**Energy and the Economy:
1997–2006**

Environmental Accounts, Statistics New Zealand

Preface

Statistics New Zealand works with many government and other agencies to produce a range of statistics about the natural environment and the impact of economic and social activities on the environment. As part of this work, Statistics New Zealand has developed environmental accounts for several natural resources: energy, fisheries, forestry, minerals, and freshwater. Environmental accounts consist of physical and monetary stock and flow accounts. The physical stock and flow accounts are referred to as natural resource accounts. They measure the physical stocks and flows of natural resources in units such as tonnes and joules. Where practical and meaningful these quantities are valued, resulting in monetary figures that form environmental accounts and can be linked to economic statistics such as the gross domestic product (GDP).

Figure 1

Statistics New Zealand's Environment Statistics Framework
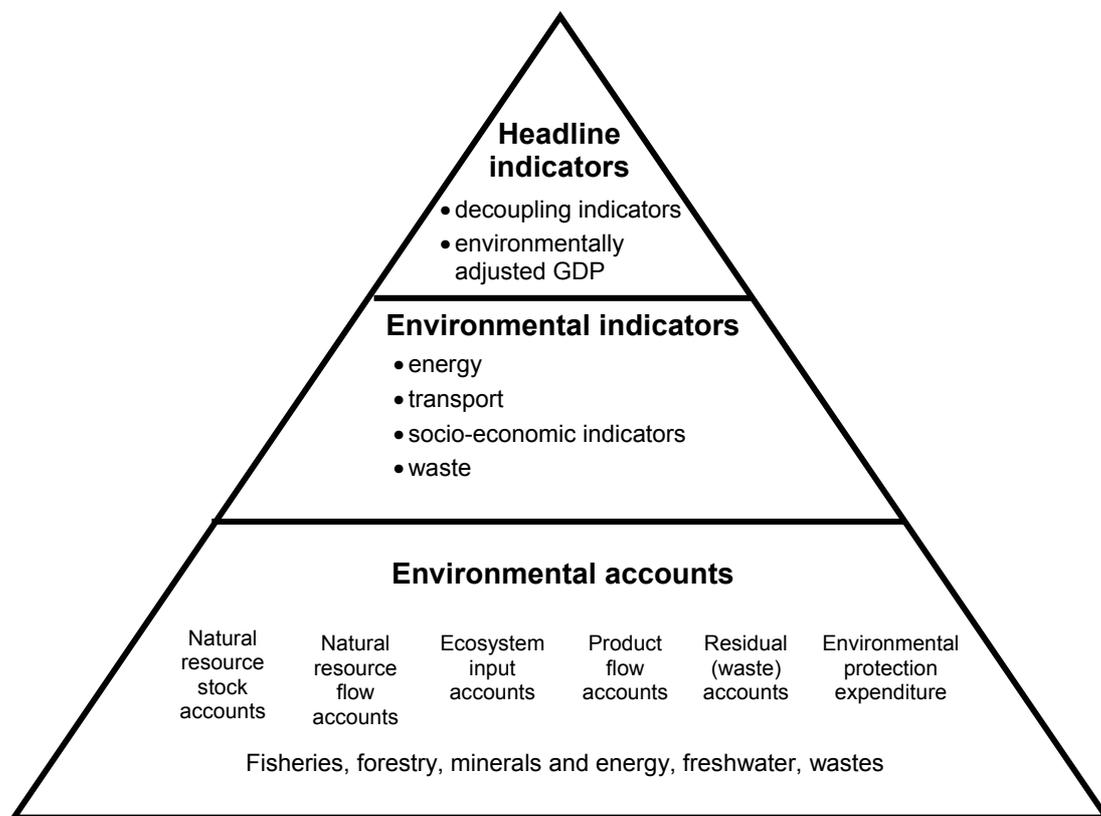
The release of natural resource and environmental accounts reflects an international trend towards compiling information beyond the traditional measures of economic activity. The accounts reflect the view that the environment has a finite capacity to supply materials and absorb waste. For more information on the environmental statistics framework, and uses of natural resource and environmental accounts, refer to the environment homepage of Statistics New Zealand's website www.stats.govt.nz

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Percentage changes
Percentage movements are, in a number of cases, calculated using data of greater precision than published. This could result in slight variations.

Rounding procedures
On occasion, figures are rounded to the nearest thousand or some other convenient unit. This may result in a total disagreeing slightly with the total of the individual items as shown in tables. Where figures are rounded the unit is in general expressed in words below the table headings, but where space does not allow this the unit may be shown as (000) for thousands, etc.

Source
All data is compiled by Statistics New Zealand, except where otherwise stated. Both administrative and survey data have been used in this report.

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Further information is contained in the following tables

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Abbreviations

ANZSIC	Australian and New Zealand Standard Industrial Classification
CP1	Commitment Period 1 January 2008
EECA	Energy Efficiency and Conservation Authority
EDF	Energy Data File
EEUDB	Energy End Use Database
GDP	gross domestic product
GJ	gigajoule
HCE	household consumption expenditure
IEA	International Energy Agency
LPG	liquefied petroleum gas
MED	Ministry of Economic Development
MEUS	Manufacturing Energy Use Survey
MfE	Ministry for the Environment
NGL	natural gas liquids
NZES	New Zealand Energy Strategy
OECD	Organisation for Economic Co-operation and Development
PJ	petajoule
TFCD	total final consumer demand

1. Concepts and definitions

This report is an update of the Energy and the Economy 1997–2005 report published in 2007. Information included in this report is calculated using international statistical benchmarks for environmental accounting. Energy supply[1] data from the Ministry of Economic Development's (MED) Energy Data File (EDF) is used as a proxy for demand by industry due to lack of comprehensive end user data. Where data is unallocated it is modelled by using the Energy Efficiency Conservation Authority's (EECA) Energy End Use Database (EEUDB).

Appendix 1 provides a concordance between the industry-based classification used by the Energy End Use Database (EEUDB) and the classification used by the System of National Accounts to produce the gross domestic product (GDP) figures.

Differences in the nature of the datasets mentioned above raised issues about the comparability of data flows. For this reason some industries present in the Energy and Economy 1997–2005 have been aggregated to ensure more accurate comparisons:

- The wood processing and wood products industry was merged with the paper, printing and publishing industry. The resulting industry is called wood and paper product manufacturing in this report and includes printing and publishing.

- The metal product manufacturing industry was merged with the machinery and equipment manufacturing industry. The resulting industry is called metal product, machinery and equipment manufacturing in this report.

Data limitations: Estimates of total energy demand for large energy consumers are relatively robust. However, estimates for smaller energy consumers require further modelling due to limited data availability. The data presented in this report was subjected to various levels of modelling, therefore the use of absolute figures requires care and trends in the figures are deemed to be indicative.

While it would be preferable to provide these statistics over a longer time period, limited availability of consistent and complete data for all variables has restricted the report to the period 1997–2006. Economic growth statistics (chain-volume GDP growth) are also presented in this report to illustrate the relationship between energy use and economic activity.

Decoupling: This report produces a set of energy use and economic performance decoupling measures for New Zealand, where decoupling refers to breaking the link between environmental pressures and economic benefits. Decoupling occurs when the growth of an environmental pressure (eg energy demand) is less than that of its economic driving force (eg GDP) over a given period (OECD, 2002).

Decoupling can be either *absolute* or *relative*. Absolute decoupling occurs when the environmentally relevant variable is stable or decreasing while the economic driving force is growing. Decoupling is said to be relative when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable.

Total final consumer demand (TFCD): A term created for this report to describe energy demand and distinguish it from other accounting systems. TFCD includes demand of **energy products**, such as gas or electricity, by New Zealand's households and intermediate consumers (government and businesses). It also includes:

- international transport (used by business units resident in New Zealand)

- refinery intermediates and residues.

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[1] This refers to the total amount of energy that is available for use, rather than the energy actually used.

TFCD currently excludes the use of primary energy products (coal and gas) used for electricity transformation to avoid double counting. Also, energy use of wood and direct use of geothermal energy (ie uses other than electricity generation) are not included in the totals due to data limitations. Finally, non-energy use of energy products (such as gas for methanol and urea manufacturing) has also been excluded from the totals.

TFCD will be referred to as **consumer demand** throughout the report.

Units: The units used to describe energy use in this report are petajoules (PJ), or 10^{15} joules. A petajoule is roughly equivalent to the electricity required to power 35,000 households for a year, or a coastal tanker load of 25 million litres of oil.

The units of measure used to describe energy intensity are gigajoules (GJ) per $1,000 of contribution to New Zealand's GDP. A GJ is roughly equivalent to the energy content of 30 litres of petrol or 45kg of coal (Ministry of Economic Development, 2004).

Industrial classification: The industries presented in this report are an aggregation based on the Australian New Zealand Standard Industrial Classification of 1996 (ANZSIC 96). This classification is used by the System of National Accounts to produce gross domestic product (GDP) figures. All figures presented in this report and supplementary tables are for years ended in March. For example the year to March 2005 encompasses a period starting on 1 April 2004 and ends on 31 March 2005.

Revision to Energy and the Economy: 1997–2005

Figures in this report may differ slightly from those reported in the Energy and the Economy: 1997–2005 report due to two revisions of Statistics New Zealand's outputs and one from the Ministry of Economic Development.

The report uses estimates of the resident population at 31 March produced by Statistics New Zealand. The estimates from 2001–2006 have been revised in light of results from the 2006 Census.

The gross domestic product by industry, annual chain-volume series expressed in 1995/96 prices (March years) is also used. This series is subject to revision as additional or improved data becomes available[2].

Energy supply data from the Ministry of Economic Development's (MED) Energy Data File (EDF) is used as a proxy for energy demand. The revisions in the Energy Data File, released in June 2007, are due to MED's reporting requirements to the International Energy Agency (IEA).

Future developments

It is noted that the exclusion of energy use of wood and direct use of geothermal energy represents a significant gap in data. These are areas currently being investigated in an effort to improve the coverage of the report. Improving the robustness of underlying data is also a high priority and initiatives are already underway in conjunction with the Ministry of Economic Development (MED) and the Energy Efficiency Conservation Authority (EECA). One such initiative is the Manufacturing Energy Use Survey (MEUS) and further improvements to the energy data gathering systems are being investigated. Previous reports included a measure of greenhouse gas and ozone precursor emissions. New methods for emissions calculation are currently under development to ensure the quality of the data for possible inclusion in future reports.

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[2] More information on the revision policy for gross domestic product is available at:
http://www.stats.govt.nz/products-and-services/hot-off-the-press/gross-domestic-product/gross-domestic-product-dec07qtr-hotp.htm?page=para003Master

Statistics New Zealand welcomes feedback on this report and its future direction. For any questions, comments or responses please email us at environment@stats.govt.nz.

2. Introduction

The impact of humans on the environment is a function of many variables, including total population, resource consumption, waste generation, the type of technologies used and the capacity of the environment to absorb waste (Wackernagel and Rees, 1996). Energy is an essential element of contemporary societies and economies. Virtually all everyday activities and productive processes involve energy in one form or another. Internationally, economies are extremely reliant on energy, especially in the form of non-renewable oil-based fuels, such as petrol and diesel. This reliance, coupled with finite reserves of petroleum resources, raises issues of energy security, particularly for nations that are dependent on oil imports. Also, there is an increasing pressure to reduce the use of fossil fuels, as the Kyoto protocol agreement began the commitment period (CP1) on 1 January 2008.

Questions on where the available energy is being used, and how efficiently it is being used are becoming increasingly important, as governments plan their energy futures. The focus of recent strategies in New Zealand, including the New Zealand Energy Strategy (NZES) and the New Zealand Energy Efficiency and Conservation Strategy, is on tackling carbon emissions by increasing the uptake of low-emission technologies, such as electricity generation from renewable resources. The other main concern is about delivering a secure supply of energy at affordable prices.

This report aims to improve the understanding of the relationship between the environment and economic activity, in relation to energy. It presents measures of energy use (in petajoules) and economic performance (in constant price GDP) at a national and industry level. This information can be used to understand the pressures placed on the environment through the use of energy resources in the form of final consumer energy demand, which is then linked to measures of economic activity, creating decoupling measures. This information identifies where, and how efficiently, energy is being used in New Zealand's economy and can aid the development of effective energy strategies and policies, it can also be used to monitor the effect of these policies on future energy use.

Included in this report and its supplementary tables is information on energy demand for nine[3] fuel types by 24 aggregated ANZSIC categories. This energy use data is classified on a consistent basis with measures of economic activity (GDP), allowing for measures of energy intensities at both a national and industry level.

Highlights

In 2006, households, and transport and storage industries accounted for over half of the nation's total consumer demand for energy. Households were the single largest users of energy, accounting for 31 percent of total final consumer demand. The second largest user was the transport and storage industry, which accounted for 25 percent of energy demand.

Other highlights for the period 1997–2006 include:

- energy use per capita increased by 9 percent

- energy import volumes (crude oil, refined petroleum oils and coal) increased by 42 percent

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[3] Table 1 shows only eight fuel types; coal and lignite have been combined, but are separate in the supplementary tables.

- energy intensity across the national economy decreased by 9 percent as the economy grew at a faster pace than energy use

- the most energy-intensive industries were fishing, and transport and storage

- the least energy-intensive industries were communication services, and finance, insurance, business and property services

- a number of industries decreased their energy intensity, most notably 'other community services', wholesale and retail trade, communication services, construction, health and welfare services, and food, beverage and tobacco manufacturing industries

- households accounted for 83 percent of New Zealand's petrol consumption.

3. New Zealand totals

New Zealand's GDP per capita for the 1997–2006 period grew by 20 percent. During the same period, New Zealand's total population increased by 11 percent. As both the economy and population have continued to grow, so has the demand for energy per capita which increased by 9 percent, especially in the form of fossil fuels. The larger component of GDP per capita increase indicates a decreased reliance on energy to generate value added. Figure 2 shows energy demand per capita, GDP per capita and population growth over the period 1997 to 2006.

Figure 2

Change in Population, Energy Demand per Capita and GDP per Capita
Year ended March 1997–2006
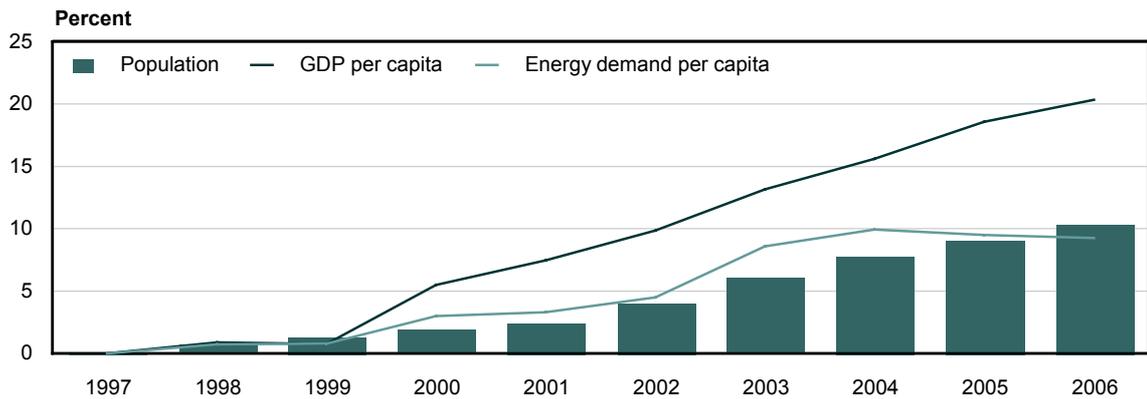
Total final consumer energy demand[4]

Demand for consumer energy in New Zealand increased by 21 percent (425 to 513 PJ) during the period 1997–2006 (see figure 3). Over the same period, GDP increased by 33 percent (from $97 billion to $129 billion). This trend is illustrated in figure 3 and indicates a slight relative energy decoupling for New Zealand. The increase in energy use for the period was driven mainly by increased use of fossil fuels (non-renewable), which grew by 88 PJ (26 percent) for the period 1997–2006 (from 339 to 428 PJ) as seen in figure 4.

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[4] This includes international transport and refinery intermediates and residues. It excludes direct use of geothermal and wood use, due to data limitations, and also excludes gas and coal used in electricity generation (to avoid double counting in totals).

Figure 3

Change in Total Energy Demand versus GDP[1]
Year ended March 1997–2006
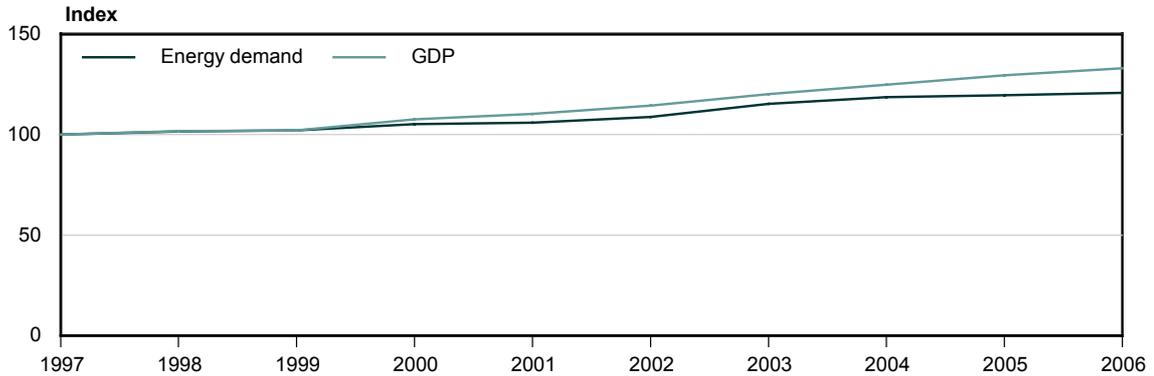
(1) Base: 1997 (=100)

Figure 4[5]

Fossil Fuel Component of Energy Demand
Year ended March 1997–2006
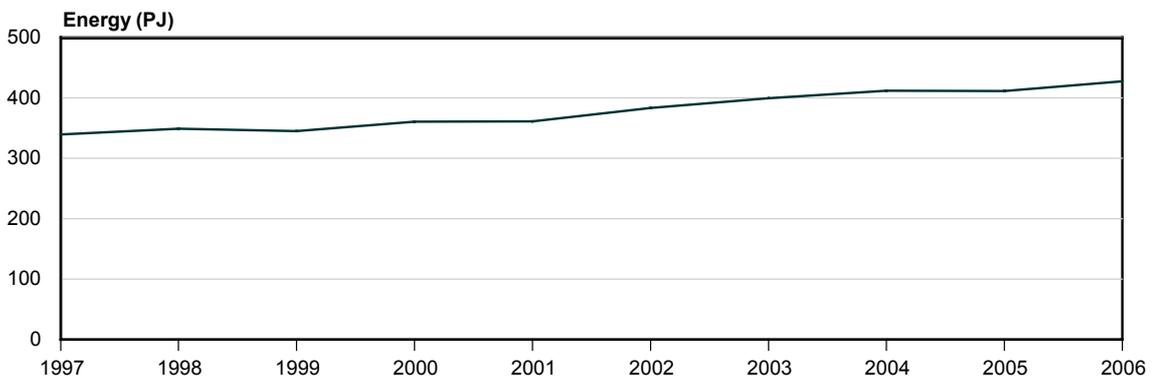
Energy security

Energy security refers to the maintenance of access to necessary energy resources (to sustain economic and other activities) at affordable prices. Energy security is an increasingly important issue, as demand for energy is increasing, while the reserves of fossil fuels (non-renewable resources) are considered finite. There are a number of variables that affect energy security, including reliance on foreign resources (imports), international prices of energy resources, and international political stability. New Zealand's position as a net importer of energy increases the risk of energy security issues.

During the period 1997–2006, New Zealand's demand for imported energy (made up entirely of fossil fuels) increased by 42 percent (from 242 PJ to 344 PJ) as seen in figure 5. This increase has been driven by national transport, although there has also been an increased reliance on imports for coal-generated electricity (MED, 2008). In 2006 the composition of energy imports was dominated by crude oil (67 percent), followed by refined petroleum products (petrol, diesel and others) and coal (25 and 8 percent, respectively).

New Zealand energy exports include crude and condensate, high-grade coal and

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[5] These figures were calculated by subtracting the proportion of electricity generated from renewable resources.

refined petroleum products. During the 1997–2006 period exports decreased by 14 percent despite a 39 percent increase in coal exports. The decrease is mainly associated with the reduced extraction of crude and condensate from the depleting Maui field (Melhuish, 2006).

Figure 5

Total Energy Imports and Exports
Year ended March 1997–2006
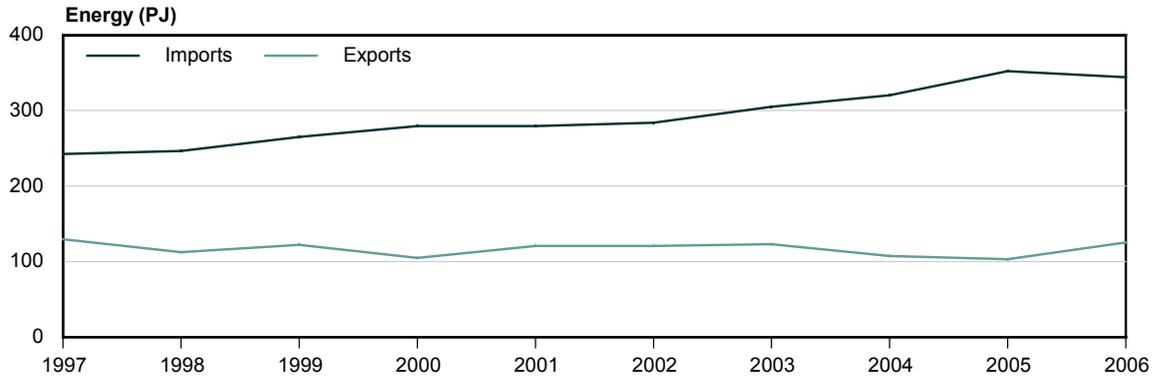
Non-energy use of energy products

A significant amount of the total primary energy supply[6] is used for purposes other than energy, in other words, it is not used as a source of heat or power. While this component of the energy market has been excluded from consumer demand analysis,[7] it is important to monitor the use of these energy resources. A brief description of these uses is included below.

The main non-energy uses of energy products in New Zealand for the period 1997–2006 were synthetic petrol (ceased in 1997); methanol and urea manufacturing from natural gas; and coal for steel production (MED 2007). The total non-energy use of energy products has decreased by 61 percent, from 99 PJ in 1997 to 38 PJ in 2006. The main factor for this reduction is the decreased availability of natural gas for methanol and urea production, due to the depletion of the Maui gas field off the coast of Taranaki. This overall decrease has occurred despite an increase of 20 percent in coal used for steel manufacturing during the same period.

There are other minor uses of fuels for non-energy use, such as the use of gasoline as a solvent, oils for lubricants and bitumen for roads. However, there is little data available on these uses for inclusion in this report.

Wood as an energy source

In New Zealand there is considerable use of wood as a source of heat for industrial processes and home heating. Historically there has been little data available for accurate wood use allocations across industrial and home users. Recent studies[8], however, have made new data available that will enable more consistent estimations as

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[6] Total primary energy supply (TPES) is the total energy available in New Zealand for end use or transformation. It includes raw energy products as they are extracted from the ground.

[7] While previously included in consumer demand (*Energy, Economy and Emissions 1997–2003*), non-energy use of energy has been excluded in this report for subsequent releases. These energy products are used as raw inputs for manufacturing processes and not energy to power production.

[8] Statistics New Zealand's Manufacturing Energy Use Survey (MEUS) published in March 2006 and Household Energy End-Use Project, Year 10 report published by BRANZ also in 2006.

it is integrated into the existing consumer demand methodology.

The Energy Data File estimates that for the year ended March 2006, 35 PJ of energy were derived from wood[9] (biomass) and that 78 percent of this use was industrial and 22 percent was residential. The results of the Manufacturing Energy Use Survey (MEUS) released by Statistics New Zealand in March 2007 indicate that within the manufacturing industry, the wood and wood product manufacturing industry was the main user of wood for energy purposes at approximately 99 percent.

A major obstacle in accounting for energy derived from wood is the unknown use of waste wood for home heating, which is estimated to be considerable. For example, discarded wood that ends up in wood burners.

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[9] Ministry of Economic Development, Energy Data File, September 2007

4. Industry information

Energy profile for 2006

In 2006, consumer demand reached 513 PJ (see table 1), an increase of 21 percent over the period 1997–2006. Electricity was the largest form of energy used, accounting for 26 percent of the total, followed by petrol and diesel with 22 and 21 percent, respectively.

Households were the largest users of energy in 2006, accounting for 31 percent of the total energy used, followed by the transport and storage industry at 25 percent. Other large users include the metal product, machinery and equipment manufacturing industries, and food, beverage and tobacco manufacturing.

New methods are now being developed for the possible inclusion of wood and geothermal steam as sources of energy. As a result of this, the energy-use profile may increase considerably for households, and for the wood and paper product manufacturing industry.

Table 1

Energy Demand[1] Profile
2006

Industry	Petajoules (PJ)								
	Coal[2]	Natural gas	LPG/ NGL	Petrol	Diesel	Fuel oil	Aviation fuels[3]	Electricity	Total
Household	0.8	6.4	2.4	91.1	14.4	-	-	44.0	**159.2**
Transport and storage	0.1	0.2	1.3	7.0	49.0	17.5	52.5	2.4	**130.0**
Metal product, machinery and equipment manufacturing	0.1	2.1	0.6	0.1	3.5	0.5	0.0	25.3	**32.2**
Food, beverage and tobacco manufacturing	9.7	9.1	0.7	1.0	2.9	0.1	0.0	8.5	**32.0**
Agriculture	0.7	1.8	-	2.8	14.4	0.0	0.1	4.9	**24.7**
Wood and paper product manufacturing[4]	0.5	7.9	0.6	0.0	0.1	0.3	0.0	12.6	**22.2**
Petroleum, chemical, plastic and rubber product manufacturing[5]	0.3	2.3	0.1	0.0	1.6	0.1	0.0	2.9	**21.0**
Wholesale and retail trade	0.8	1.9	1.1	5.4	1.9	0.0	-	9.1	**20.3**
Non-metallic mineral production	5.2	4.2	0.5	0.0	0.5	0.0	0.0	0.9	**11.3**
Fishing	-	-	-	0.0	5.7	1.1	0.0	0.3	**7.1**
Mining	0.6	0.2	-	0.2	3.9	0.3	-	1.2	**6.5**
Construction	-	0.1	0.3	1.1	4.1	0.0	0.1	0.9	**6.4**
Finance, insurance, business and property services	0.0	1.0	-	-	-	0.1	-	4.5	**5.6**
Accommodation, restaurants and bars	0.0	1.2	0.3	0.2	0.2	0.0	-	3.6	**5.4**
Central government administration and defence	0.2	0.4	-	0.1	1.8	0.2	0.8	1.4	**4.8**
Health and welfare services	1.2	1.1	-	0.2	-	-	-	2.0	**4.5**
Education	0.8	0.7	-	-	0.5	0.0	-	2.2	**4.2**
Other community services	0.0	0.1	-	0.2	0.4	0.0	-	2.5	**3.3**
Textile and apparel manufacturing	0.5	1.2	0.0	0.0	0.5	0.1	0.0	0.7	**2.9**
Forestry and logging	-	-	-	0.4	1.8	0.3	0.0	0.3	**2.8**
Communication services	-	0.0	0.0	0.2	0.7	-	-	1.4	**2.3**
Local government administration	0.1	0.3	-	0.3	0.3	-	-	1.1	**2.0**
Electricity, gas and water supply	-	-	-	-	-	-	-	1.4	**1.4**
Furniture and other manufacturing	-	-	0.0	0.0	0.0	0.0	-	0.6	**0.7**
NZ total	**21.6**	**42.0**	**7.9**	**110.5**	**108.2**	**20.8**	**53.6**	**134.6**	**512.9**

(1) Energy demand includes final consumption of energy products (but excludes energy used for electricity generation).
(2) Coal includes bituminous, sub-bituminous coal and lignite
(3) Aviation fuels include kerosene.
(4) Wood and paper products include printing and publishing.
(5) Petroleum, chemicals, plastic and rubber includes 13.8 PJ of refinery intermediates and residues.
Symbol:
- Nil or amount to small to be expressed

Energy intensity

Energy intensity is a measure of the energy efficiency of a system, and refers to the relationship between the energy inputs and the units of output by that system. In terms of this report, energy intensity is measured as the number of GJ of consumer demand required to produce $1,000 of value added (in constant price GDP).

In this report, intensities have been calculated for 23 industries in New Zealand based on the ANZSIC classification (see table 2). In order to produce the measures of energy intensity shown in table 1 the energy supply data provided annually by MED is allocated to each industry using EECA's Energy End Use Database (EEUDB) (See appendix 1 for

a concordance table).

Energy-intensive industries include the fishing industry and the transport and storage industry, which require large quantities of liquid fuels to operate vessels and vehicles. Other energy-intensive industries are the heavy manufacturing industries, such as the petroleum, chemical, plastic and rubber industry (which includes petroleum refining), and the metal product machinery and equipment manufacturing industry. These industries require large amounts of energy to operate heavy machinery and run heat-intensive processes.

Less energy-intensive industries are those industries in which the energy requirements are primarily related to running offices or light equipment. These industries include the finance, insurance, business and property services industry and the communication services industry. Across the national economy, energy intensity decreased by 9 percent over the period 1997–2006, as the economy grew at a faster pace than energy use.

Table 2

Energy Intensity by Industry
Years ending March 1997–2006

Industry	(GJ/$000)									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Fishing	22.9	23.8	22.8	21.2	23.7	24.7	31.9	33.6	32.1	32.7
Transport and storage	23.4	23.6	22.4	21.8	20.6	20.4	21.4	21.5	21.3	21.5
Non metallic mineral production	11.9	12.4	13.2	11.5	12.5	13.3	13.7	14.0	12.2	13.6
Petroleum, chemical, plastic and rubber product manufacturing	11.6	12.1	11.9	10.8	9.9	10.2	10.2	11.2	10.5	12.6
Metal product, machinery and equipment manufacturing	7.5	7.0	7.9	7.5	6.6	6.4	5.6	6.2	6.3	6.5
Wood and paper product manufacturing[1]	6.2	5.8	6.7	7.5	7.1	6.3	6.8	6.7	6.2	6.1
Mining	3.7	3.8	3.7	3.7	4.4	4.6	4.5	5.3	4.9	5.8
Food, beverage and tobacco manufacturing	6.2	5.7	5.6	5.5	4.9	5.2	5.3	5.4	4.5	4.8
Textile and apparel manufacturing	3.3	3.4	3.4	3.2	3.1	3.4	3.6	4.0	3.1	4.0
Agriculture	3.7	3.9	4.0	3.9	3.6	3.7	3.9	3.6	3.8	3.8
Accommodation, restaurants and bars	2.8	3.2	3.0	3.0	3.4	3.6	3.4	3.0	2.9	2.7
Forestry and logging	1.9	1.9	2.0	2.0	2.0	2.0	1.8	2.0	1.9	2.0
Local government administration	0.8	1.2	1.2	1.4	1.7	1.7	1.9	1.6	1.8	1.4
Central government administration and defence	1.4	1.4	1.5	1.6	1.6	1.5	1.6	1.4	1.5	1.2
Furniture and other manufacturing	0.7	0.8	0.6	0.9	1.0	0.9	1.5	0.9	1.1	1.1
Wholesale and retail trade	2.0	1.8	1.7	1.5	1.4	1.3	1.4	1.3	1.2	1.1
Construction	1.6	1.7	1.6	1.3	1.3	1.3	1.2	1.1	1.1	1.0
Education	0.8	1.0	1.0	0.9	1.0	1.1	1.1	1.0	1.1	0.9
Other community services	1.4	0.9	0.8	1.0	0.9	0.8	0.8	0.8	0.8	0.8
Health and welfare services	1.0	1.0	0.8	0.8	1.0	1.0	1.1	1.0	0.9	0.7
Electricity, gas and water supply	0.2	0.6	0.6	0.5	0.7	0.5	0.9	0.7	0.6	0.6
Communication services	0.5	0.5	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3
Finance, insurance, business and property services	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
New Zealand total	4.4	4.4	4.4	4.3	4.2	4.2	4.2	4.2	4.1	4.0

(1) Wood and paper products include printing and publishing.

5. Selected profiles

Transport and storage[10]

In 2006, the transport and storage industry contributed $6.1 billion (5 percent of the total) to New Zealand's GDP, and accounted for 25 percent (130 PJ) of consumer demand (see figure 6). Value added from the transport and storage industry increased steadily, amounting to an increase of over 30 percent for the period 1997–2006. During this period, the transport industry used liquid fuels (petrol, diesel, fuel oil, and aviation fuels) for 97 percent of its energy needs. Figures for this industry include the energy component for international travel.

In terms of energy intensity, this industry required 21.5 GJ of energy for every thousand dollars it contributed to New Zealand's total GDP in 2006. This represents a decrease of 8 percent since 1997. In 2006, the transport and storage industry was the largest user of diesel, aviation fuels and fuel oil, as well as the second largest user of petrol (after households).

Figure 6

Transport and Storage Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
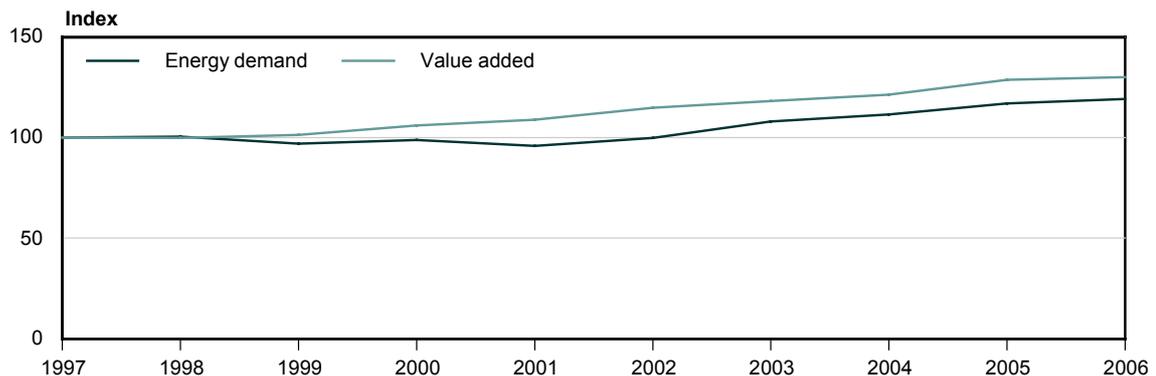
Metal product, machinery and equipment manufacturing[11]

In 2006, the metal product, machinery and equipment manufacturing industry contributed $4.9 billion (3.8 percent of the total) towards New Zealand's GDP and accounted for over 6 percent of consumer demand (see figure 7). For the period 1997–2006, the industry relied primarily on electricity to meet its energy needs, which consistently accounted for around three quarters of energy use in this industry.

In terms of energy intensity, the metal product, machinery and equipment manufacturing industry used around 6.5 GJ for every thousand dollars it contributed to GDP in 2006, which represents a decrease of 13 percent over the period. Over the same period contributions to GDP have increased at a greater rate than energy demand, although the magnitude of this trend has decreased since 2003.

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[10] Refers to the transport and storage 'industry' rather than 'sector'.

[11] This category represents an amalgamation of Statistics New Zealand's industrial classifications to ensure consistent comparability with those used by the Energy Efficiency and Conservation Authority (EECA). See appendix 1 for details.

Figure 7

**Metal Product, Machinery and Equipment Manufacturing Energy Demand
versus Value-added Index**

*Year ended March 1997–2006*

Base: 1997 (=100)
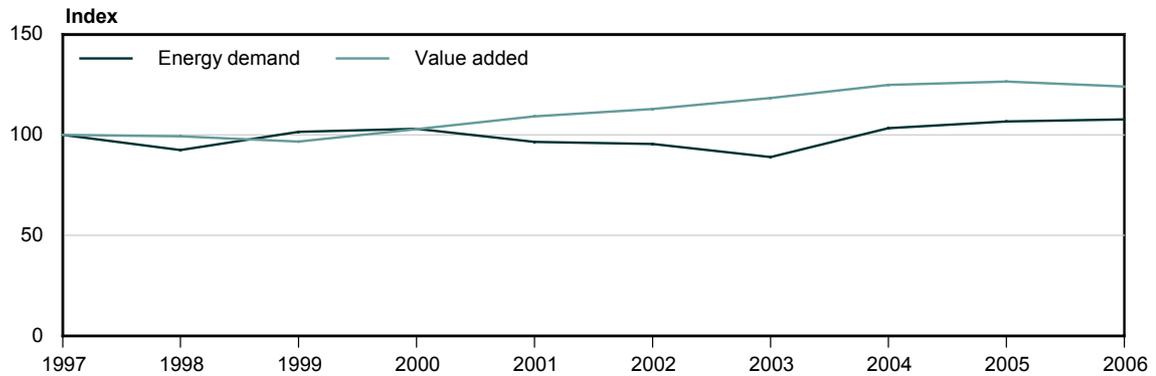
Food, beverage and tobacco manufacturing[12]

In 2006, the food, beverage and tobacco manufacturing industry directly contributed $6.7 billion (5 percent) towards New Zealand's GDP and accounted for approximately 6 percent (32 PJ) of New Zealand's consumer demand (see figure 8). For the period 1997 to 2006, the food, beverages and tobacco manufacturing industry used natural gas and coal to meet nearly two-thirds of its energy requirement. In 2006, natural gas made up 28 percent of energy demand for this industry. Other significant sources of energy used by this industry in 2006 were coal (24 percent) and electricity (26 percent).

In terms of energy intensity, in 2006 the food, beverage and tobacco manufacturing industry demanded 4.8 GJ of energy for every thousand dollars it contributed towards GDP (see table 2), a 22 percent decrease since 1997. While there have been fluctuations in energy intensity over the 1997–2006 period, the trends still follow each other for the most part, indicating a degree of correlation between energy use and value added.

Figure 8

**Food, Beverage and Tobacco Manufacturing Energy Demand
versus Value-added Index**

Year ended March 1997–2006

Base: 1997 (=100)

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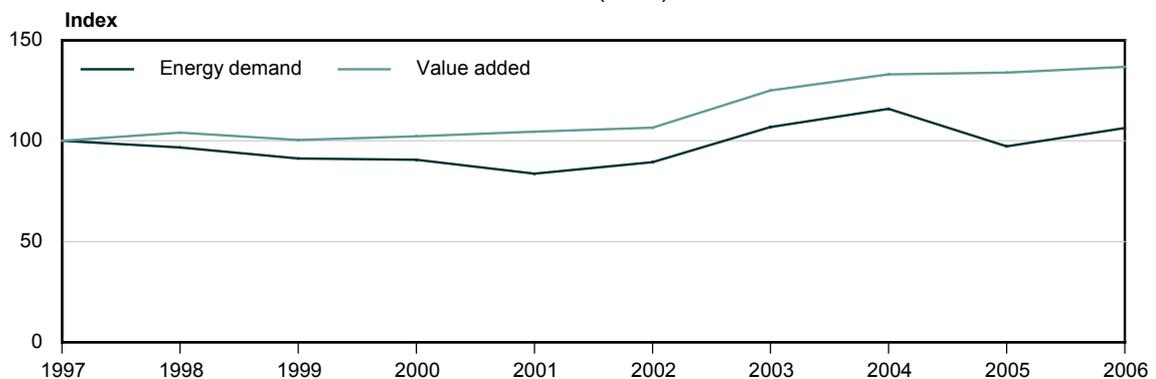
[12] Food, beverages and tobacco manufacturing includes meat and dairy processing.

Agriculture

In 2006, the agriculture industry directly contributed $6.5 billion (5 percent of the total) towards New Zealand's GDP and accounted for 5 percent of consumer demand (see figure 9). For the period 1997–2006, the agriculture industry relied heavily on liquid fuels, petrol and diesel in particular, which consistently accounted for around three quarters of energy use in this industry. Also, during this period there was a shift towards replacing comparatively more expensive petrol, the use of which decreased by 2.5 PJ (45 percent) to less costly diesel, which increased by 25 percent over the same period. Agriculture was also a significant user of electricity at 4.8 PJ (20 percent) in 2006.

In terms of energy intensity, the agriculture industry used around 3.8 GJ for every thousand dollars it contributed to GDP in 2006. During this period energy use and contributions to GDP have been reasonably steady. However, since 2001 energy use increased at a slightly faster rate than contribution to GDP.

Figure 9

Agriculture Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
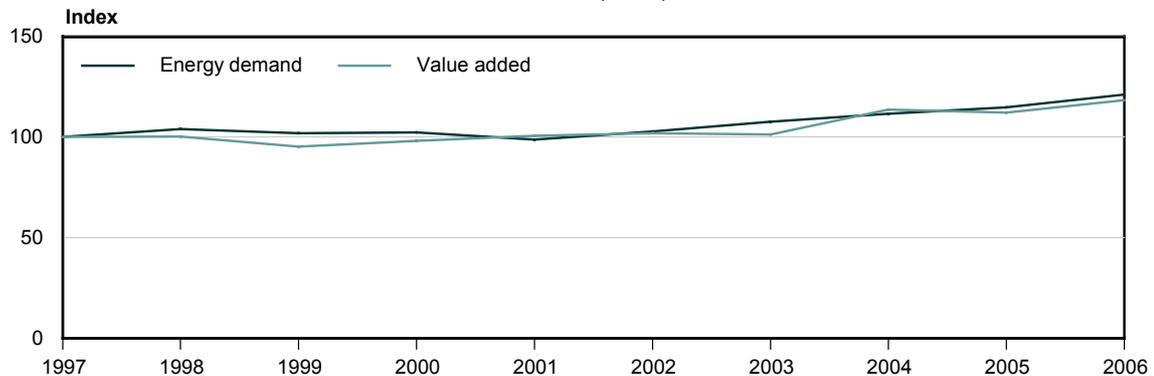
Wood and paper product manufacturing[13]

In 2006, the wood and paper product manufacturing industry directly contributed $3.6 billion (2.8 percent) towards New Zealand's GDP, and accounted for 4 percent (22 PJ) of New Zealand's consumer demand (see figure 10). During this period, the industry used natural gas and electricity to meet the bulk of its energy needs, representing on average 36 and 56 percent of energy use, respectively.

In terms of energy intensity, the wood and paper product manufacturing industry demanded 6.1 GJ of energy for every thousand dollars it contributed to GDP in 2006 (see table 2). This represents a decrease in energy intensity of 2 percent from 1997.

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[13] This category represents an amalgamation of Statistics New Zealand's industrial classifications to ensure consistent comparability with those used by the Energy Efficiency and Conservation Authority (EECA). See appendix 1 for details.

Figure 10
Wood and Paper Product Manufacturing Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
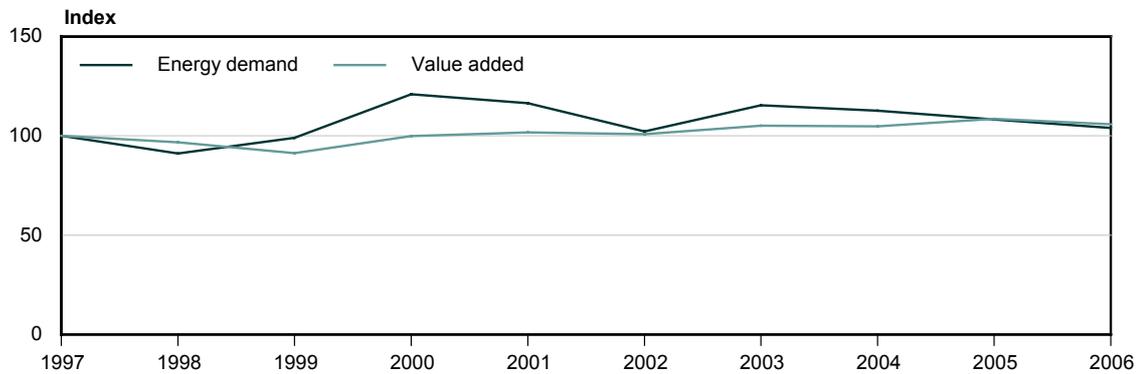
## Petroleum, chemical, plastic and rubber product manufacturing

In 2006, the petroleum, chemical, plastic and rubber product manufacturing industry directly contributed $1.7 billion (1 percent) towards New Zealand's GDP, and accounted for 4 percent (21 PJ) of New Zealand's consumer demand (see figure 11). Petroleum refiners rely heavily on refining by-products as energy sources. These include refinery gas, petroleum coke, and other oil by-products. These intermediates have been the main energy product used in this industry over the period 1997–2006, representing on average 69 percent of consumer demand.

In terms of energy intensity, the petroleum, chemical, plastic and rubber product manufacturing industry in 2006 demanded 12.6 GJ of energy for every thousand dollars it contributed towards GDP (see table 2). This industry has experienced an overall increase in energy intensity of 9 percent since 1997.

Figure 11
Petroleum, Chemical, Plastic and Rubber Product Manufacturing Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
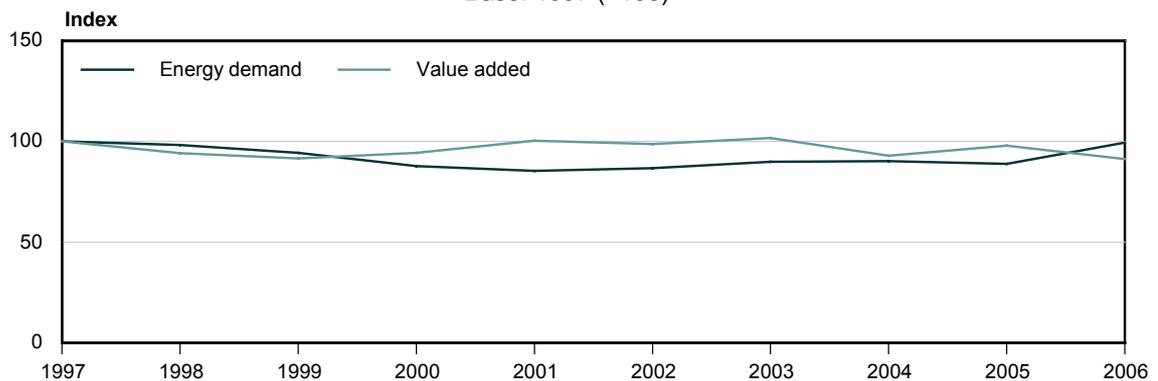
Wholesale and retail trade[14]

In 2006, the wholesale and retail trade industry directly contributed $17.9 billion (14 percent) towards New Zealand's GDP, and accounted for 4 percent (20.3 PJ) of new Zealand's consumer demand (see figure 12). Over the 1997–2007 period, this industry's contribution to total GDP has increased by 40 percent, which is a greater increase than total GDP at 33 percent. On average over the same period, electricity and petrol have been the main energy products used, representing 37 percent and 35 percent of demand, respectively. While petrol demand in petajoules decreased by 60 percent from 1997–2006, over the same period electricity use increased by 23 percent.

In terms of energy intensity, the wholesale and retail trade industry in 2006 demanded 1.1 GJ of energy for every thousand dollars it contributed towards GDP (see table 2). This industry has reduced its energy intensity since 1997. This intensity reduction is largely explained by a 19 percent decrease in total energy demand and a corresponding 40 percent increase in value added.

Figure 12

Wholesale and Retail Trade Energy Demand versus Value-added Index
Year ended March 1997–2006

Base: 1997 (=100)
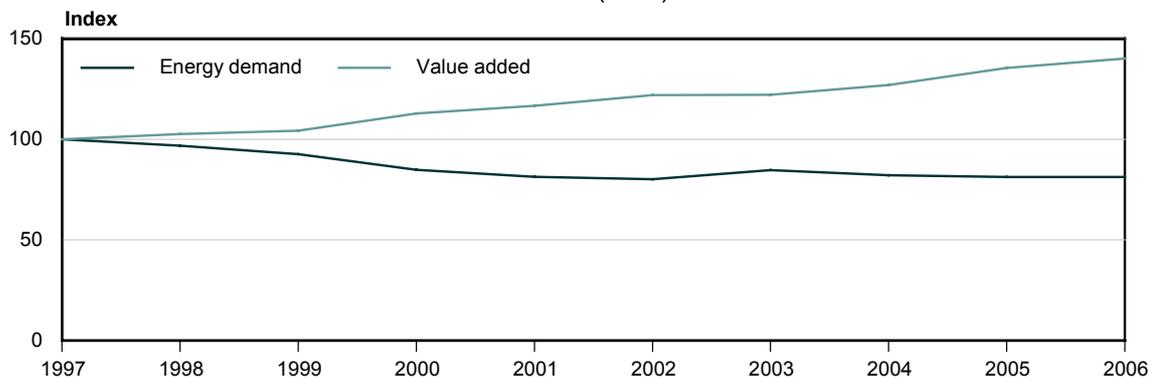
Non-metallic mineral production

In 2006, the non-metallic mineral production industry directly contributed $834 million (1 percent) towards New Zealand's GDP, and accounted for 2 percent (11.3 PJ) of New Zealand's consumer demand (see figure 13). Coal has been the main energy type used by this industry, averaging 49 percent of demand over the period 1997–2006. Over the same period, total energy demand (in petajoules) has increased by 54 percent with large increases in the amounts of natural gas, LPG/NLG and aviation fuels used.

In terms of energy intensity, the non-metallic mineral production industry in 2006 demanded 13.6 GJ of energy for every thousand dollars it contributed towards GDP (see table 2). This industry has increased its energy intensity by 14 percent since 1997. Although value added is increasing for this industry it is exceeded by the growth of energy demand.

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[14] This category represents an amalgamation of Statistics New Zealand's industrial classifications to ensure consistent comparability with those used by the Energy Efficiency and Conservation Authority (EECA). See appendix 1 for details.

Figure 13
Non-metallic Mineral Production Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
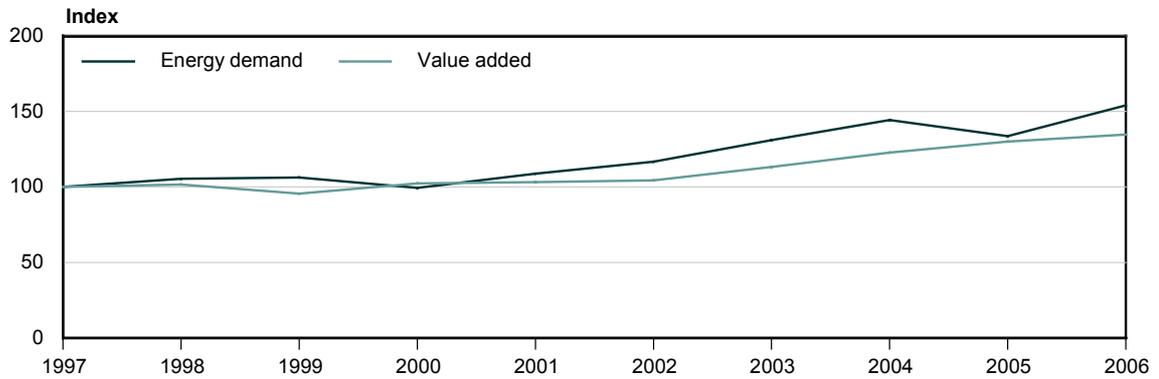
## Fishing

In 2006, the fishing industry directly contributed $217 million (0.2 percent of the total) towards New Zealand's GDP and accounted for 1 percent (7.1 PJ) of consumer demand (see figure 14). Declining total allowable commercial catch (TACC) in a number of economically significant species since 2000 and, more recently increasing fuel prices, are likely to be associated with the decrease in contribution to GDP by this industry (Statistics New Zealand, 2008). Diesel and fuel oil required for running the fishing fleets are the most significant forms of energy used in this industry, accounting for 97 percent of its energy use on average over the period.

In terms of energy intensity, the fishing industry demanded approximately 32.7 GJ for every thousand dollars it contributed to GDP in 2006. Figure 13 illustrates this trend of increased reliance on energy and decreasing contributions to GDP.

Figure 14
Fishing Energy Demand versus Value-added Index
Year ended March 1997–2006
Base: 1997 (=100)
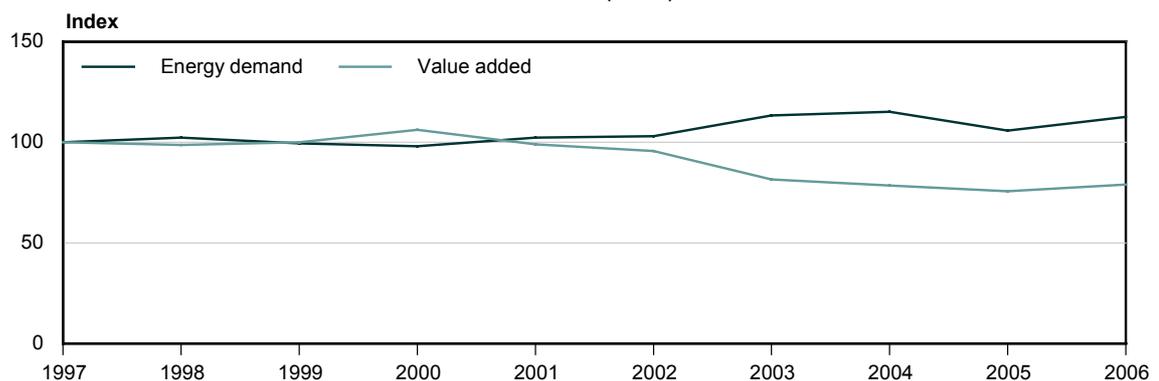
Household[15]

In 2006, households made up approximately 31 percent (195 PJ) of New Zealand's energy demand, making households the largest energy user in New Zealand (see figure 15). On average over the period 1997–2006, the majority of this energy demand was in the form of petrol (56 percent) and electricity (30 percent).

Households are the largest users of petrol, in 2006 they accounted for 83 percent of New Zealand's consumer petrol. Households also use a considerable amount of wood for space heating; however, there is insufficient data available to produce accurate estimates. This is an area for further development of this report.

Energy decoupling for households is not measured using their contribution to GDP as households do not produce value added in terms of GDP. Energy demand is compared with total household consumption expenditure (HCE). Figure 15 shows that energy demand by households was increasing at a higher rate than total spending until 2002. From 2003 onwards, the gap between these variables has been decreasing.

Figure 15

Household Energy Demand versus Household Consumption Expenditure
Year ended March 1997–2006

Base: 1997 (=100)

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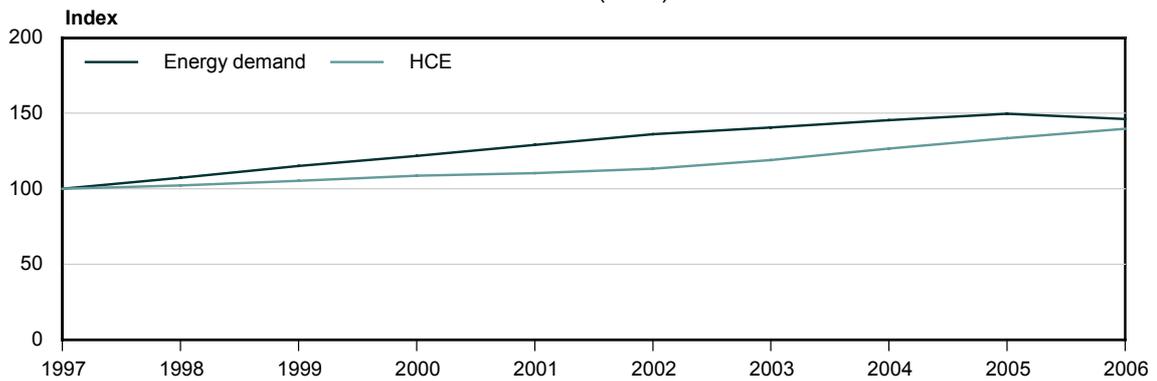
[15] This includes all energy uses by private citizens, such as petrol and diesel for personal transport and electricity and gas for heating.

6. Methodology

Energy demand data in this report is calculated using the Ministry of Economic Development (MED) Energy Data File (EDF) supply data as a proxy for demand by different economic industries. Energy that remained unallocated in the EDF (energy use that was not allocated to a specific industry) was allocated to industries using the Energy Efficiency and Conservation Authority's 1997 and 2002 Energy End Use Databases (EEUDB). This is carried out by calculating the proportion of energy that each industry was attributed in the EEUDB and applying it to the unallocated proportions of the EDF.

Energy use in this report includes combustive activities and excludes coal used for coking in steel manufacturing, as well as natural gas used for chemical methanol and urea (nitrogen fertilizer) production. At this stage, wood, solar and geothermal energy demand figures are unavailable, due to limited data.

Measures of economic activity (constant price GDP) from the system of National Accounts include all operators that are resident to New Zealand. Within the System of National Accounts industries are classified by their primary economic activity, that is, the activity that generates the greater proportion of a firm's profit. In this report, intensities have been calculated for 23 industries in New Zealand based on the ANZSIC classification (see table 1). In order to produce the measures of energy intensity shown in table 1 the energy supply data provided annually by the Ministry of Economic Development (MED) is allocated to each industry using the Energy Efficiency Conservation Authority's (EECA) Energy End Use Database (EEUDB). Appendix 1 provides a concordance between the industry-based classification used by the Energy End Use Database (EEUDB) and the classification used by the System of National Accounts to produce the gross domestic product (GDP) figures.

Information in this report is considered accurate at the national and total levels. Users of this data should be aware that the further levels of detail require greater reliance on modeled data. Industry data in this report is provided at the level of aggregated ANZSIC96 industrial classifications. Information on energy demand refers to direct demand and therefore needs to be interpreted with care, especially when addressing industries involved in energy transformation.[16] The information provided does not include embedded energy.[17]

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[16] These include electricity generation and oil refining.

[17] Embedded energy is the sum of the energy necessary to produce a service or product from the extraction of the raw material to post-use disposal.

7. Glossary

Decoupling: Refers to breaking the link between 'environmental bads' and 'economic goods'. In particular, it refers to the relative growth rates of a pressure on the environment and of an economically relevant variable to which it is causally linked (OECD, 2002).

Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving force (eg GDP) over a given period. Decoupling can be either *absolute* or *relative.* Absolute decoupling occurs when the environmentally relevant variable is stable or decreasing while the economic driving force is growing. Decoupling is said to be relative when the growth rate of the environmentally relevant variable is positive, but less than the growth rate of the economic variable.

Decoupling indicators measure *changes over time* and the concept of decoupling is attractive for its simplicity. However, it is important to note that the concept of decoupling has no automatic link to the environment's capacity to sustain, absorb or resist environmental pressure.

Energy intensity: Gigajoules of energy per $000 value added to constant price GDP (GJ/$000).

Gross domestic product (GDP): Is a measure of the total economic activity occurring within the national boundary of a country. It measures the total market value of goods and services produced in New Zealand, after deducting the cost of goods and services used in the process of production, but before deduction allowances for the consumption of fixed capital. Constant price GDP (95/96 base year) is used throughout this report.

Industry: An industry consists of a group of establishments engaged in the same, or similar, kinds of production activity (United Nations, 1993).

Petajoule (PJ): 10^{15} joules, or 1 million gigajoules (the most commonly used unit for energy).

Total final consumer demand: Final demand of energy product by households and intermediate consumers (government and businesses) includes international transport, but excludes non-energy use of commodities, such as natural gas used for chemical methanol and urea production. Total final consumer demand also excludes coal and gas used for electricity generation to avoid double counting in totals.

Value added: Monetary contribution to New Zealand's economy in constant prices.

Appendix 1

Concordance of industrial classifications
used to derive the energy by industry figures

EECA sector breakdown	Energy and economy energy intensity	Gross domestic product by industry, annual chain-volume series expressed in 1995/96 prices[1]
Agriculture	Agriculture	Agriculture
Fishing	Fishing	Fishing
Forestry and logging	Forestry and logging	Forestry and logging
Mining and quarrying	Mining	Mining
Chemicals, related products and plastics	Petroleum,[2] chemical, plastic and rubber product manufacturing	Petroleum, chemical, plastic and rubber product manufacturing
Water works and supply[3]	Electricity, gas and water supply	Electricity, gas and water supply
Beverages and other food processing	Food, beverage and tobacco manufacturing	Food, beverage and tobacco manufacturing
Dairy products		
Slaughtering and meat processing		
Textile, apparel and leather goods	Textile and apparel manufacturing	Textile and apparel manufacturing
Wood processing and wood products	Wood and paper product manufacturing[4]	Wood and paper product manufacturing
Paper and paper products, printing and publishing		Printing, publishing and recorded media
Concrete, clay, glass and related minerals manufacture	Non-metallic mineral production	Non-metallic mineral products manufacturing
Basic metal industries	Metal product, machinery and equipment manufacturing	Metal product manufacturing
Fabricated metal products, machinery and equipment		Machinery and equipment manufacturing
Other manufacturing industries	Furniture and other manufacturing	Furniture and other manufacturing
Construction	Construction	Construction
Wholesale and retail trade – Non-food	Wholesale and retail trade	Wholesale trade
Retail trade – food		Retail trade
Wholesale trade – food		
Motels, hotels, guest houses	Accommodation, restaurants and bars	Accommodation, restaurants and bars
Communication	Communication services	Communication services
Finance, insurance, real estate and business services	Finance, insurance, business and property services	Finance and insurance
		Business services
		Property services
Central government administration	Central government administration and defence	Central government admin and defence
Central government defence services		
Local government administration	Local government administration	Local government administration
Education services: pre-school, primary and secondary	Education	Education
Education services: tertiary education		
Health and welfare services	Health and welfare services	Health and community services
Other social and related community services	Other community services	Cultural and recreational services
Sanitary and cleaning services		Personal and other community services
Commercial transport and storage	Transport and storage	Transport and storage
Household	Household Consumption Expenditure[5]	
Household (private transport)		

(1) For further information: http://www.stats.govt.nz/products-and-services/info-releases/gdp-info-releases.htm
(2) Energy use figures for petroleum refining have been derived directly from the Energy Data File and the New Zealand Energy Greenhouse Gas Emissions 1990–2006 produced by the Ministry of Economic Development.
(3) Includes an energy use allocation for electricity and gas supply.
(4) Includes printing and publishing
(5) Energy intensity for households is not measured using their contribution to GDP as households do not produce value-added in terms of GDP. Energy demand is compared with total household consumption expenditure.

References

Energy Efficiency and Conservation Agency (2005). "Energy End Use Database". http://www.eeca.govt.nz/enduse/endusesearch.aspx [3 June 2008].

Melhuish, 2006. "Energy and sustainable development in New Zealand" [31 May 2008] http://www.helio-international.org/reports/pdfs/NZ-EN.pdf

Ministry of Economic Development, (2008). "New Zealand Energy Quarterly" Ministry of Economic Development. December 2007 Quarter. [3 June 2008] http://www.med.govt.nz/upload/55768/NZEQ_dec07.pdf

Ministry of Economic Development, (2007) "New Zealand Energy greenhouse Gas Emissions 1990-2006" Ministry of Economic Development, Wellington.

Ministry of Economic Development (2006). "New Zealand Energy Data File: Calendar Year Edition, September 2006". http://www.med.govt.nz/ers/en_stats.html [31 May 2008].

Ministry of Economic Development (2004). "Sustainable Energy". Ministry of Economic Development, Wellington, 2004.

OECD (2002). "Indicators to measure decoupling of environmental pressure from economic growth". http://www.oecd.org/dataoecd/0/52/1933638.pdf [31 May 2008].

Statistics New Zealand (2007). "Fish Monetary Stock Account 1996-2007" [31 May 2008]   http://www.stats.govt.nz/analytical-reports/fish-monetary-stock-account-1996-2007.htm

United Nations (1993). "System of National Accounts 1993", http://www.unstats.un.org [4 May 2004].

Wackernagel M and W Rees (1996). "Our Ecological Footprint: Reducing Human Impact on the Earth". Gabriola Island, BC: New Society Publishers.