, medium and long term.

OTHER MEASURES

If a shortage of gas were to threaten electricity supply, then the fast-start 165 MW peaking plant Whirinaki, which runs on gasoil, could be used. Notably, this is the only plant that has a government obligation to hold stocks (of gasoil).

CRITIQUE

New Zealand has a market-based approach to the development of the natural gas sector balanced against consumer and environmental concerns. Since the previous in-depth review in 2006, New Zealand has made substantial progress in the natural gas sector to develop new supply options and bring about market reforms. The gas industry is in a transition phase and facing a number of possible future scenarios. Regardless of the outcome, the industry needs strong leadership from government in order to develop a competitive market framework, and to enable a maximum contribution from the natural gas industry to the economy. This framework should include effective governance arrangements that deliver cost-effective market access to new entrants and predictable decision making by appropriate institutions.

New Zealand's natural gas market is characterised by a high level of industry concentration and vertical integration. Over the past 30 years, supply of natural gas was dependent on the large Maui gas field. This is depleting quickly and there is a growing reliance on smaller fields. While the development of future gas reserves remains uncertain, the market has not supported investment in imports through the establishment of an LNG import terminal.

New Zealand is highly prospective and over the past year the government has increased incentives for the exploration of gas by means of tax exemptions and public investment in seismic data. This could lead to discovery and development of major gas reserves and transform the domestic natural gas industry. To support this strategy, New Zealand needs to create an attractive environment for investors in the form of a strong and consistent regulatory framework that provides access to market information and network infrastructure at an efficient price.

The government has successfully undertaken a number of initiatives to increase competition and transparency in the downstream gas sector. These include a range of projects undertaken by the Gas Industry Company (GIC), a market co-regulation body that oversees pipeline access conditions, critical contingency management, wholesale market development, customer switching, compliance and enforcement, and consumer outcomes. The Commerce Commission is also in the process of developing a revised information disclosure regime and tariff determination for regulated transmission and distribution pipelines. These initiatives are important to promote transparency, efficiency and competition as a means of ensuring low-cost energy to consumers.

Governance arrangements for New Zealand's gas industry are complex and seem to have developed in an *ad hoc* manner and are spread across a number of agencies, including the Commerce Commission, the Ministry of Economic Development, the Ministry of Consumer Affairs, the GIC and a number of safety bodies. The governance framework appears to suffer from a lack of co-ordination, timeliness and general effectiveness causing uncertainty and time delays for industry.

Industry has expressed concerns regarding the appropriateness of the role of the GIC as a co-regulation body (with strong representation from industry incumbents) to effectively undertake the role of rule making, compliance and consideration of market power and competition issues. These functions would be more appropriately undertaken by a gas market regulator within the policy framework set by government. However, it is important that initiatives to reform the gas sector involve considerable industry input to achieve workable, low-cost solutions. This could be achieved through a gas market regulator establishing and consulting with an industry reference group consisting of representatives from across the entire sector, including potential market entrants.

The government has made efforts to set a framework within which natural gas emergencies are managed, which is detailed in the Gas (Critical Contingency Management) Regulations 2008.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Develop a gas-sector strategy statement that draws together co-ordinated policies for all sub-sectors of the industry (including upstream and storage) and the related governance and legislative structure.*
- Review the overall effectiveness of present gas-sector governance arrangements in providing a strong, transparent and certain framework, including the possible establishment of a sector regulator.*
- Facilitate increased competition and transparency in the market through the provision of increased information and access arrangements.*

8. OIL

OVERVIEW

Oil consumption has grown steadily since the mid-1980s, reaching almost 150 thousand barrels per day (kb/d) in 2009 (including international transport). Although there was notable domestic crude oil production, approximately 54 kb/d in 2009, imports still met around two-thirds of New Zealand's oil demand. One refinery, located at Marsden Point, supplies approximately 70% of the country's product demand.

New Zealand places no minimum stockholding obligation on industry. Since 2007, the government meets the country's overall minimum 90-day net import obligation (as a member of the IEA) by acquiring stockholding rights in other IEA member countries, in the form of ticket reservations. In an IEA co-ordinated action, New Zealand would likely contribute to the collective response by releasing these public stocks and implementing a campaign for voluntary demand restraint. There would also be the potential to respond by using measures in the Oil Emergency Response Strategy, including mandatory quantity rationing, an emergency relaxation of fuel specifications and a limited production surge.

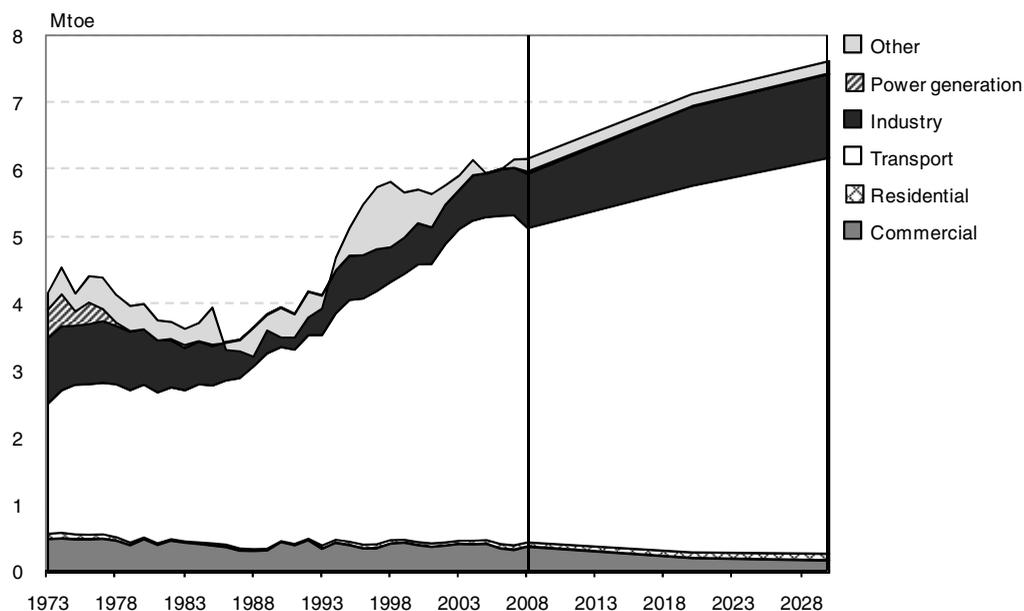
SUPPLY AND DEMAND

Domestic crude oil production was almost 54 kb/d in 2009, and is expected to be similar in 2010. No sizeable new fields are forecast to come on line in the coming years, and production will decline rapidly if no new oilfields are discovered.

New Zealand's crude is generally light-sweet and high-grade (average density of 0.80), and close to 90% of production is exported for its premium value. As New Zealand's sole refinery (Marsden Point) is a relatively sophisticated refinery, it processes mainly heavier and sourer (and thus cheaper) imported crudes (that account for around two-thirds of oil imports).

The transport sector accounts for an increasing share of total oil demand – close to 80% in 2009. Motor gasoline, gas/diesel oil, and jet kerosene are the main transportation fuels. Demand for diesel oil has grown at an annual average of 2.1% in the period 2000 to 2009, compared to a rate of 1.1% for total oil demand. It is currently projected that oil demand will continue to grow at a similar rate, and that future growth will be the result of increases in the use of these transport fuels. Consumption in all other sectors is projected to remain the same or decline although these expectations are subject to a substantial degree of uncertainty.

Figure 16. Oil supply by sector*, 1973 to 2030



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

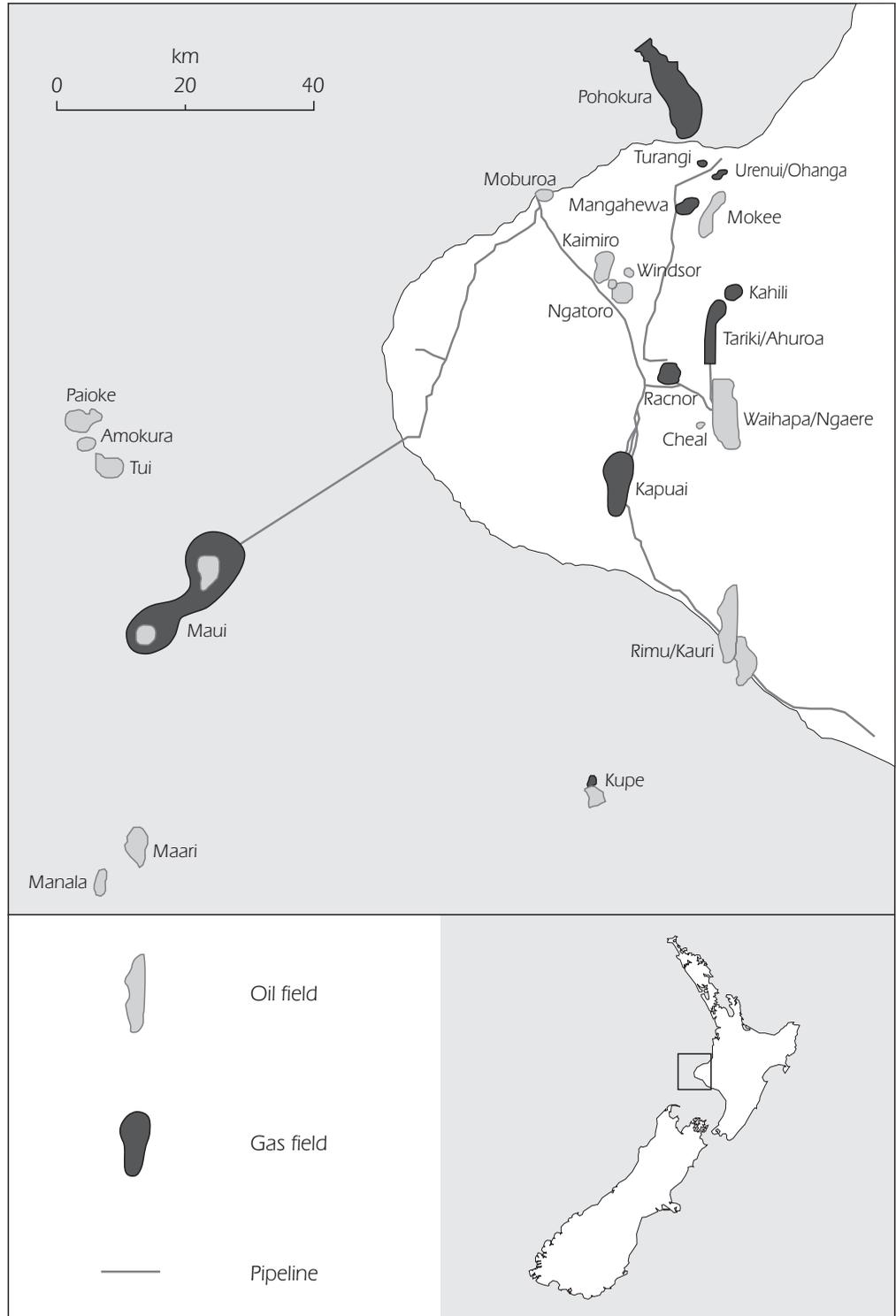
PRODUCTION

All petroleum production comes from fields located in the Taranaki basin, on the west coast of the North Island. The Maui field has been the major domestic producer of oil, but, as this field depletes, more diverse sources of oil (and gas) have been found. Production is located offshore in five fields with a further 12 smaller producing fields located onshore. In 2009, New Zealand is producing oil from 17 fields in the Taranaki region, with three offshore fields, Pohokura (12 kb/d), Maari (16 kb/d) and Tui (17 kb/d), dominating production in 2009. As a result, New Zealand's oil production in 2009 stood at 54 kb/d - up by over 30% (13 kb/d) from 2007 production (41 kb/d) but down by 8% (4 kb/d) from 2008 production (58 kb/d).

The type of oil produced in New Zealand also changed with the addition of the Tui, Maari and Pohokura fields. Historically, New Zealand oil consisted of mainly condensate, with some quantities of crude oil and naphtha. With the Tui field and the recently commissioned Maari field now on line, crude oil will now account for over two-thirds of domestically produced oil.

Production is expected to decline progressively if no new fields are discovered. This will have a significant impact on the country's oil security. The fast rate of expected decline owes to the fact that recently commissioned producing fields, for example Tui, are relatively small and have a high rate of depletion.

Map 4. Oil and natural gas fields



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.
 Source: Ministry of Economic Development.

REGULATION

UPSTREAM REGULATION

Crown Minerals, part of the Business Services Branch of the Ministry of Economic Development, manages the New Zealand government's oil, gas, minerals and coal resources, known as the Crown Mineral Estate. Its key objectives are to efficiently allocate rights in respect of Crown-owned minerals and to obtain for the Crown a fair financial return from its minerals.

Petroleum exploration and production are regulated by means of the Crown Minerals Act 1991, the Minerals Programme for Petroleum 2005 and the Minerals Programme for Petroleum 1995 (high-level policy documents that set out policies and procedures for granting petroleum and mining permits). The Crown Minerals (Petroleum) Regulations 2007 specify permit application and information reporting requirements.

DOWNSTREAM REGULATION

Deregulation of the oil industry in 1988 removed price controls, government involvement in the refinery, licensing of wholesalers and retailers, and restrictions on imports of refined products.

REFINING AND INFRASTRUCTURE

REFINERY OUTPUT

New Zealand's entire refining capacity is located at its one hydro-cracking refinery at Marsden Point, near Whangarei, at the north of the North Island. Marsden Point is owned and operated by the New Zealand Refining Company (NZRC), a publicly listed company that has been operating the refinery since 1964. The refinery completed the Point Forward Project (PFP) in late 2009, increasing the refinery's topping capacity to approximately 135 kb/d, and increasing yields of middle distillates and gasoline by around 17%. It supplies the greater Auckland area and airport by pipeline, thus providing a major source of competitive advantage for the refinery.

The NZRC operates the refinery as a tolling operation (referred to as a "toll refiner"), that is, it charges a toll on each litre of fuel produced. While it processes crude on behalf of refinery users (who are also shareholders), the NZRC does not own the crude or the products. This fee is based on the difference between the value of initial feedstocks and final products, according to reported regional refining margins (Singapore prices), and stands at 70% of the gross refining margin. The gross refining margin is benchmarked off Singapore's quoted prices and international freight rates with a quality premium applied to reflect New Zealand's tighter fuel specifications. It is normally cheaper to supply regional ports in this manner than importing products, even from much larger refineries in the Asia-Pacific region. The refinery undertook a review of its processing arrangements in mid-2009.

Four oil majors (BP, Chevron, ExxonMobil and Greenstone Energy) own 73% of the refinery, and are the only companies entitled to products from the refinery owing to a processing agreement signed when the refinery was first built in 1964. Each company

manages the planning of its own crude slate and product off-take. Capacity allocation is not related to shareholding but to market share, the latter calculated on a three-year rolling average.

The refinery benefits from a number of core strengths. Geographically, it is relatively isolated, selling products into a market which is short on all major products (with the exception of heavy fuel oil). The Refinery-to-Auckland pipeline makes it extremely competitive for all product supplies to New Zealand's largest market. The refinery is very flexible (it can run on different crudes) and its configuration's bias towards middle distillates fits with future trends in domestic demand. The processing fee arrangement essentially guarantees that it is used to full capacity. Meanwhile, New Zealand's relatively tight fuel specifications, which differ slightly from those of other countries in the Asia-Pacific, mean that there are only a few refineries in the region that are able to directly compete with Marsden Point (although their numbers are increasing, with the increasing complexity of the Asian refining portfolio).

PIPELINES

All crude and condensate pipelines are located in Taranaki, on the west coast of the North Island. However, as New Zealand crude is virtually all exported, upstream pipelines do not markedly contribute to New Zealand's oil security.

The NZRC-owned Refinery-to-Auckland Pipeline (RAP) transports batched refined products to bulk storage facilities at Wiri in south Auckland. From here, oil product is transported across the greater Auckland and the northern Waikato region which accounts for around 40% of New Zealand's demand and is the country's major petroleum market. The pipeline has a capacity of 55.8 kb/d, and 85% of this capacity (48 kb/d) was utilised in 2009. About half of the refinery's production is distributed via the RAP pipeline. Jet fuel is transported to the Auckland airport via a 6.9 km, six-inch pipeline with a capacity of 24.2 kb/d.

STORAGE

New Zealand is a sparsely populated country. Its sinuous landmass is larger than that of the United Kingdom, but there are only just over four million inhabitants. As such, the country has specific logistical challenges for delivering oil products around the country at an acceptable cost to customers.

Coastal distribution delivers refined product from Marsden Point to a number of locations around New Zealand, where industry receives it, as well as imports. New Zealand has 13 terminal locations (including the refinery), of which 11 are seaboard terminals. The three major import terminals are Mount Maunganui, Wellington and Lyttelton. The Ministry of Economic Development (MED) has information about product storage capacities at each import terminal, but the company breakdown is not disclosed for competition reasons.

DOWNSTREAM MARKETS

At the wholesale level, New Zealand is a highly concentrated market, with the four oil majors (BP, Caltex, ExxonMobil and Greenstone Energy) maintaining significant market dominance. At the retail level, there is more competition, with at least 15 branded

networks and a rising number of unbranded sites. Collectively, these smaller networks account for over 20% of the retail market by site numbers.

In April 2010, a partnership of New Zealand company Infratil and the Guardians of New Zealand Superannuation finalised a deal to purchase Shell New Zealand's downstream assets. These assets included Shell's 17% stake in NZ Refining Company, nearly 280 service stations and truck stops around the country, plus a number of storage, marine and aviation assets. The new company "Greenstone Energy" has initially maintained the 'Shell' brand on its retail outlets.

SHIPPING AND STORAGE AGREEMENTS

The oil majors employ a system that enables each company to draw products from any location subject to having access arrangements with a specific storage provider. This system is designed to offer a great deal of flexibility and efficiency to the domestic supply chain. The system works on an accounting system in which stock volumes are credited to companies on the basis of a combination of refinery production as it accrues to the individual company processing at NZ Refining Company and as supplemented by periodic imports. A company's ability to draw stock from the system is subject to having a positive stock balance. The ownership system is monitored by COLL (Coastal Oil Logistics Limited) on behalf of the majors.

TAXES

New Zealand has the fifth-lowest taxation levels on gasoline in the OECD. These taxes include excise duty (which is paid into the National Land Transport Management Fund), the Petroleum or Engine Fuels Monitoring Levy (PEFML), the Local Authorities Petroleum Tax (LAPT), the Accident Compensation Corporation Levy (ACC), and the Goods and Services Tax (GST, 15%).²⁹ In addition, as of 1 July 2010, all liquid fuels sold in New Zealand are subject to an emissions obligation.³⁰

Diesel is not subject to excise tax, because all diesel vehicles are subject to road user charges. However, diesel fuel does incur the LAPT, PEFML and GST. Road user charges for diesel vehicles vary depending on the type of vehicle. As an example, for a two-tonne vehicle travelling 20 000 km per annum at a fuel efficiency of nine litres per 100 km, the road user charge would be equivalent to about NZD 0.40/litre.

PRODUCT SPECIFICATIONS

New Zealand's fuel specifications lag behind European and North American standards, but are among the most stringent in the Asia-Pacific region, where only Japan and South Korea have tighter caps on sulphur levels.

For gasoline, sulphur content is capped at 50 parts per million (ppm), on par with the standard in Singapore and Taiwan. There are no immediate plans to reduce sulphur levels in gasoline to 10 ppm prior to Australia reducing its levels. New Zealand's fuel specifications are still more stringent than Australia's 150 ppm limit on regular gasoline (only Australian premium gasoline is capped at 50 ppm).

29. Prior to 1 October 2010, GST was 12.5%.

30. <http://www.legislation.govt.nz/regulation/public/2008/0356/latest/whole.html#dml1635601>

New Zealand also has strict diesel specifications, some of which (e.g. cetane level and cold filter plugging point) are stricter than in neighbouring Australia. Sulphur content in diesel was capped at 10 ppm in New Zealand since 1 January 2009, similar to the cap levels of South Korea and Australia.

Owing to these specifications, New Zealand motor fuel specifications are among the tightest in Asia-Pacific and, as a result, only a limited number of regional refineries are able to meet New Zealand's standards. This has resulted in a quality premium being added to the quoted Singapore benchmark price. The strict specifications in the New Zealand motor fuel market also incur some security of supply issues and reduce the scope for competition.

EMERGENCY RESPONSE POLICY AND ORGANISATION

EMERGENCY RESPONSE POLICY

The Ministry of Economic Development (MED) is responsible for issues related to oil supply security and in an international disruption would chair the National Emergency Sharing Organisation (NESO) and take the lead in developing a plan of action. However, the Ministry of Civil Defence and Emergency Management (MCDEM) is responsible for civil contingency planning for domestic events at the local and regional levels; MCDEM's mandate covers aspects such as pandemics and natural disasters (such as earthquakes), but is leading work to improve domestic contingency planning within the petroleum sector. MED is working with MCDEM to ensure co-ordination between operational responsibilities.

In 2008, MED, in consultation with other agencies and stakeholders, released an Oil Emergency Response Strategy (the Strategy). The full document is available on the Ministry website.³¹ The Strategy outlines roles and responsibilities for action in a supply disruption and outlines the response measures available to government. The overall objectives of the Strategy are to ensure that New Zealand is able to effectively meet its obligations as a member of the IEA and to ensure that the effects of an oil supply disruption are minimised.

The Strategy includes a number of off-the-shelf plans to implement demand restraint measures in a disruption. These measures are divided between "light-handed" (public information campaign) and "heavy-handed" (quantity rationing) measures.

RESERVES

New Zealand places no minimum stockholding obligation on industry and, until recently, it relied on the industry's normal stockholding practices to meet the country's overall minimum 90-day net import obligation as a member of the IEA. Rising import dependence over the past decade resulted in the country being temporarily in a state of non-compliance with regard to minimum stock levels.

In response to this, in 2007, the New Zealand government acquired stockholding in other IEA member countries in the form of oil ticket reservations. These tickets represent around 0.8 million barrels of public stocks in 2010 (down from 3.7 million barrels in

31. http://www.med.govt.nz/templates/ContentTopicSummary____37527.aspx

2007). Owing to its growing domestic production in recent years, New Zealand's net imports have dropped, thereby reducing its IEA stockholding obligation.

All tickets are held directly by the New Zealand government, rather than through an agency on behalf of the government. In an IEA co-ordinated action, New Zealand would likely contribute to the collective response by releasing these public stock tickets and implementing a campaign for voluntary demand restraint. There would also be the potential to respond by using measures in the Oil Emergency Response Strategy, including mandatory quantity rationing and a limited production surge.

LEGAL INSTRUMENTS

There are two principal legal instruments available to authorities during an oil supply disruption: the International Energy Agreement Act of 1976 (IEA Act) and the Petroleum Demand Restraint (PDR) Act of 1981.

The IEA Act is designed to enable New Zealand to carry out its obligations as a member of the IEA, and this Act will be invoked in order to take actions for an IEA-declared emergency, including ensuring compliance with international obligations in terms of petroleum supplies.

For non-IEA emergencies, the government may introduce regulations under the Petroleum Demand Restraint Act of 1981 if petroleum products are, or are likely to be, in short supply in New Zealand. An example of a possible measure is an emergency relaxation of fuel specifications. As such, the PDR Act is intended to deal with demand and distribution issues in a domestic supply crisis. There are provisions under the Crown Minerals Act 1991 and the Energy (Fuels, Levies and References) Act 1989 that can also assist in responding to an oil supply disruption. All oil stocks held in the territory of New Zealand are company stocks held for operational and commercial purposes. The legal powers for the draw-down of oil stocks are contained within the wide powers of the PDR Act.

CRITIQUE

New Zealand has notable upstream oil production, which currently accounts for over one-third of its demand. All production is from fields in the Taranaki basin and, as with gas production, has historically been sourced primarily from the Maui field. As the Maui field has depleted, more diverse sources of oil (and gas) have been found but New Zealand's domestic production is forecast to decline significantly over the coming decade if new fields are not discovered and developed. Domestic crude oil is generally light-sweet and high-grade (average density of 0.80) and close to 90% of domestic production was exported in 2009.

Refining capacity is centred at one refinery at Marsden Point, a recently expanded 135 kb/d hydro-cracking refinery in the north of the North Island, which can now supply approximately 80% of the country's product demand. Marsden Point is operated by the New Zealand Refining Company (NZRC). Four oil companies (Greenstone Energy, BP, Chevron and ExxonMobil) enjoy sole entitlement to products from the refinery, under a processing agreement signed when the refinery was first built in 1964.

Given the size of the country and the low density of population, the supply and distribution of oil products across New Zealand come with inherent challenges. This has been well addressed by the agreement of the four oil companies to ship products

collectively around the country, and allow access to each other's storage facilities and products. However, third-party access is not allowed to this distribution system and this collective approach has the potential to create a significant barrier to entry for independents. An open and competitive market is the first line of defence against supply disruptions, and is the best guarantor of low prices for end-consumers.

New Zealand has relatively strict fuel specifications which are on par with European standards. These fuel specifications are stricter than many of its Asia-Pacific neighbours. New Zealand is a small market and imported quantities of appropriate finished products are relatively difficult to source.

Until 2006, New Zealand relied on the industry's normal stockholding practices to meet the overall minimum 90-day obligation as a member of the IEA. Commercial petroleum inventories are now insufficient to meet the minimum 90-day requirement. As a short-term measure, to ensure that New Zealand meets its IEA oil-stock obligations, the Ministry of Economic Development makes up the shortfall by tendering for additional oil stocks using "ticket" contracts (an option to purchase stock in an emergency) with major oil companies overseas. Since 1 January 2007, New Zealand has been compliant with IEA stockholding obligations; it uses overseas ticket contracts to meet 90 days of net imports. However, New Zealand's net imports are expected to rise over the coming years as its domestic production declines, thereby increasing its reliance on tickets.

KEY RECOMMENDATIONS

The government of New Zealand should:

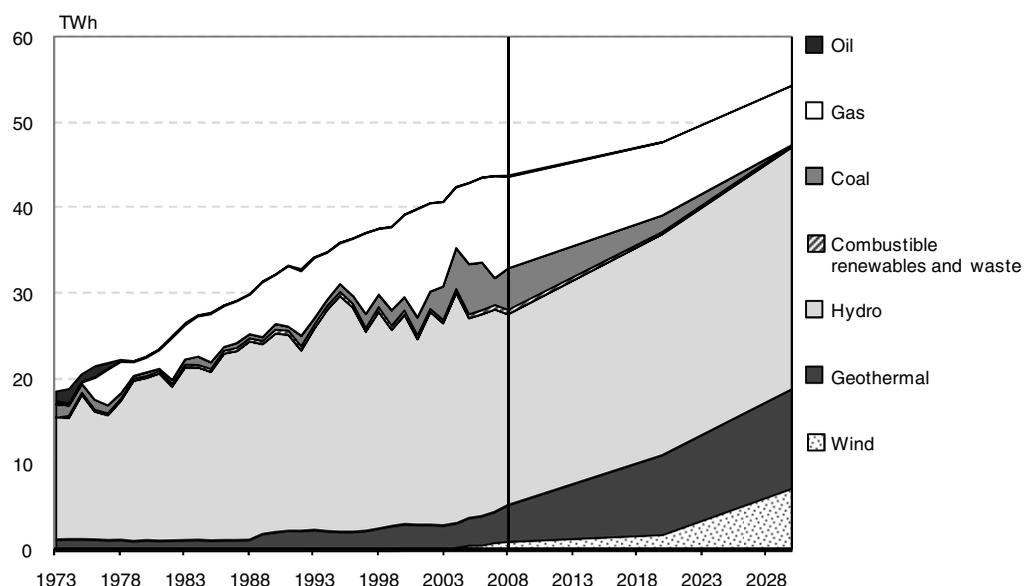
- Continue to promote upstream investments and streamline all permitting and other procedures in order to maximise potential discoveries of new upstream fields and stem the decline of their domestic oil and gas production.*
- Align its motor fuel specifications with those of the Asia-Pacific region where appropriate, thereby providing a greater degree of security for New Zealand by allowing buyers to source fuel from a greater variety of options.*
- Investigate whether third-party access to the four oil majors' shipping and storage arrangements should be allowed, thereby removing a significant barrier to entry for smaller independents.*
- Review the country's ticketing situation and examine alternative stockholding options, for example the creation of a stockholding agency, so as to strengthen domestic security of supply.*

9. ELECTRICITY

OVERVIEW

Gross electricity production in New Zealand reached 43.4 TWh in 2009 and showed little change when compared to the previous three years. More than half of electricity was generated from hydropower (51%), with the rest coming from natural gas (24.3%), coal (11%) and geothermal sources (9.6%). Smaller amounts were provided by wind (2.4%), biomass (1.3%) and oil (0.3%). Renewable energy sources contribute 64.2% of electricity output, the third-highest share among IEA member countries. Most notably, the share of electricity from geothermal sources is the highest among IEA member countries.

Figure 17. Electricity generation by source, 1973 to 2030



Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

SUPPLY AND DEMAND

SUPPLY

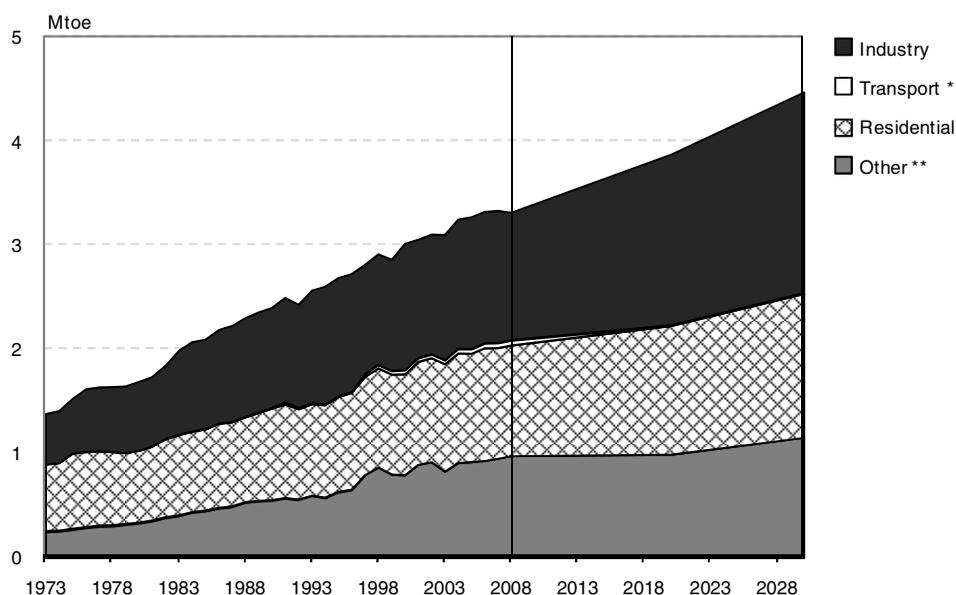
The government expects that electricity output will grow over the medium term reaching 54.2 TWh in 2030. The greatest increase, in absolute terms, is expected to come from geothermal energy. Wind power capacity is expected to multiply by a factor of six. In the meantime, the share of coal could disappear completely and gas should decrease by more than one-third.

Hydroelectricity output is subject to strong variations due to meteorological conditions; therefore, its share changes significantly from one year to another, for instance from 63% of total electricity generation in 2004 to 54% the year after. This variability is being softened by the usage of more flexible sources of power, mainly gas-fired plants, and, to a smaller extent, coal.

DEMAND

Demand for electricity is dominated by the industry and residential sectors, which in 2008 accounted for 37% and 32% of final consumption respectively. Most of the remaining volumes (23%) are consumed in the commercial and public services sector. Demand appears to have temporarily plateaued in the past four years as a consequence of the global and domestic economic downturn, but is expected to continue increasing at an average of 1% per annum to 2030 (see Figure 18).

Figure 18. Electricity consumption by sector, 1973 to 2030



* Negligible.

** Other includes commercial, public service, agricultural, fishing and other non-specified sectors.

Note: This graph shows historical data until 2008 and the government's projections from 2009 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2009 and country submission.

GENERATING CAPACITY

New Zealand maintains approximately 9 050 MW of generating capacity compared with daily peak demand of about 6 500 MW. More than half of New Zealand's electricity (58% or 5 370 MW) is hydropower, 18% (or 1 660 MW) is gas-fired, 11% (1 000 MW) is coal-fired, 6.3% (575 MW) is geothermal and the balance is wind, diesel, waste or biomass. Substantial capacity additions – over 2 000 MW – are planned for the near term, largely natural gas, wind or hydropower.

New Zealand's water storage capacity is limited, at around 3 600 GWh, equivalent to approximately ten weeks of winter demand; therefore, hydro generation is sensitive to the level of water inflows from rainfall and melting snow. For this reason, when inflows are low for a sustained period, thermal energy sources tend to replace hydro generation.

INDUSTRY STRUCTURE

GENERATION AND RETAIL

Restructuring of the New Zealand Electricity Market commenced in 1996, when the Electricity Corporation of New Zealand (ECNZ) was split into two large generators, ECNZ and Contact Energy. In 1999, the remainder of ECNZ assets were split into Genesis Power, Meridian Energy, and Mighty River Power, while at the same time Contact Energy was fully privatised.

Mighty River Power, Genesis Power and Meridian Energy remain in public ownership while two others – Contact Energy and TrustPower - are privately owned. Other sources of generation include smaller independents and CHP. The transmission system is owned and operated by a state-owned enterprise, Transpower New Zealand Limited (Transpower). The regionally based distribution network is owned by 29 line companies. Retail market participants are generally vertically integrated with large generators but are required to sell and purchase electricity on the wholesale market.

New Zealand's reliance on hydro, combined with low storage capacity compared to other countries, requires careful management of yearly and seasonal variations. Generation output on North Island is significantly less than demand and the balance is met by geothermal, wind, thermal generation and South Island hydro via a high-voltage direct current (HVDC) link.

Table 4. Market share of major generators

	Ownership	Generation market share (by volume)	Retail market share (by customer number)*
Mighty River Power Ltd (Mercury Energy)	State owned	16%	20%
Genesis Power Ltd	State owned	22%	28%
Meridian Energy Ltd	State owned	22%	12%
Contact Energy Ltd	Privately owned	24%	25%
TrustPower Ltd	Privately owned	5%	12%
Other	Privately owned	11%	3%

* Includes subsidiary companies

Source: Ministry of Economic Development.

The Electricity Commission oversees the operation of the electricity retail market, administers retail market rules and provides arrangements for the protection of consumers. Customers can switch between retailers; the switching process is straightforward and any party can be an electricity retailer provided the minimum requirements are met.

The level of retail competition varies across the country, but generally all customers have a choice of retailer: in some parts of New Zealand there are five or more competing

retailers. The retailer is responsible for the installation of appropriate metering, meter reading, billing and payment collection.

TRANSMISSION

The national grid, 12 000 km of high-voltage transmission lines, is owned by Transpower, a state-owned enterprise (SOE). Its shares are held, on behalf of the Crown, by the Minister of Finance and the Minister of State-Owned Enterprises. (SO's are government-owned companies that are run on a commercial, profit-maximising basis.) The regulatory arrangements promote open access.

Transpower, also the transmission system operator, plans, builds, maintains and operates the grid which links over 50 power stations to distribution companies and major industrial users. The grid, two alternating-current (AC) island power systems connected by a 700 MW high-voltage direct current (HVDC) link, extends from Kaitaia in the North Island to Tiwai in the South Island. Much of New Zealand's electricity is hydro, generated from lakes and rivers in the South Island, while most of the electricity demand is in the North Island, in particular the Auckland region. Consequently, large amounts of electricity need to be transmitted long distances between the two islands resulting in higher electrical losses, which average about 3% (but can be as much as 7%) of power transmitted.

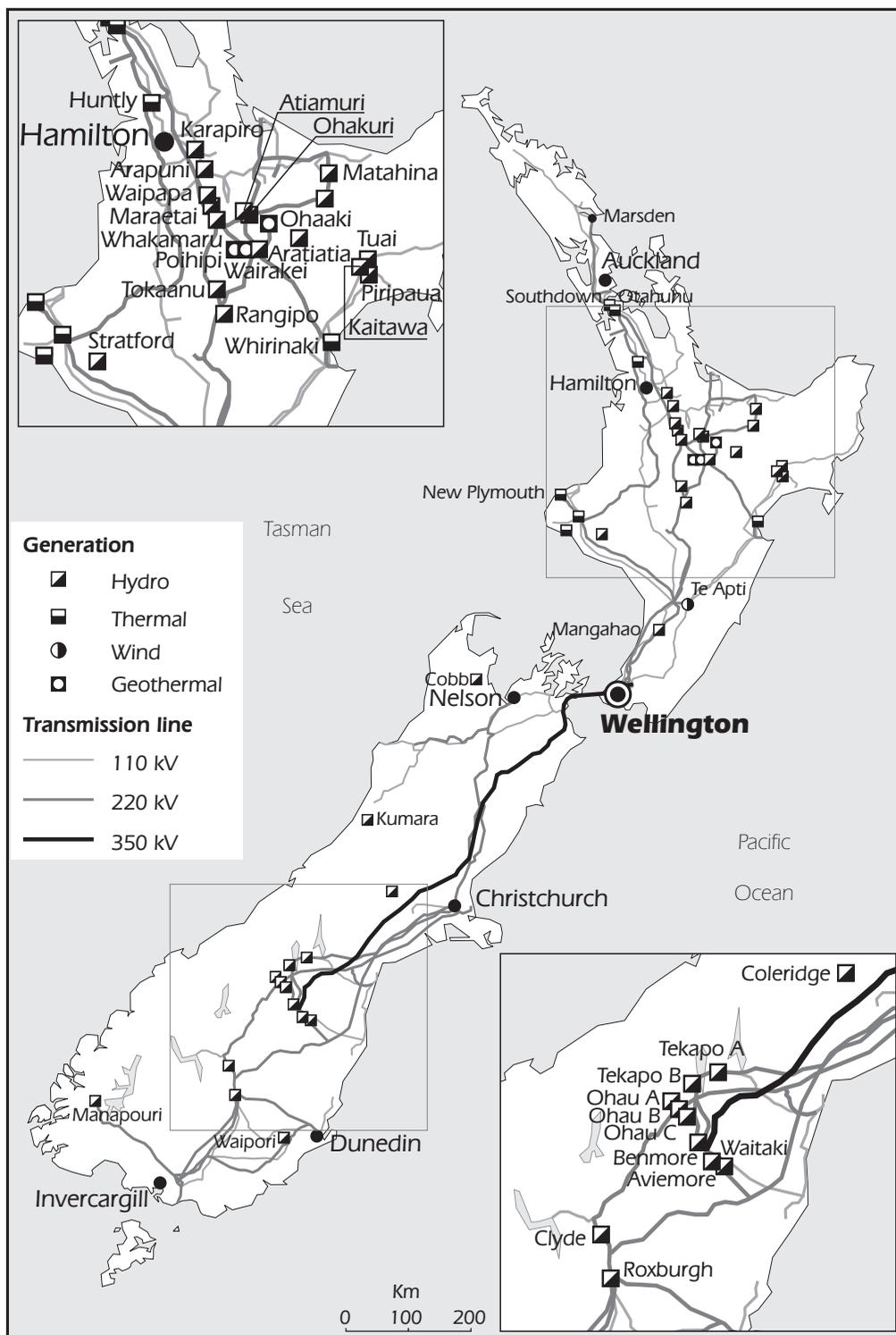
Transpower can recover the full economic costs (its regulated revenue requirement) associated with providing electricity transmission services, including capital, maintenance, operating and overhead costs in accordance with its transmission pricing methodology (TPM). The TPM is developed according to the Electricity Industry Participation Code (the Code) and is included in the Code.

The TPM recovers the costs as follows:

- *Connection assets*: the costs associated with connection assets are recovered from both off-take and injection customers on the basis of their anytime maximum demand and anytime maximum injection, respectively. The boundary between connection and interconnection is defined in the TPM. The definition is geographically based and can be described as a deep definition of connection;
- *Interconnection assets*: the costs associated with interconnection assets (all assets not defined as connection or HVDC) are recovered solely from off-take customers, with the allocation based on their contribution to the average regional coincident peak demand in four separate pricing regions; and
- *HVDC assets*: the costs associated with HVDC assets are recovered from South Island injection customers on the basis of their historic anytime maximum injection (HAMI). The charge payable by a given generator is a function of both the postage-stamped DC rate (DCR) (NZD/kW) and its 12 peak injections (HAMI) over a historical period.

Investment in the network appears to have been inadequate from 1995 to 2005 (below NZD 100 million per year); so major upgrades are now necessary to maintain reliability and meet growing demand. There was significant increase in expenditure from 2005 to 2008 (between NZD 200 million and NZD 400 million per year). This was an initial programme of "tactical" upgrades to address pressing constraints in a number of areas.

Map 5. Electricity transmission system



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the IEA.
 Source: Transpower.

Approximately NZD 5 billion of expenditure is forecast for the next 10 years. Major projects to upgrade the national grid include the following:

- North Island Grid Upgrade Project: Transpower is building a new power link between Whakamaru and Auckland. This is one of the largest transmission projects to be undertaken in New Zealand since the 1960s.
- North Auckland and Northland Grid Upgrade Project: Transpower is reinforcing the transmission network through Auckland and into north Auckland with new underground cables and a new transformer.
- HVDC Inter-Island Link Project: Transpower is constructing and installing new AC/DC converter equipment at Benmore (South Island) and Haywards (North Island) substations to increase the capacity of the high-voltage direct current inter-island link.
- Wairakei to Whakamaru Replacement Transmission Line Project: Transpower is building a new double circuit transmission line between Wairakei and Whakamaru to help connect more generation being built in the area.

DISTRIBUTION

There are over 150 000 km of distribution lines in New Zealand and almost all consumers are connected to a distribution network along with a number of embedded small-scale generators. The majority of customers are connected to a distributor such as Vector, Powerco, Orion or Wellington Electricity Lines. Generally, the 29 distribution companies sell their services to retailers who manage the electricity supply agreements with end-consumers.

All distribution companies come under the Commerce Commission's information disclosure regime in the new Part 4 of the Commerce Act. Those that are not community-owned come under revenue regulation and price/quality control. Distributors are prohibited from retailing and are only allowed to own small amounts of generation (subject to corporate separation rules) under the Electricity Industry Reform Act 1998.

The Electricity Governance (Connection of Distributed Generation) Regulations became effective in August 2007 to facilitate connection of distributed generation. The Regulations mandate the application and approval process between the prospective generator and the distribution company. The Regulations also provide default terms of connection, dispute resolution processes and pricing principles, though all these can be contracted out of by mutual agreement of the parties.

The Electricity Commission is currently undertaking a Wind Generation Integration Project to investigate further wind integration, including forecasting, unit commitment, and dispatch issues. The Commission has also been undertaking a "Synthetic Wind Data" project to increase the industry's knowledge of wind generation.

SECURITY OF SUPPLY

In addition to overseeing the electricity industry and markets, the Electricity Commission has also been charged with the objective of ensuring security of electricity supply. New Zealand is vulnerable to disruption in dry years owing to its reliance on hydro generation, combined with limited water storage capacity. The government requires the Electricity Commission to use reasonable endeavours to ensure security of supply in a 1-in-60 dry

year, without assuming any demand reduction from emergency conservation campaigns, while minimising distortions to the normal operation of the electricity market.

The Commission is responsible for monitoring security of supply in the long term (up to 10 years) and publishing forecasts to assist participants in assessing future supply risk and making investment decisions. The aim is to avoid the requirement for reserve energy by encouraging timely investment decisions.

RESERVE ENERGY SCHEME

The Commission also assesses reserve energy and capacity needs in the medium term (two to five years) by forecasting supply and demand and calculating the winter energy margin and the winter capacity margin. If insufficient new generation or demand-side initiatives are forthcoming, additional reserve energy or capacity may have to be contracted. The decision to contract will be delayed as long as possible in order to provide as much opportunity for other solutions to be implemented and to reduce the possibility of redundant reserve energy or capacity.

The Reserve Energy Scheme enables the Electricity Commission to contract for reserve generation and demand responses and to recover the costs by a levy on all consumers. To date, the only reserve generator is the 155 MW diesel-powered Whirinaki station, which was commissioned in 2004. Operated by Contact Energy, its operating costs are intended to be covered by spot revenue, but its fixed costs are recovered by an industry levy.

LONG-TERM ELECTRICITY SECURITY

Each year, the Electricity Commission is required to publish ten-year forecasts of electricity supply and demand in both the North and South islands. The forecasts include an assessment of likely future generation projects along with an assessment of the winter energy margin and winter capacity margin for each year. The winter energy margin is calculated by dividing expected supply for New Zealand (or the South Island) by expected demand for the whole of New Zealand (or the South Island) and subtracting one. The winter capacity margin is calculated by subtracting a metric of North Island's expected demand from North Island's expected capacity.

On the basis of this assessment, the Electricity Commission will consider the procurement of reserve energy if within a period of three years from the time of the assessment the winter energy margin is forecast to fall below 17%, or if the winter energy margin is forecast to fall below 30% for the South Island. The Commission will also consider the procurement of reserve capacity if within two years from the time of the assessment the winter capacity margin is forecast to fall below 780 MW.

If insufficient new generation or demand-side initiatives come to market, the Commission may consider contracting for new capacity.

SHORT-TERM ELECTRICITY SECURITY

The Commission is also required to monitor hydro storage and publish assessments of short-term security by comparing hydro storage against hydro risk curves. Hydro risk curves are designed to reflect the risk of future electricity shortages using a range of likely inflows and taking into account any transmission constraints.

MARKET DESIGN AND REGULATORY FRAMEWORK

MARKET DESIGN

In New Zealand, all electricity is bought and sold via a gross half-hourly pool. All grid-connected generators and distribution-connected generators of over 30 MW offer power into the pool while retailers and large off-take customers submit half-hourly bids. The market is cleared on an *ex post* basis using volumes actually generated and consumed. The market is an energy-only market and there are no capacity markets or capacity payments. A half-hourly instantaneous reserve market is also operated alongside the energy market to ensure that enough backup generation (or, alternatively, load reduction) is available should the largest generator unexpectedly fail. Energy and instantaneous reserve prices are determined half-hourly at all grid injection and exit points (approximately 250 nodes) based on security-constrained dispatch. Pricing is determined *ex post*, and final prices for both energy and instantaneous reserve are normally available by midday on the following day. All pricing, clearing and settlement are administered by the Marketplace Company Limited (M-co), a private company under contract to the Electricity Commission.

The half-hourly wholesale electricity market commenced operation in October 1996. A notable feature of the market is its “full nodal pricing” regime whereby the marginal cost of meeting a change in load or generation at each grid injection and exit point (node) on the country’s electricity network is calculated separately for each node. The differences in prices across the nodes reflect the costs of half-hourly transmission losses and constraints, or congestion. Nodal prices represent the change in the total cost (as represented by market participants’ bids and offers) of meeting system energy requirements caused by a change in load or generation at each node. As such, the price at each node represents the locational value of energy, which includes the cost of the energy and the cost of delivering it, *i.e.* transmission losses and congestion.

In the wholesale market, therefore, nodal prices incorporate the effects of generation bids and demand offers, and transmission losses and constraints, on the total cost of meeting system load requirements. Nodal prices are also affected by the price of instantaneous reserves. This is a result of the trade-off between the cost of energy and instantaneous reserves arising from the co-optimisation of energy and instantaneous reserve markets. As the nodal spot prices signal the marginal cost of delivered energy at each node, this can lead to significant local price fluctuations that can be difficult to manage.

Electricity retailers and a small number of customers (generally large industrial users) buy electricity directly from the spot market. As electricity spot prices can vary significantly across the different nodes, on a half-hourly, weekly and seasonal basis, these parties will typically also enter into financial hedges which smooth out some, or all, of the volatility in spot prices.

Financial and transmission hedging mechanisms are not well developed, largely because of the complexity of the nodal pricing system which, at times of high transmission constraints and losses, can lead to a fragmentation of the national market into smaller regional markets. It has proven difficult to develop a standardised energy hedging product that could be exchanged or traded for such small regional markets when fragmentation occurs. Likewise, the small number of market players (sometimes only

one) at each node means there is likely to be limited liquidity in any transmission hedging product at that node.

The system operator dispatches generation in accordance with generator offers, in order to ensure that supply and demand balance in real time. Prior to real time it produces half-hourly schedules of expected volumes and prices, for information purposes only. Frequency keeping reserve is procured by the system operator who typically has one dedicated generating unit in each island. Scheduling, dispatch and pricing are regulated and administered by the Electricity Commission.

The instantaneous reserve market is split into the “fast” (six-second reaction) and “sustained” (sixty-second) instantaneous reserve markets. Providers of these services must be registered with the system operator. Offers to provide the service are submitted to the system operator in the same way as the energy market. Interruptible load makes up to 20%-40% of offers into the instantaneous reserve market. The dispatch model does not prefer one type of reserve over another. Instantaneous reserve prices are calculated at the same time as the energy spot prices. As instantaneous reserve prices typically reflect the opportunity cost of generation, they are often higher than the energy spot price when supply is low. The cost of instantaneous reserves procured through the market is allocated to those generating stations (or the HVDC link) that are setting the need for instantaneous reserve, being the largest unit(s) operating on the system at that point in time – known as the largest contingent event. If a generating station (or the HVDC link) actually fails and causes a low-frequency event, there are other charges laid against the causer of the event.

REGULATION

Relative to the size of the market, the governance arrangements appear somewhat complex. Two bodies, the Electricity Commission and the Commerce Commission oversee the operation of the sector, albeit with very different functions.

The *Electricity Commission* is a Crown entity established in 2003 under the Electricity Act. Its objectives and outcomes are set out in a Government Policy Statement on Electricity Governance published in May 2009. The principal objective of the Electricity Commission is to ensure that electricity is produced and delivered to all consumers in an efficient, fair, reliable and environmentally-sustainable manner and to promote energy efficiency. The Electricity Commission regulates the technical operation of the electricity industry and markets (wholesale and retail) in accordance with the Electricity Act and government energy policy.

The *Commerce Commission* is New Zealand's primary competition and economic regulatory agency. It is an independent Crown entity established under Section 8 of the Commerce Act 1986, and its purpose is to achieve the best possible outcomes in competitive and regulated markets for the long-term benefit of New Zealand. The Commerce Commission regulates the revenue of electricity transmission and distribution networks, as well as gas pipelines, airports, telecommunications and the dairy industry.

A key finding of the *Ministerial Review into Electricity Market Performance*, published in December 2009, is that additional measures are needed to improve electricity market governance. The government replaced the Electricity Commission with an Electricity (EA) as an independent Crown entity in October 2010. The objective of the EA is to promote competition, reliable supply and efficient operation of the electricity market for the long-

term benefit of consumers. Set-up and ongoing costs of the EA are to be met by a levy on electricity industry participants from January 2010. The role of the EA will also be simplified by transferring a number of functions to other bodies:

- The system operator will undertake emergency management and provision of information and forecasting on security of supply, subject to rules set by the EA.
- The Commerce Commission will review and approve grid expenditure plans by Transpower as part of its overall regulation of Transpower's revenue requirements and expenditure under Part 4 of the Commerce Act.
- The Energy Efficiency and Conservation Authority (EECA) will absorb the Electricity Commission's energy efficiency programmes.

A Security and Reliability Council, comprising senior representatives from the electricity sector, including electricity users, will be established. Its purpose will be to help monitor and provide advice on the system operator's performance of its functions and on security of supply issues.

MARKET REFORM

Ministerial Review of Electricity Market Performance 2009

In response to a public perception that the New Zealand electricity supply system is fragile and vulnerable to frequent crises, the Ministry of Economic Development initiated an electricity market review in April 2009. The review was led by an independent Electricity Technical Advisory Group (ETAG), appointed by the Minister of Energy and Resources, with assistance from officials from the Ministry of Economic Development. The objective of the review was to improve the performance of the electricity market, its institutions and its governance arrangements. The review focused on the objective of ensuring that the electricity sector contributes to economic growth by providing security of supply and efficient prices.

The review found that all consumers were paying prices higher than justified by the cost of new generation, with domestic customers bearing a large portion of the cost. A discussion document setting out the review team's preliminary recommendations was released for public consideration in August 2009. In December 2009, the Minister of Energy and Resources announced the outcome of the review; 29 new measures to improve electricity market performance. Among the measures were proposals to reduce prices and costs by boosting competition, to improve security of supply, and to improve electricity market governance.

The most significant and controversial proposals relate to the reconfiguration of the assets of state-owned enterprises (SOEs). Two power stations at Tekapo (Tekapo A and B) will be transferred from Meridian Energy to Genesis Power while the government-owned Whirinaki plant – currently part of the Reserve Energy Scheme – will be transferred to Meridian Energy. The purpose of this change is to stimulate competition by providing each utility with access to generating capacity outside their home island. This is in contrast to the position taken at the time of market liberalisation, when the decision was taken to keep all stations on each river-chain under common ownership, to prevent gaming and to maximise hydro management efficiency. With this asset swap,

Genesis (the largest thermal generator) now controls the upstream hydro supply to Meridian (the largest hydro generator).

In addition, Meridian Energy, Genesis Power and Mighty River Power were mandated to undertake “virtual asset swaps” involving one-off long-term (15-year) financial hedge contracts as follows:

- Meridian Energy to sell 1 000 GWh per year of “South Island” energy to Mighty River Power, and buy 1 000 GWh per year of “North Island” energy from Mighty River Power;
- Meridian Energy to sell 450 GWh per year of “South Island” energy to Genesis Power, and buy 450 GWh year of “North Island” energy from Genesis Power.

The development of a liquid hedge market has been a focus for the Electricity Commission since it was given priority in the May 2008 Government Policy Statement. The Commission has been working on several proposals since 2006. Changes implemented include the publication of the key aspects of hedge contracts, the development of a standardised schedule for trading electricity derivatives, and the development of EnergyHedge, a privately owned market platform. The Australian Stock Exchange has recently begun trading New Zealand electricity futures and options contracts.

As part of the reform programme, the Minister of Energy and Resources instructed major generator-retailers (with over 500 MW of capacity) to develop some form of exchange-traded electricity contracts by means of market-maker arrangements offering buy and sell prices with a maximum spread. The objective is to provide liquidity and open access for new-entrant generators and retailers and for consumers. The market is to have the following components:

- standardised, tradable contracts;
- a clearing house to act as counter-party for all trades;
- low barriers to participation and low transaction costs; and
- market makers (offering buy and sell prices within a maximum spread) to provide basic market liquidity.

An assessment of market liquidity is to be completed by June 2011. This assessment will be judged against a threshold definition of satisfactory liquidity set at 3 000 GWh of unmatched open interest (contracts without matching offsetting contracts). In the event that the new market fails to achieve satisfactory liquidity, the Electricity Market Authority reserves the right to impose mandatory market making on the major generators.

The Electricity Commission is also taking steps to improve ease of market entry for smaller retailers, for example cleared funds payment, clarity for invoice disputes, and the transfer of wholesale obligations to other participants. As a result, smaller retailers have entered the market and become established.

Commerce Commission’s Electricity Markets Investigation

In May 2009, the Electricity Commission completed a four-year review of wholesale and retail electricity markets. The investigation was prompted by complaints about use of market power by vertically integrated generators and retailers (gentailers) and the perceived high level of prices and industry profits.³² The purpose of the investigation was to determine

32. Meridian Energy, Contact Energy, Genesis Power and Mighty River Power.

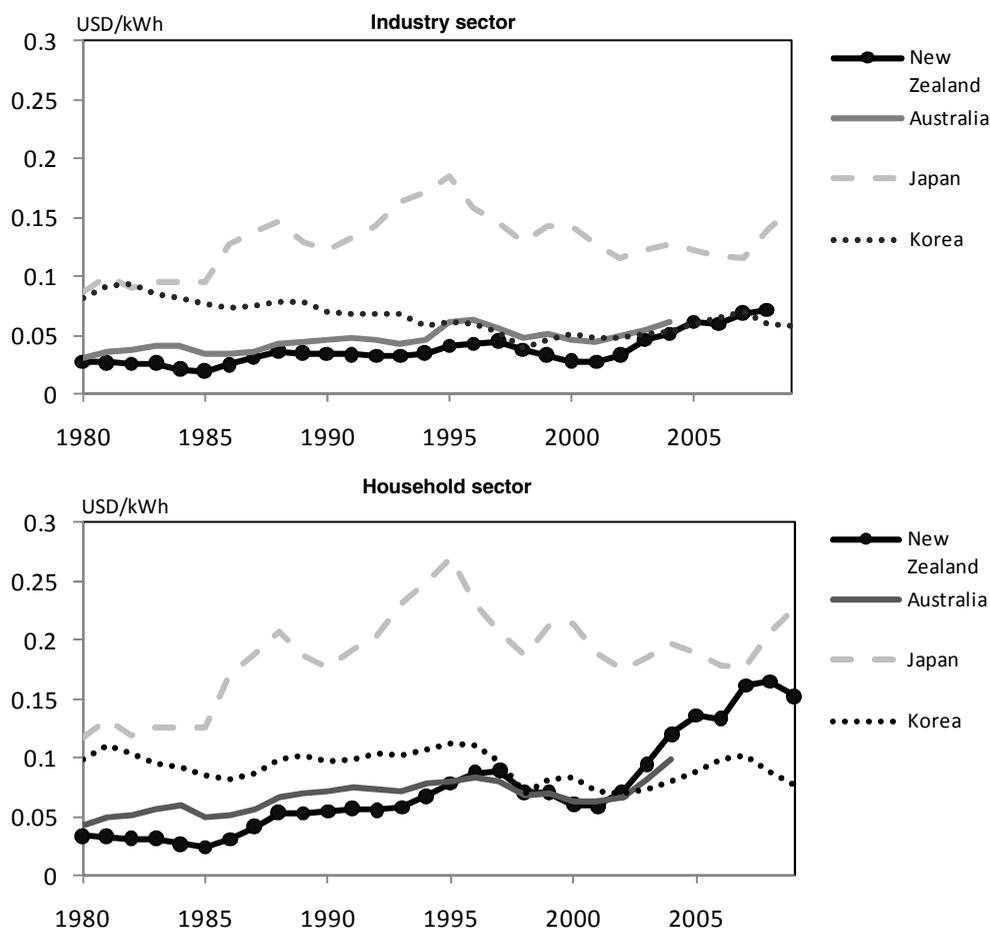
whether “any gentailers have a substantial degree of market power, and have used it to inhibit competition” and also whether “any gentailers have entered into contracts or arrangements that have substantially lessened competition in breach of the Commerce Act.”

Evidence gathered during the study suggested that over certain periods (when hydro storage levels are low or becoming low), all four companies under investigation have the ability to exercise market power, and actually do so. Among other things, the investigation found no evidence that companies had attempted to use their market power to harm competitors and found no evidence of conduct that would lead to a breach of the Commerce Act. The investigation found that periods of high prices reflected generators lawfully using their market power to maximise profit rather than being the result of anti-competitive behaviour.

PRICES AND TARIFFS

Electricity prices in New Zealand are unregulated with the exception of transmission and distribution charges. Retailers are required to provide low fixed-charge tariff options for low energy users under the Electricity (Low Fixed Charge) Regulations 2004. Prices for households are among the lowest in the OECD while prices in the industrial sector are understood to be among the lowest. However, retail prices have risen significantly since the late 1990s.

Figure 19. Electricity prices in New Zealand and in other selected IEA member countries, 1980 to 2008



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2010.

Box 3. Smart metering in New Zealand

The current roll-out of smart meters (Advanced Metering Infrastructure or AMI) in New Zealand is being undertaken by the industry on a voluntary basis and guided by light-handed regulatory policies.

In 2007, the Electricity Commission consulted widely with the industry on requirements for AMI in New Zealand. The outcome of that consultation was the publication of the Advanced Metering Policy (the Policy) and Guidelines on Advanced Metering Infrastructure v2.0 (the Guidelines) in May 2008. These Guidelines set out recommended minimum standards for AMI systems being installed in New Zealand. Utilities were not required to comply with the Guidelines, which are recommendations only.

In May 2009, a Government Policy Statement was published, which required the Electricity Commission to report to the Minister of Energy and Resources (the Minister) by the end of 2009 regarding regulation of smart meters. The report included the Electricity Commission's recommendations on whether the roll-out of AMI should be regulated, whether technical standards for AMI should be regulated, or whether the present voluntary AMI Guidelines are adequate.

Unlike many other jurisdictions, metering in New Zealand – including the provision of AMI services – is a competitive activity. In addition, during the Electricity Commission's investigation, concerns were expressed that there is a lack of international consensus on standards for AMI components such as the home area network (HAN). Owing to this lack of consensus, extensive mandating of the technology used in AMI at this stage runs the risk of "locking in" a sub-optimal technology, or stranding assets if a better technology is adopted in the future. The Electricity Commission's recommendation to the Minister, therefore, was that it is not necessary to extensively regulate the roll-out of AMI at this time, as the benefits of regulation do not outweigh the costs. Nonetheless, the Commission gave a commitment to continue to monitor the development of AMI standards and technology, and will review its recommendations should standards, technology or practice change to the extent that further regulation becomes desirable.

In coming to its conclusion, the Electricity Commission noted broad concerns that an unregulated, retailer-led AMI roll-out may result in AMI functionality that delivers benefits to retailers rather than to consumers.

However, the Electricity Commission found that the AMI systems being rolled out provide a full range of benefits with the key exceptions being information that may assist local distribution companies such as last gasp functionality, and the interface with a home area network (HAN). Conversely, the Commission concluded that some aspects of AMI will be regulated: information formats and protocols; access to and use of data stored by AMI systems; and the disconnection of pre-pay consumers by AMI systems.

In response to the Electricity Commission's findings, the Parliamentary Commissioner for the Environment (PCE) raised concerns around two smart meter functions: HAN's communication capability; and real-time in-home displays. The PCE noted that 800 000 meters without HAN capability are planned for roll-out by 2012. The PCE claimed that without HAN capability, the benefits from smart meters almost entirely accrue to the retailer, while consumers may end up paying for meters that provide them with minimal direct benefits. Adding functionality at a later date is estimated by the PCE to cost NZD 60 million more, thereby creating an unnecessary barrier. It should be noted that some industry participants, including metering companies, dispute this cost estimate. Therefore, among other suggestions, the PCE recommended to the government that:

- power companies are required to only install smart meters that will not need the capability for home area network communication retrofitted, by making the relevant Electricity Commission's Guidelines mandatory.
- the HAN protocols used in all smart meters and smart appliances to be either the same or "open access" in order to avoid a potential barrier to consumers switching between retailers.

CRITIQUE

New Zealand is almost unique among IEA member countries in that it cannot rely on electricity imports or exports to balance supply and demand. The supply mix is dominated by hydropower largely situated in the South Island, which is transported to the North Island via an HVDC link, where most demand is located. Since the last IEA in-depth review in 2006, the government has made a number of positive changes, including improving the regulatory regime for distribution to provide for efficient and cost-effective regulation of infrastructure services which are not subject to competition. In December 2009, the Ministerial Review of Electricity Market Performance proposed 29 measures to improve the performance of the electricity market and its institutions and governance arrangements. These are welcome steps.

Despite its size and peripheral location, New Zealand was among the first OECD member countries to reform its electricity market along competitive market-oriented lines. While the innovative nodal-pricing regime delivered benefits in the early years, progress in recent years in developing the market has been slow. Generators and retailers tend to be both vertically integrated and geographically concentrated, while there have been indications that retail profit margins are relatively high and that margins tend to be highest in regions with less active or fewer retailers.

There are five large players in the market at present, each one being both a generator and a retailer: Meridian Energy; Contact Energy; Genesis Power; Mighty River Power; and TrustPower. With the exception of Contact Energy and TrustPower, all are state-owned enterprises (SOEs). There are also a number of smaller generators and niche retailers. The SOEs enjoy approximately 60% market share in both the generation and the retail markets. Retail businesses tend not to be active throughout the country but concentrated in the regions where they have access to generating capacity or large urban centres, thereby limiting choice for many customers. One of the reasons for this is the inability to hedge financially for transmission costs, which can be highly volatile in transmission-constrained areas owing to the nodally priced network. The lack of financial hedging encourages the physical hedge of co-locating supply and demand.

Following an inconclusive Commerce Commission review, and in response to other concerns, the government undertook a Ministerial Review of Electricity Market Performance, the findings of which were published in late 2009. The main decisions of the review included a significant reconfiguration of SOE assets in order to stimulate greater levels of generation and retail competition, and measures to encourage the development of a liquid hedge market. These changes should facilitate the emergence of greater levels of competition and the entry of new market participants. On the other hand, there remains some concerns regarding hydro management and gaming.

The government also decided to take steps to improve electricity market governance by replacing the Electricity Commission with an Electricity Authority (EA) as an Independent Crown entity in October 2010, and by simplifying the role of the new EA. Again, measures to streamline and simplify the regulatory arrangements for the electricity market are welcome.

Given New Zealand's heavy reliance on hydropower, the country's electricity supplies are at risk during drought periods. This can result in higher prices and unpopular public conservation campaigns, Droughts in 2001, 2003 and 2008 have highlighted the vulnerability of the country's electricity supply system. As a result, the market has

responded, new generation has been commissioned and a number of gas-fired, wind, and geothermal generation projects have been proposed. It should be noted that these capacity additions will meet baseload demand growth, rather than assist with dry-year management, and will make the 90% renewables target more difficult to achieve. The government has also taken further steps to ensure security of supply by making certain that the second phase of the review of the Resource Management Act takes into account the needs of significant generation projects.

Owing to the location of hydropower production in the South Island and the concentration of consumption in the North Island, the inter-island HVDC link plays a major role in transporting electricity. It is important to the functioning of the whole market. The inter-island link has had capacity restrictions and transmission constraints. Transmission investment over the past decade has been inadequate, grid performance is falling, the network is often overloaded and constraints are frequent. In this regard, the publication of *Transmission 2040*, an update of the Transpower Grid Development Strategy in August 2008, was a welcome step. Transpower, the transmission grid owner and an SOE, has since started work on upgrading and refurbishing important infrastructure including the upgrading of the HVDC inter-island link. Improvements in infrastructure are welcome but further changes to the structure of the market, such as the development of congestion or transmission hedges and a capacity market, are needed. The New Zealand energy market is an energy-only market; it does not have a parallel capacity market to deliver adequate supply and system reliability. At present, wholesale spot prices reflect transmission losses and congestion at each of the nodes on the system, and generators and consumers face their own nodal price. Market participants hedge spot-price risk by contracting bilaterally, usually by self-contracting, where the generator and supplier are the same utility. There is no market for financial transmission rights or other financial transmission hedges, and market players face risk when contracting at spot prices. In the Canadian province of Manitoba, which relies on hydropower for much of its electricity production, a market for transmission capacity has been successfully introduced.

New Zealand is to be complimented for its continuous efforts to maintain arms-length regulation; however, this can sometimes lead to sub-optimal results. One example is the introduction of smart meters. Smart metering is being rolled out across New Zealand, generally installed by retailers, in contrast to the preferred approach in many of other IEA member countries, where metering is owned by the distribution companies. The Electricity Commission has introduced voluntary guidelines for smart meters and has considered developing mandatory metering standards. Regardless of the ownership of the meters, they should provide necessary energy efficiency capability, open-access communications, customer switching and should facilitate the development of smart grids. The early smart meters are already missing load control possibilities. In five years time, almost 1.8 million meters will have been replaced by smart meters.

Smart meters form an important part of energy policy and environmental policy, but the government has no influence on the outcome of the present programme, which may result in a sub-optimal outcome. The technology being rolled out in New Zealand will deliver benefits to retailers, but limited benefits to the environment or to electricity consumers. More sophisticated metering technology is required to fully integrate consumers into the smart grid of the future and fully realise the undoubted potential of the technology by, for example, allowing small-scale electricity generators to participate

in the market, and by allowing the more efficient roll-out of electric vehicles. We urge the government not to miss out on the present opportunity.

There are 29 different distribution companies in New Zealand and each determines its own conditions for access. Consequently there is an enormous amount of different conditions for access to the distribution networks. This forms a barrier against retailers becoming active throughout the country owing to the administrative burden of negotiating new conditions for access to each network. Standardisation of distribution access conditions for retailers can assist the development of retail competition.

The electricity sector shares several regulatory agencies and institutions. The government has recognised the need to restructure the roles of these agencies, an improvement that is widely supported by the different market sectors. However, it may be more efficient to have all regulatory functions relating to the electricity market integrated in the new Electricity Authority. In the most recent government proposals, responsibility for approval of investments in infrastructure, along with revenue regulation of transmission and distribution services, is vested in the Commerce Commission.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Continue to remove barriers to entry for new market participants and improve competition both at wholesale and at retail markets, by first implementing the relevant proposals from the Electricity Market Performance Review.*
- Recognise that self-regulation can lead to undesirable outcomes and intervene when necessary, for example by regulating the introduction of smart metering and standardisation of distribution third-party access conditions.*
- Improve New Zealand's electricity market provisions for meeting dry years, primarily by means of market-based solutions, including strengthening the HVDC inter-Island link, introducing transmission congestion hedges, and creating a market for transmission capacity.*
- Integrate all regulatory tasks into one Electricity Authority and let the Commerce Commission focus solely on competition issues in the energy sector.*
- Review the decision with regard to the regulation of the roll-out of advanced metering technology and take into greater consideration the needs of the future smart grid.*

PART III
ENERGY TECHNOLOGY

10. ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT

OVERVIEW

The overall goal of energy research and development (R&D) policy is to support and enhance innovation in energy opportunities. New Zealand's geographic isolation and unique mix of energy resources means there are a number of sectors where investments in energy-related research activities can bring value.

GOVERNMENT INSTITUTIONS AND AGENCIES.

The *Ministry of Research, Science and Technology* (MoRST) is the lead policy ministry for research and development. The ministry provides advice to the Minister of Research, Science and Technology and oversees the government's investment in research, science and technology (RS&T). The ministry manages the NZD 745 million public funding for RS&T by advising the minister on priorities for investment and ensuring there are systems in place so that the money spent can be evaluated, of which approximately 4% is allocated to energy-related R&D. The ministry also helps to facilitate links between the New Zealand RS&T sector and overseas research interests, as well as with New Zealand businesses and the general public.

The *Foundation for Research, Science and Technology* (FRST) was established by government in 1990 to invest in research, science and technology for the benefit of New Zealand. FRST administers energy R&D funding for government, contracts research and provides investment support for the Energy and Minerals Research Scheme.

In June 2010, the government agreed to establish a new ministry, the Ministry of Science and Innovation, formed from the amalgamation of MoRST and the Foundation for Research, Science and Technology. The amalgamation is part of the government strategy to boost the contribution of science to the economy. In addition to combining the existing functions of the two bodies, the new ministry will advise shareholding ministers on the performance of Crown Research Institutes. At the same time, the government announced measures to ensure that research funding decisions will be independent and new legislation is being prepared to permit the minister to appoint boards that will take independent funding decisions based on published criteria. As is the case now, the minister will not be able to direct decisions on individual research proposals. The new ministry is likely to be established in the early part of 2011, once enabling legislation is in place.

The Ministry of Research, Science and Technology has published a number of Government Policy Statements, which provide details of government policy or decisions related to RS&T. A number of these statements, or Roadmaps for Science, which are designed to guide New Zealand's science and research strategy, relate directly to the energy sector. The main purpose of the Roadmaps is to communicate the needs and opportunities for publicly funded science within selected science areas.

Crown Research Institutes (CRIs) are government-owned research agencies responsible for much of the scientific infrastructure in New Zealand. Relevant examples include the Institute of Geological and Nuclear Sciences (GNS Science) and Scion.

GNS Science is a government-owned research institute operating as a limited liability company. It is a provider of earth, geoscience and isotope research and consultancy services to apply geological knowledge to accelerate petroleum exploration. GNS Science is overseen by an independent board of directors. Similar to other CRIs, it receives funding through contestable and non-contestable government investments and from the sale of consultancy services and research contracts.

The CRI *New Zealand Forest Research Institute Limited*, better known as *Scion*, is supporting the international competitiveness of the New Zealand forest industry and building a stronger bio-based economy. One of its goals is to accelerate the development of bio-products from renewable resources.

Energy research is also undertaken in other CRIs, in universities and in independent research agencies. For example CRL Energy is an energy and environmental research and consulting company, active in energy technologies such as hydrogen and biomass conversion and fossil fuel energy, particularly coal-related research. CRL Energy's research programme, funded by the Foundation for Research, Science and Technology, includes coal gasification, carbon capture and storage (CCS) and hydrogen production from coal, plus environmental protocols for coal and mineral mining.

The *Ministry of Transport* has published a Transport Research Strategy, which sets out the government transport sector's research needs for the short term and includes a research work programme that identifies priorities for the transport sector over the next five years.

POLICY OVERVIEW

There is limited policy guidance for energy-related R&D in New Zealand. Energy R&D policy is guided by a range of energy legislation, regulation and policies, which are in turn implemented by a range of government and state-owned agencies. In April 2009, the Ministry of Research, Science and Technology published its annual Statement of Intent; the document which sets out the ministry's operating intentions for the period 2009 to 2012. The Statement identified two immediate priorities for the broad research sector: first, simplifying the system and reducing processes around applications and compliance, and secondly, developing a clearer statement on the government's science priorities so that ongoing research and investment can be better focused. For the energy sector, the document identified the need to enhance international relationships in the areas of renewable energy research and development to help support New Zealand's energy security and economic development.

The *Energy Research Roadmap*, published in December 2006, assists with this process. The Roadmap sets out the national and international context for energy research, identifies the broad range of research capabilities New Zealand needs to develop and gives direction on how to maintain and improve those capabilities. This Roadmap focuses primarily on publicly funded research. It also highlights the need for enhanced co-operation and co-ordination of research activities. The Roadmap does not attempt to identify or prioritise the more detailed research that will contribute to any particular energy future that may be chosen; instead, it identifies three directions for energy

research in New Zealand. These reflect the fact that while energy research is essential, the value and contribution of the research is enhanced through a range of partnerships and linkages between research institutions and industry. The research directions identified are:

- the building and maintenance of a broad suite of critical energy research capabilities;
- identification of priority research capabilities for the near term; and
- system enhancements to ensure that energy research contributes effectively to a sustainable energy future for New Zealand. This will be done by means of greater co-ordination in research areas where capability is dispersed across research institutions and across different disciplines and technology options; by effective connections developed with overseas research teams and international initiatives; and by research capability which is strongly linked with industry partners where appropriate.

The Roadmap identified seven areas as critical research capabilities for New Zealand, reflecting the state of capability and challenges at the time. The critical energy research capabilities identified in the Roadmap were:

- indigenous energy resources and energy use assessment;
- bioenergy;
- carbon capture and storage technologies;
- new energy sources (including wind, marine, biomass and new technologies such as hydrogen-powered fuel cells) and carrier technologies;
- economic and whole-system energy sector modelling;
- acceleration of uptake and consumer behavioural change for efficiency and energy/growth decoupling; and
- smart integrated grids for distributed and variable energy sources.

An *Environment Research Roadmap* was published in May 2007. One of the purposes of this Roadmap was to provide long-term direction for the development of key environmental science capabilities and to align New Zealand's RS&T with government strategies to manage the environment. The Roadmap highlights that a number of government strategies and policies provide frameworks and directions for environmental management but parallel science strategies are few. It attempts to address this gap and to provide direction for the future development of New Zealand's RS&T, aligning it closely and more effectively with government strategies. The Roadmap identifies six broad environmental research areas, including the need for better modelling to predict future climate-change scenarios and enhanced international collaboration. It supports renewable energy research and understanding of greenhouse gases, opportunities for their mitigation, the consequences for international reporting, and social and economic adaptation to global change.

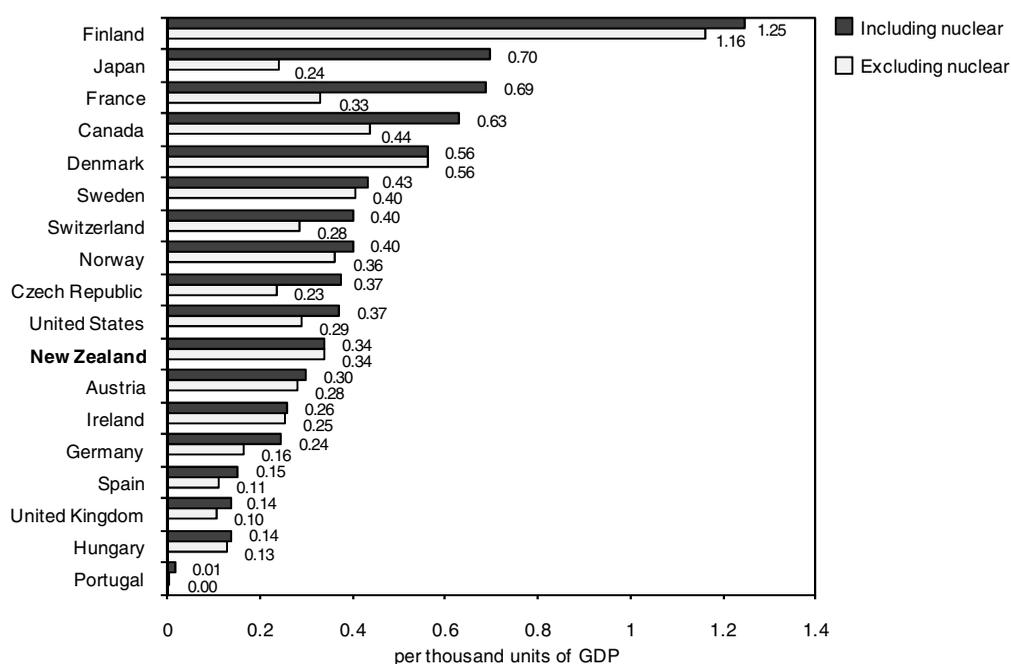
In December 2009, following a consultation with stakeholders, the government established new science priorities for public investment in research, science and technology. Among these priorities were research to improve mineral extraction and energy security, efficient and affordable energy use, research to improve building and infrastructure durability, research to underpin the management, protection and improvement of ecosystems, land and freshwater resources, climate and atmosphere both in New Zealand and Antarctica. These priorities came into effect on 1 July 2010. The amount of funding for each priority area was announced in the May 2010 Budget (see Table 5).

OTHER POLICY INITIATIVES

Concurrent to these changes, a Crown Research Institute (CRI) Taskforce was established by government in October 2009. The purpose of the Taskforce was to review the existing model to ensure CRIs are effectively contributing to New Zealand's development. The report of the Taskforce was released by the Minister of Research, Science and Technology on 4 March 2010. The report recommended streamlined funding processes, strengthening of governance structures and clarified goals for each CRI.

In May 2010, the government released *Igniting Potential: New Zealand's Science and Innovation Pathway*. This document sets out in detail the government's strategy for science and innovation, identifies research priorities and provides a more direct pathway for implementing priorities. Research in environment, minerals and energy were identified as priority outcome areas.

Figure 20. Government RD&D budgets in IEA member countries, 2008



Note: Data not available for Australia, Greece, Italy, Korea, Luxembourg, the Netherlands, Poland, Slovak Republic and Turkey.
Sources: OECD *Economic Outlook*, OECD Paris, 2009 and country submissions.

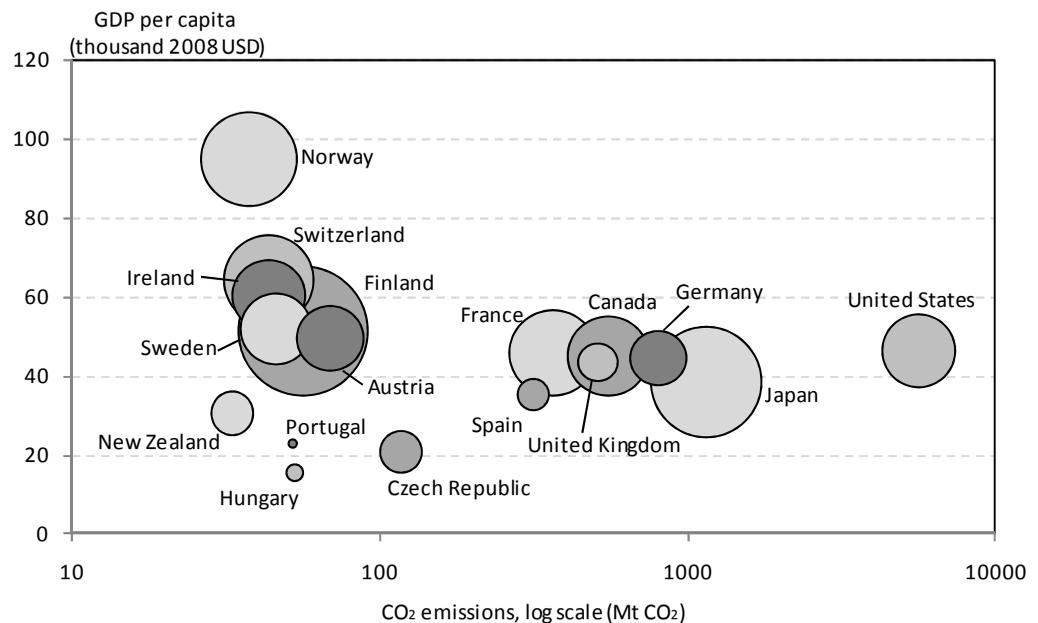
The government also decided to revise the 2007 New Zealand Energy Strategy and the New Zealand Energy Efficiency and Conservation Strategy. The former, published in July 2010, indicates that government will prioritise research funding in sectors directly related to the country's resource strengths and unique characteristics, where there is commercial potential. Government research funding will support research to improve petroleum and mineral extraction, energy security and efficient and affordable energy use. Bioenergy and geothermal energy are also identified as research priorities. The accompanying draft New Zealand Energy Efficiency and Conservation Strategy 2010 affords priority to energy R&D funding to develop renewable energy and demand-side management technologies that will contribute to improved energy security, and efficient and affordable energy use.

FUNDING

New Zealand's general innovation system has a number of weaknesses, including a low level of public investment in R&D compared to other OECD countries.

Even if publicly funded spending on R&D has increased significantly over the past five years, government investment in energy-related R&D remains low (see Table 5). Conversely, while overall investment in energy-related R&D activities is increasing, most of the incremental spending is being absorbed by two sectors: biofuels and geothermal energy. The government announced its investment in research, science and technology in Budget 2010 on 11 May. Support totalling NZD 321 million over four years was made available for investment in new initiatives.

Figure 21. **Public-sector low-carbon RD&D spending per capita as a function of GDP per capita and CO₂ emissions**³³



Source: IEA.

The various Crown agencies and ministries that make up the New Zealand government are funded through a series of packages called "votes". The vote Research, Science and Technology (RS&T) - currently stands at NZD 768 million (2010/11 Budget) excluding goods and services tax. The vote is made up of a number of output expenses, a group of outputs that deliver a common set of goods or services. The funding for each output expense is specified in the budget each year. The energy-related output expenses include:

- energy and minerals research; support for research and research applications to improve mineral extraction, improve energy security and to obtain efficient and affordable energy use;

33. The size of the bubble indicates public spending on a per-capita basis. GDP and population statistics were taken from the World Bank; RD&D spending data are taken from the most recent IEA statistics (2009/10). All data are expressed in 2008 US dollars. CO₂ emissions data sourced from IEA, CO₂ Emissions from Fuel Combustion, 2009 edition.

- environmental research; support for research, and research applications, to underpin the management, protection and enhancement of natural ecosystems, land and freshwater resources, climate and atmosphere within New Zealand, including Antarctica.

Table 5. Government funding for energy-related R&D, 2009/10

Research area	Funding (million NZD)
Biofuels	10.45
Oil and gas	4.4
Geothermal	3.81
Demand/efficiency	1.4
Hydrogen	1.38
Marine (excluding deployment fund)	1.15
Solar photovoltaic	1.15
Carbon capture and storage	1
Energyscape (policy)	0.9
Other	1.26
Total	26.9

Source: Foundation for Research, Science and Technology.

In recent years, the greatest increase in funding has been in biofuels which has grown from NZD 1.1 million in 2007/08 to NZSD 10.5 million in 2009/10. Geothermal has increased from NZD 2 million to NZD 3.8 million in the same period.

New Zealand identified a need to support the piloting, scale-up and proving of good ideas in the laboratory to ready them for commercial investment. The Low-Carbon Energy Technologies Fund (LCET) was established in 2007 to support research related to the scale-up and demonstration of existing research on second-generation biofuels, other low-carbon liquid biofuels and low-carbon energy technologies. The NZD 12 million funding pool has been fully allocated over three years and funding will cease at the end of the three-year term of the fund.

The Marine Energy Deployment Fund is administered by the Energy Efficiency and Conservation Authority. It provides grants to deploy research devices in the marine environment. Grants are being made over four rounds, from 2008 to 2012, from a fund of NZD 8 million. Round One allocated NZD 1.85 million to the Kaipara Harbour Project to install a 1.0 MW pilot marine turbine. Round Two allocated NZD 0.76 million to New Zealand-designed and built wave device. The Wave Energy Technology-New Zealand (WET-NZ) Project is a consortium R&D programme previously funded by the Foundation for Research, Science and Technology. The partners are two Crown Research Institutes: Industrial Research Limited and the National Institute of Water and Atmospheric Research (together with Power Projects Limited).

Round Three has awarded NZD 2.16 million to a proposal from Chatham Islands Marine Energy Ltd (CHIME) to install a shore-based device to capture wave energy. The device, comprising two 110 kilowatt Wells turbines, will be installed on the south-west coast of Chatham Island, and will supply electricity into the island's electricity network.

Separately, the Biodiesel Grants Scheme promotes the biodiesel production industry in New Zealand, and encourages the deployment/uptake of environmentally responsible fuels. The programme will provide grants up to NZD 36 million over three years, at a maximum rate of NZD 42.5 cents per litre of biodiesel.

Private-sector investment in energy R&D activities is generally understood to be low although indicators such as take-up of tax credits suggest this is growing rapidly. In the recent past, private-sector investment in R&D could take advantage of an R&D tax credit. The credit applied at the rate of 15% of eligible R&D expenditure or depreciation loss in an income year and operates on a self-assessment basis. The tax credit was replaced in 2010 by two schemes to support R&D: technology development grants to support companies with existing strong R&D capabilities, and technology transfer vouchers for companies with emerging or growing R&D capabilities.

INTERNATIONAL COLLABORATION

New Zealand is a member of, and an active participant in, the International Energy Agency, in the Energy Working Group (EWG) of the Asia-Pacific Economic Co-operation (APEC), in the Science and Technology Working Group of APEC (ISTWG); and in the International Partnership for the Hydrogen Economy. Results of research carried out in these forums are disseminated from those attending standing committees, working groups, expert groups, implementing agreements, etc. to various industry associations and through the distribution of relevant publications.

New Zealand also belongs to eight IEA Implementing Agreements: Buildings and Community Systems; Solar Heating and Cooling; Demand Side Management; Greenhouse Gas R&D; and four renewable energy and hydrogen agreements.³⁴ New Zealand has joined the Carbon Sequestration Leadership Forum (CSLF) and the Global Carbon Capture and Storage Institute (GCCSI) and is also a member of the Cooperative Research Centre for Greenhouse Gas Technologies (CO₂CRC)

New Zealand, the United States and Iceland are partners in the International Partnership for Energy Development in Island Nations (EDIN). This partnership focuses on deployment of renewables but also encourages research and development linkages.

OTHER COLLABORATIONS AND PARTNERSHIPS

New Zealand encourages the development of private-public partnerships in energy and has established a CCS partnership. Funds such as the LCET and the Marine Energy Deployment Fund require co-funding from business and encourage future partnerships, though both funds currently have a finite life of three and four years respectively.

34. New Zealand recently gave 12-months notice of its intention to withdraw from the Solar Heating & Cooling Implementing Agreement and has indicated that it intends to give 12-months notice of withdrawal from the Demand Side Management IA also.

CRITIQUE

Investment in energy technology research and development in New Zealand is traditionally at the lower end of the OECD scale in terms of dollars spent per unit of GDP. Nonetheless, the amount of money invested in R&D is increasing, with investment generally in line with government priorities, with much of the increase in funding over recent years targeted on the biofuels and geothermal energy sectors. Total government funding, excluding marine energy, in the most recent budget year was approximately NZD 26 million, almost double what it was four years ago. Renewable energy and fossil fuels attract the bulk of the available resources; 53% (of which biofuels is the most significant beneficiary) and 19% respectively.

The IEA views energy R&D as an important policy instrument to meet national energy policy objectives and, given limited resources, a coherent energy R&D strategy with clear prioritisation in line with national energy policy goals is essential. Accordingly, the existence of a clear national energy policy is an important precondition to formulate a stringent and target-oriented public energy R&D strategy. In the case of New Zealand, a national energy strategy is absent at present; therefore, the link between energy R&D and other relevant policy areas is not as clear as it needs to be. Nonetheless, it is obvious that the major objectives of energy R&D are aligned to the government's general economic policy goals but this could be strengthened further by an energy strategy that clearly articulates the link between R&D and long-term policy goals. A clear link between energy policy and energy R&D and other relevant policy areas (e.g. research, innovation, education and industrial policies) should be established in order to maximise efficiency of energy R&D.

Since the last in-depth review, an Energy Research Roadmap has been developed and implemented following substantive engagement with other government ministries and industry stakeholders and in parallel with the previous energy strategy. Concurrently, since our last visit in December 2009, co-ordination across the various agencies and ministries has improved along with co-operation between the public bodies and the private sector. For example, the New Zealand Energy Federation developed an Energy Research Investment Strategy discussing future energy scenarios for New Zealand³⁵ The Royal Society of New Zealand established a panel on sustainable energy which produced a detailed report.³⁶ In addition, sector organisations such as the Bioenergy Association and the Marine Energy Association, AWATEA, actively participate in energy R&D discussions.

The period from early 2005 to 2008 was a particularly active period in the development of energy policy with the publication of the NZES and NZECS and also with a range of other energy and energy research-related initiatives. For example, the New Zealand Energy Federation developed an Energy Research Investment Strategy involving workshops discussing future energy scenarios for the country. The Royal Society of New Zealand established a panel on sustainable energy which consulted and produced a report titled *2020: Energy Opportunities*. In addition sector organisations such as the Bioenergy Association and the Marine Energy Association, AWATEA, hold workshops and conferences with private and public sector participation. R&D is always one of the topics addressed at such events.

Regarding funding mechanisms, there are a number of state institutions active in the sector, each competing for central government funding and in some cases private-sector

35. *Energy Investment Research Strategy*, Energy Federation of New Zealand, 2006.

36. *2020: Energy Opportunities Report of the Energy Panel of The Royal Society of New Zealand*, Royal Society of New Zealand, 2006.

support For example, the Ministry of Research, Science and Technology (MoRST) and the Foundation for Research, Science and Technology (FRST), which will soon be merged to form the Ministry of Science and Innovation, and a number of Crown Research Institutes, including, GNS Science and Scion. The creation of a Ministry of Science and Innovation should provide the industry with greater clarity and direction as will the related decision to ensure that research funding decisions will be independent. The IEA understands that the new funding system will provide balance that will ensure that investment goes to research areas of government priority, while also allowing for independent decisions.

Given New Zealand's unique energy circumstances, a balanced energy R&D portfolio is important since individual R&D projects may well fail to achieve their goals, technologies may change, or additional energy resources may become available. In the case of New Zealand, the scope of research appears balanced but funding has become skewed towards a small number of sectors in recent years and the link between public funding and private-sector investment is unclear, particularly in the petroleum sector. Greater clarity on the role of public funding, where there is private-sector involvement, would be helpful both to avoid duplication of effort and to deliver maximum benefit to tax-payers. Also, New Zealand should consider implementing an energy R&D programme impact evaluation, working with key stakeholders from academia and industry to set programme goals at the outset, before funding is received, and then to conduct interviews/measurement of outputs (*e.g.* patents, exports, technology deployment) and/or surveys to assess whether R&D spending is achieving its goals.

In the case of the petroleum sector, present energy R&D priorities include upstream oil and gas technologies such as mapping the vast New Zealand Exclusive Economic Zone and exploring the potential for gas hydrates. New Zealand imports large volumes of oil and these volumes are likely to increase in the absence of further discoveries. At present, the quality of petroleum reserve data seems weak and annual reported reserves appear to fluctuate from one year to the next. The government's strategic objective for petroleum, contained in the draft New Zealand Energy Strategy, is to ensure New Zealand is a highly attractive global destination for petroleum exploration and production investment, such that the country is able to develop the full potential of its petroleum resources. The immediate focus will be on increasing exploration activity and improving knowledge of petroleum basins. The draft strategy also points to the development of a pathway to realise the potential of New Zealand's gas hydrates endowment. These goals suggest that there needs to be a more integrated and co-ordinated approach to government petroleum research funding, which is decreasing when measured as shares of the overall spend in recent budgets. (Note that the government, through Crown Minerals, has made significant investments in offshore seismic surveys to support oil and gas exploration. These surveys are not recorded as R&D funding.)

Under existing funding arrangements, renewable energies are a government priority, including bioenergy and ocean energy, within the context of revised government policy that has shifted the focus towards those technologies that deliver the greatest economic benefit. Owing to their near-term potential, biofuels and geothermal energy receive the bulk of government support for renewable energy when compared to marine energy, which has also been identified as a potential domestic energy resource. Further investment in marine energy is unlikely to come from the private sector, at least in the short to medium term. As a result, the government should consider whether to expand its funding for marine energy.

KEY RECOMMENDATIONS

The government of New Zealand should:

- Continue to increase levels of public-sector investment in energy research and development to levels of its OECD peers and competing economies. Also enhance efforts to leverage greater private R&D through extending the R&D tax credit and expanding public-private partnerships.*
- Continue to focus energy R&D funding on those sectors that have the potential to deliver long-term sustainable benefits to the economy.*
- Work with stakeholders in academia and industry to regularly review energy technology R&D priorities to ensure that these priorities remain consistent with, and form a part of, broader energy, environmental and economic policies.*
- Regularly review energy R&D policy to ensure that funding priorities are consistent with emerging energy strategies and economic policy and directed towards those sectors most in need of public support. Evaluation methodologies should also be developed and applied to ensure that R&D funds are achieving their stated goals.*

**PART IV
ANNEXES**

ANNEX A

ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The *Shared Goals*, which were adopted by the 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 presented in Annex C.

REVIEW TEAM

The in-depth review team visited Wellington from 7 December to 11 December 2009. During the week-long visit, the review team met with government officials, representatives from ministries and government agencies, energy producers and suppliers, interest groups and various other organisations and stakeholders. This report was drafted on the basis of these meetings and the government response to the IEA energy policy questionnaire and other information. The team is grateful for the co-operation and hospitality of the many people it met during the visit. Thanks to their openness and candour, the review visit was highly productive.

In particular, the team wishes to express its gratitude to Mr. Bruce Parkes, Deputy Secretary, Energy and Communications, Ministry of Economic Development, for his personal engagement in briefing the team on current energy policy issues. His willingness to share information and gracious hospitality contributed in no small way to a successful and productive visit. The author is particularly thankful to Mr. Andrew Roberston and Ms Jo Mackay from the Ministry of Economic Development, government of New Zealand and Mr. Jeffrey Clarke, New Zealand Delegation to the OECD, for co-ordinating the team visit and their ongoing support throughout the drafting process.

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Kieran McNamara managed the review and drafted the report with the exception of Chapter 8 on Oil, which was drafted by James Simpson, who also contributed to Chapter 7 on Natural Gas. Aad van Bohemen provided helpful input to Chapter 6 on Coal. Ulrich Benterbusch, Shinji Fujino, Nigel Jollands, Prof. Ralph Sims, Tom Kerr, Georg Bussmann and Rebecca Gaghen contributed helpful comments throughout.

Georg Bussmann and Bertrand Sadin prepared the figures. Karen Treanton and Alex Blackburn provided support on statistics. Muriel Custodio, Delphine Grandrieux, Anne Mayne, Jane Barbière and Madeleine Barry managed the production process. Viviane Consoli provided editorial assistance and Marilyn Ferris helped in the final stages of preparation.

ORGANISATIONS VISITED

Over the course of the review week, the team met with, or received submissions from, the following energy and environment stakeholders:

Aotearoa Wave and Tidal Energy Association
Bioenergy Association of New Zealand
BP Oil New Zealand
Chevron New Zealand
Coal Association of New Zealand

Commerce Commission
Consumer New Zealand
Contact Energy
Department of Building and Housing
Electricity and Gas Complaints Commission
Electricity Commission
Electricity Networks Association
Energy Efficiency and Conservation Authority
Energy Management Association of New Zealand
Environment and Conservation Organisations
Foundation for Research, Science and Technology
Gas Association of New Zealand
Gas Industry Company
Genesis Power
Geological and Nuclear Sciences
Institute of Geological and Nuclear Sciences (GNS Science)
Gull Petroleum
Jeanette Fitzsimons MP
LPG Association of New Zealand
Major Electricity Users Group
Meridian Energy
Mighty River
Ministry of Economic Development
Ministry for the Environment
Ministry of Research, Science and Technology
Ministry of Transport
Mobil Oil New Zealand
New Zealand Geothermal Association
New Zealand Refining Company Limited
New Zealand Transport Agency
New Zealand Wind Energy Association
Parliamentary Commissioner for the Environment
Petroleum Exploration and Production Association of New Zealand
Scion
Shell New Zealand
Solar Industries Association
Solid Energy Limited
Sustainable Electricity Association of New Zealand
Sustainable Energy Forum
Transpower New Zealand
TrustPower
Vector Limited

ANNEX B

ENERGY BALANCES AND KEY STATISTICAL DATA

	Unit: Mtoe						
SUPPLY	1973	1990	2000	2007	2008	2020	2030
TOTAL PRODUCTION	4.05	11.40	14.19	13.89	14.89	17.30	18.45
Coal	1.29	1.39	2.33	2.83	2.89	3.60	3.29
Peat	-	-	-	-	-	-	-
Oil	0.18	1.96	1.92	2.07	2.92	1.15	0.90
Gas	0.28	3.90	5.06	3.65	3.44	3.25	2.76
Comb. Renewables & Waste ¹	-	0.55	0.86	1.02	1.03	1.20	1.38
Nuclear	-	-	-	-	-	-	-
Hydro	1.23	1.99	2.10	2.03	1.92	2.22	2.43
Wind	-	-	0.01	0.08	0.09	0.16	0.62
Geothermal	1.07	1.58	1.86	2.17	2.56	5.72	7.07
Solar/Other ²	-	0.04	0.04	0.04	0.04	-	-
TOTAL NET IMPORTS²	4.02	1.33	2.55	3.12	1.73	3.98	4.72
Coal Exports	0.02	0.23	1.12	1.46	1.80	2.00	2.00
Coal Imports	-	0.01	-	0.39	0.32	-	-
Coal Net Imports	-0.02	-0.22	-1.12	-1.08	-1.48	-2.00	-2.00
Oil Exports	-	1.47	1.43	1.79	2.86	1.09	0.85
Oil Imports	4.56	3.81	5.93	7.18	7.28	8.60	9.49
Oil Int'l Marine and Aviation Bunkers	-0.53	-0.79	-0.83	-1.20	-1.20	-1.53	-1.92
Oil Net Imports	4.04	1.55	3.68	4.20	3.22	5.98	6.72
Gas Exports	-	-	-	-	-	-	-
Gas Imports	-	-	-	-	-	-	-
Gas Net Imports	-	-	-	-	-	-	-
Electricity Exports	-	-	-	-	-	-	-
Electricity Imports	-	-	-	-	-	-	-
Electricity Net Imports	-	-	-	-	-	-	-
TOTAL STOCK CHANGES	-0.05	-0.04	-0.06	-0.32	0.32	-	-
TOTAL SUPPLY (TPES)³	8.02	12.70	16.69	16.69	16.94	21.28	23.17
Coal	1.26	1.13	1.04	1.54	1.69	1.60	1.29
Peat	-	-	-	-	-	-	-
Oil	4.17	3.51	5.71	6.16	6.17	7.13	7.62
Gas	0.28	3.90	5.06	3.65	3.44	3.25	2.76
Comb. Renewables & Waste ¹	-	0.55	0.86	1.02	1.03	1.20	1.38
Nuclear	-	-	-	-	-	-	-
Hydro	1.23	1.99	2.10	2.03	1.92	2.22	2.43
Wind	-	-	0.01	0.08	0.09	0.16	0.62
Geothermal	1.07	1.58	1.86	2.17	2.56	5.72	7.07
Solar/Other ²	-	0.04	0.04	0.04	0.04	-	-
Electricity Trade	-	-	-	-	-	-	-
Shares (%)							
Coal	15.7	8.9	6.2	9.2	10.0	7.5	5.6
Peat	-	-	-	-	-	-	-
Oil	52.0	27.7	34.2	36.9	36.4	33.5	32.9
Gas	3.5	30.7	30.3	21.9	20.3	15.3	11.9
Comb. Renewables & Waste	-	4.3	5.2	6.1	6.1	5.6	5.9
Nuclear	-	-	-	-	-	-	-
Hydro	15.3	15.7	12.6	12.2	11.3	10.4	10.5
Wind	-	-	0.1	0.5	0.5	0.8	2.7
Geothermal	13.3	12.4	11.2	13.0	15.1	26.9	30.5
Solar/Other	-	0.3	0.2	0.2	0.2	-	-
Electricity Trade	-	-	-	-	-	-	-

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

Forecasts are based on a reference scenario which does not include new technology.

Unit: Mtoe							
DEMAND							
FINAL CONSUMPTION BY SECTOR	1973	1990	2000	2007	2008	2020	2030
TFC	5.87	9.30	12.79	12.47	12.42	13.99	15.24
Coal	0.87	0.95	0.60	0.58	0.62	0.71	0.90
Peat	-	-	-	-	-	-	-
Oil	3.49	3.94	5.21	6.04	5.94	6.95	7.44
Gas	0.14	1.30	3.05	1.44	1.45	1.16	0.94
Comb. Renewables & Waste ¹	-	0.45	0.70	0.85	0.87	1.04	1.22
Geothermal	-	0.27	0.23	0.23	0.23	0.28	0.29
Solar/Other	-	-	-	0.01	0.01	-	-
Electricity	1.37	2.39	3.01	3.32	3.30	3.86	4.46
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	14.8	10.2	4.7	4.7	5.0	5.0	5.9
Peat	-	-	-	-	-	-	-
Oil	59.4	42.4	40.7	48.4	47.9	49.7	48.8
Gas	2.4	13.9	23.8	11.5	11.7	8.3	6.2
Comb. Renewables & Waste	-	4.8	5.4	6.8	7.0	7.4	8.0
Geothermal	-	2.9	1.8	1.9	1.9	2.0	1.9
Solar/Other	-	-	-	0.1	0.1	-	-
Electricity	23.3	25.7	23.5	26.6	26.6	27.6	29.3
Heat	-	-	-	-	-	-	-
TOTAL INDUSTRY⁴	2.21	4.03	5.57	4.40	4.56	5.34	5.90
Coal	0.69	0.82	0.49	0.45	0.47	0.58	0.73
Peat	-	-	-	-	-	-	-
Oil	0.99	0.59	0.62	0.71	0.81	1.19	1.25
Gas	0.05	1.06	2.62	1.18	1.25	0.91	0.76
Comb. Renewables & Waste ¹	-	0.39	0.50	0.66	0.68	0.85	1.03
Geothermal	-	0.22	0.13	0.14	0.14	0.19	0.20
Solar/Other	-	-	-	-	-	-	-
Electricity	0.48	0.96	1.21	1.27	1.22	1.64	1.93
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	31.1	20.3	8.8	10.2	10.3	10.9	12.4
Peat	-	-	-	-	-	-	-
Oil	44.6	14.6	11.1	16.2	17.7	22.2	21.3
Gas	2.4	26.2	46.9	26.7	27.4	16.9	12.9
Comb. Renewables & Waste	-	9.6	9.0	15.0	14.8	15.8	17.4
Geothermal	-	5.4	2.4	3.2	3.0	3.5	3.3
Solar/Other	-	-	-	-	-	-	-
Electricity	21.9	23.8	21.8	28.7	26.8	30.6	32.7
Heat	-	-	-	-	-	-	-
TRANSPORT³	1.94	2.96	4.18	4.98	4.75	5.48	5.91
TOTAL OTHER SECTORS⁵	1.73	2.30	3.03	3.09	3.11	3.17	3.43
Coal	0.19	0.13	0.11	0.13	0.15	0.13	0.16
Peat	-	-	-	-	-	-	-
Oil	0.57	0.46	0.44	0.39	0.44	0.29	0.27
Gas	0.09	0.18	0.43	0.26	0.20	0.25	0.18
Comb. Renewables & Waste ¹	-	0.06	0.20	0.19	0.19	0.19	0.19
Geothermal	-	0.05	0.10	0.10	0.10	0.09	0.09
Solar/Other	-	-	-	0.01	0.01	-	-
Electricity	0.88	1.42	1.76	2.01	2.03	2.22	2.53
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	10.7	5.5	3.7	4.3	4.8	3.9	4.8
Peat	-	-	-	-	-	-	-
Oil	32.9	19.8	14.6	12.8	14.1	9.1	7.9
Gas	5.3	7.8	14.2	8.3	6.3	7.8	5.1
Comb. Renewables & Waste	-	2.8	6.5	6.2	6.2	6.1	5.7
Geothermal	-	2.3	3.1	3.1	3.1	2.9	2.7
Solar/Other	-	-	-	0.2	0.3	-	-
Electricity	51.2	61.9	57.9	65.1	65.4	70.1	73.9
Heat	-	-	-	-	-	-	-

	Unit: Mtoe						
DEMAND							
ENERGY TRANSFORMATION AND LOSSES	1973	1990	2000	2007	2008	2020	2030
ELECTRICITY GENERATION⁶							
INPUT (Mtoe)	3.18	4.92	6.24	7.10	7.52	10.24	11.50
OUTPUT (Mtoe)	1.59	2.77	3.38	3.76	3.76	4.10	4.66
(TWh gross)	18.53	32.26	39.25	43.75	43.78	47.66	54.24
Output Shares (%)							
Coal	8.5	2.1	3.9	7.2	11.0	4.1	-
Peat	-	-	-	-	-	-	-
Oil	6.1	-	-	-	0.3	-	-
Gas	1.4	17.7	24.4	27.1	24.3	17.8	12.7
Comb. Renewables & Waste	-	1.5	1.5	1.3	1.3	0.6	0.5
Nuclear	-	-	-	-	-	-	-
Hydro	77.3	71.9	62.3	54.0	51.0	54.2	52.1
Wind	-	-	0.3	2.1	2.4	3.9	13.3
Geothermal	6.7	6.6	7.4	8.1	9.6	19.4	21.3
Solar/Other	-	-	-	-	-	-	-
TOTAL LOSSES	2.28	3.56	3.69	4.36	4.91	7.29	7.93
of which:							
Electricity and Heat Generation ⁷	1.59	2.19	2.90	3.37	3.78	6.14	6.84
Other Transformation	0.27	0.62	-0.05	0.01	0.09	0.47	0.44
Own Use and Losses ⁸	0.43	0.75	0.83	0.99	1.04	0.69	0.65
Statistical Differences	-0.13	-0.15	0.21	-0.14	-0.40	-	-
INDICATORS	1973	1990	2000	2007	2008	2020	2030
GDP (billion 2000 USD)	32.51	39.62	52.66	66.97	66.24	85.75	102.94
Population (millions)	2.97	3.49	3.88	4.26	4.31	4.74	5.06
TPES/GDP ¹	0.25	0.32	0.32	0.25	0.26	0.25	0.23
Energy Production/TPES	0.51	0.90	0.85	0.83	0.88	0.81	0.80
Per Capita TPES ¹⁰	2.70	3.64	4.30	3.91	3.93	4.49	4.58
Oil Supply/GDP ⁹	0.13	0.09	0.11	0.09	0.09	0.08	0.07
TFC/GDP ⁹	0.18	0.24	0.24	0.19	0.19	0.16	0.15
Per Capita TFC ¹⁰	1.98	2.67	3.30	2.92	2.89	2.96	3.01
Energy-related CO ₂ Emissions (Mt CO ₂) ¹¹	17.1	22.0	29.8	32.5	33.3	35.8	34.6
CO ₂ Emissions from Bunkers (Mt CO ₂)	1.6	2.4	2.5	3.6	3.6	4.6	5.7
GROWTH RATES (% per year)	73-79	79-90	90-00	00-07	07-08	08-20	20-30
TPES	1.6	3.4	2.8	0.0	1.5	1.9	0.9
Coal	-4.5	1.5	-0.8	5.7	9.9	-0.5	-2.1
Peat	-	-	-	-	-	-	-
Oil	-0.8	-1.1	5.0	1.1	0.2	1.2	0.7
Gas	20.3	14.7	2.6	-4.6	-5.8	-0.5	-1.6
Comb. Renewables & Waste	-	1.3	4.7	2.4	1.3	1.2	1.4
Nuclear	-	-	-	-	-	-	-
Hydro	4.6	2.0	0.5	-0.5	-5.6	1.2	0.9
Wind	-	-	-	34.6	13.8	4.8	14.5
Geothermal	-2.2	4.9	1.7	2.2	18.0	6.9	2.1
Solar/Other	-	-	-	0.7	-7.5	-100.0	-
TFC	2.1	3.1	3.2	-0.4	-0.4	1.0	0.9
Electricity Consumption	3.0	3.5	2.3	1.4	-0.5	1.3	1.5
Energy Production	4.5	7.2	2.2	-0.3	7.2	1.3	0.6
Net Oil Imports	-2.5	-7.0	9.0	1.9	-23.4	5.3	1.2
GDP	0.0	1.8	2.9	3.5	-1.1	2.2	1.8
Growth in the TPES/GDP Ratio	1.5	1.6	-0.1	-3.4	2.8	-0.3	-1.0
Growth in the TFC/GDP Ratio	2.0	1.3	0.3	-3.7	1.1	-1.2	-1.0

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

FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

- 1 Combustible renewables and waste comprises solid biomass, and biogas. Data are often based on partial surveys and may not be comparable between countries.
- 2 Other includes ambient heat used in heat pumps.
- 3 Excludes international marine bunkers and international aviation bunkers.
- 4 Industry includes non-energy use.
- 5 Other Sectors includes residential, commercial, public services, agriculture, forestry, fishing and other non-specified sectors.
- 6 Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
- 7 Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 15% for geothermal and 100% for hydro, wind and photovoltaic.
- 8 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.
- 9 Toe per thousand US dollars at 2000 prices and exchange rates.
- 10 Toe per person.
- 11 “Energy-related CO₂ emissions” have been estimated using the IPCC Tier I Sectoral Approach from the Revised 1996 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2008 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX C**INTERNATIONAL ENERGY AGENCY “SHARED GOALS”**

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to 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, member countries 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 are 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 respect the Polluter Pays Principle where practicable.
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 member countries wish to retain and improve the nuclear 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 encourages 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.)

*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, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

ANNEX D

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 abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

AAU	assigned amount unit (under the Kyoto Protocol)
bcm	billion cubic metres
b/d	barrels per day
CCS	carbon capture and storage
CDM	clean development mechanism (under the Kyoto Protocol)
CHP	combined heat and power
cm	cubic metre
CO ₂	carbon dioxide
EECA	New Zealand Energy Efficiency and Conservation Authority
ERU	emissions reduction unit
ETS	Emissions Trading Scheme
GDP	gross domestic product
G8	Group of Eight (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States)
GHG	greenhouse gas
GW	gigawatt, or 1 watt by 10 ⁹
HFC	hydrofluorocarbon
IEA	International Energy Agency
JI	joint implementation (under the Kyoto Protocol)
kt	kilotonne
kWh	kilowatt-hour, or 1 watt x 1 hour x 10 ³
LNG	liquefied natural gas

LPG	liquefied petroleum gas
m ²	square metre
mb	million barrels
mcm	million cubic metres
Mt	million tonnes
Mt CO ₂ -eq	million tonnes of CO ₂ -equivalent
Mtce	million tonnes of coal equivalent
Mtoe	million tonnes of oil equivalent, see toe
MW	megawatt, or 1 watt x 10 ⁶
MWh	megawatt-hour, or 1 watt x 1 hour x 10 ⁶
NGL	natural gas liquids
NO ₂	nitrogen dioxide
NO _x	nitrous oxides
NZES	New Zealand Energy Strategy
OECD	Organisation for Economic Co-operation and Development
PFCs	perfluorocarbons
PJ	petajoule
PPP	purchasing power parity
PV	photovoltaic
R&D	research and development
RES	renewable energy sources
t	tonne
tcf	trillion cubic feet
tcm	trillion cubic metres
TFC	total final consumption of energy
toe	tonne of oil equivalent, defined as 10 ⁷ kcal
TPES	total primary energy supply
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change
VOC	volatile organic compound



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