ENERGY AND BUILDING TRENDS

Energy in New Zealand

2017

2016 CALENDAR YEAR EDITION

Comprehensive information on and analysis of
New Zealand's energy supply, demand and prices

MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

New Zealand Government

Energy in New Zealand 2017 provides annual information on and analysis of New Zealand's energy sector and is part of the suite of publications produced by the Energy & Building Trends team of the Ministry of Business, Innovation & Employment (MBIE).

The 2017 edition includes information up to the end of the calendar year 2016.

Full data tables may be downloaded from the *Energy in New Zealand* webpage:

www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand

Prepared by:

Energy & Building Trends

Evidence, Monitoring & Governance

Ministry of Business, Innovation & Employment

PO Box 1473, Wellington 6140
New Zealand

Email: energyinfo@mbie.govt.nz

ISSN 2324-5913

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Acknowledgements

The authors are grateful to the individuals, companies and organisations that provided information and gave generously of their time to assist with the work reported here.

Authorship

This publication was prepared by the Energy and Building Trends team of the Ministry of Business, Innovation & Employment. Principal contributors were Nathan Young, Maria Botes, Jeff Lean, Hannah Talosaga, Michael Smith, Chris Barnett and James Hogan. The authors would like to thank New Zealand Petroleum & Minerals and the MBIE Design team for their contribution to this report.

Availability

A free electronic version of this publication can be downloaded from: www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/

ISSN 2324-5913

September, 2017

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1 petajoule (PJ)
is enough energy in a year to:

Drive about **30,000** cars on regular petrol

or

Power about **40,000** households with electricity

The Marsden Point refinery produced enough **jet fuel** to fly around the world roughly **1000 times**

Domestic transport accounts for **82%** of demand from oil products

New Zealand produced enough energy to meet **78%** of its energy requirements

The Dubai Crude Oil price averaged **$41 USD/bbl** in 2016, the lowest in over a decade

There were **2,535** electric vehicles registered in NZ at the end of 2016

75% of coal production was in the South Island

All natural gas is produced and consumed in the North Island, 86% of which comes from just **4 fields**

85% of electricity was generated from renewable sources, a 35 year high

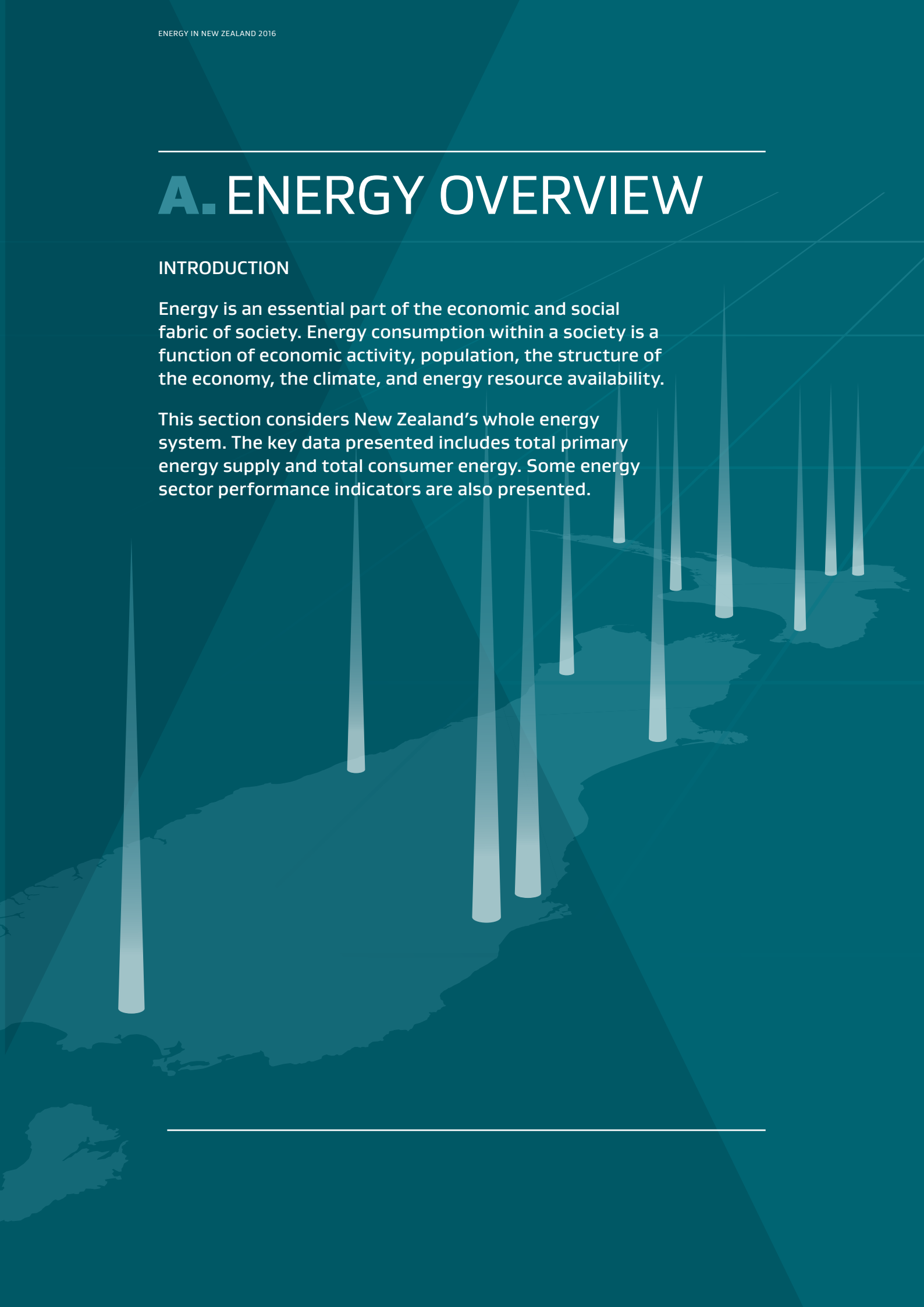
48% of natural gas demand comes from the Chemical Manufacturing industry

A. ENERGY OVERVIEW

INTRODUCTION

Energy is an essential part of the economic and social fabric of society. Energy consumption within a society is a function of economic activity, population, the structure of the economy, the climate, and energy resource availability.

This section considers New Zealand's whole energy system. The key data presented includes total primary energy supply and total consumer energy. Some energy sector performance indicators are also presented.



Snapshot of energy in 2016

Energy Supply
0.0%
unchanged from 2015 levels

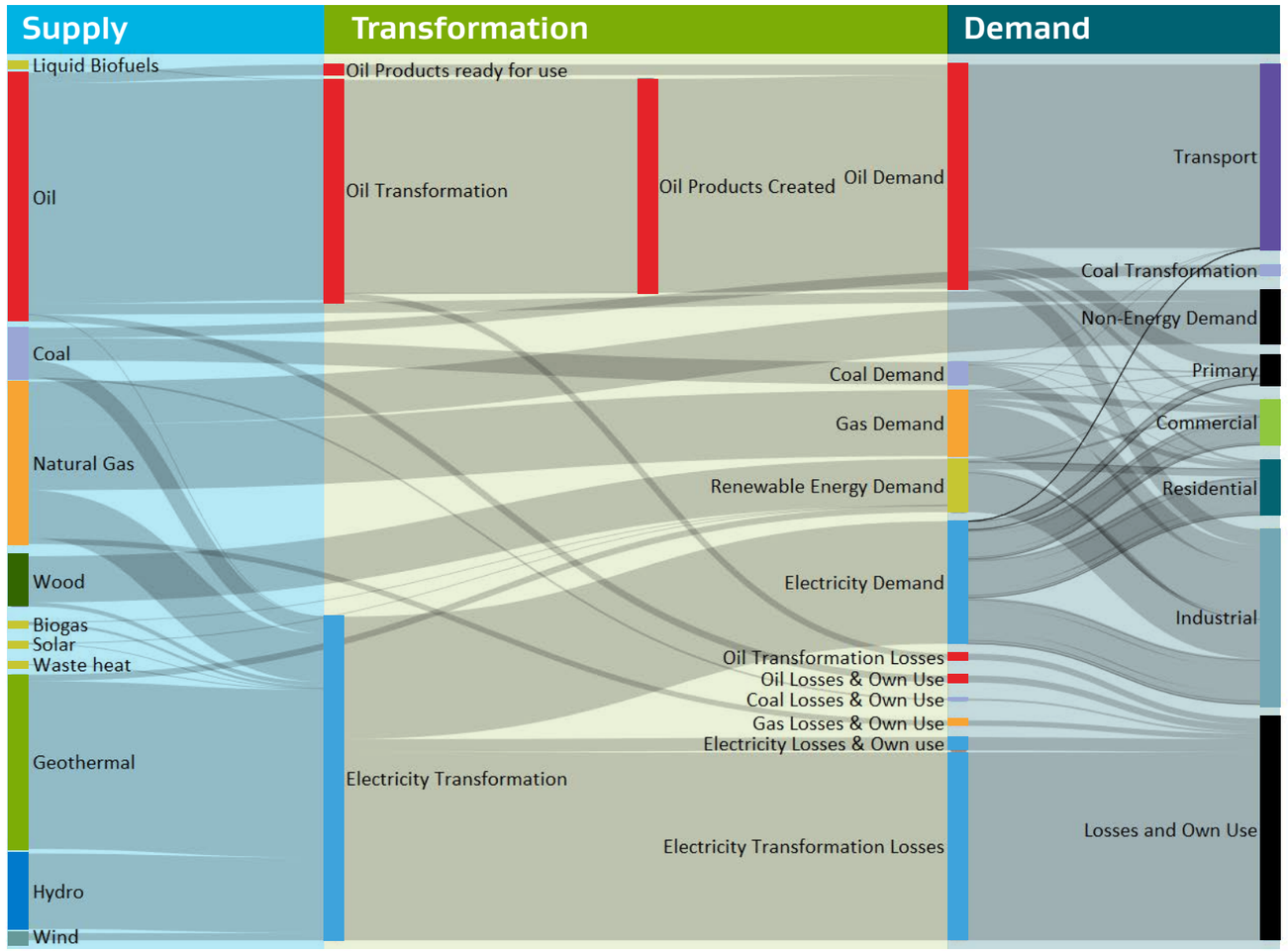
Exports ▼ 19% in an environment of low international commodity prices

Coal exports ▼ 12%, falling for the 4th year in a row
Oil exports ▼ 22%

Production ▼ 2.4% from 2015 levels because of lower oil and coal production

Imports ▲ 5.4% from 2015 levels mostly due to higher levels of diesel entering the country

NZ's energy self-sufficiency fell to 78% because of lower production and higher imports



The statistical difference between calculated energy demand and observed energy demand has been apportioned proportional based on the observed demand in each sector.

Energy Demand
1.0%
from 2015 levels

Transport demand ▲ 1.9% reaching a new high in 2016

The largest contributor was diesel use for land transport

Industrial demand ▲ 2.7% after Methanex returned to 90% capacity

Energy Intensity (MJ/$GDP) [1] **continues to improve,** it has improved by 1.2% on average since 1990

Improvements in Energy intensity have been driven by sustained economic growth in the Commercial Sector

On average the Commercial sector use about 8% the amount of energy the industrial sector [2] uses to produce $1 of GDP

1. Energy use per dollar of GDP
2. Excludes Chemical and Metals industries that have a small number of very heavy energy users

Renewable energy was 40% of energy supply in 2016

Hydro supply ▲ 5.6%, while geothermal and other renewable supply fell

New Zealand has the 4th highest renewable share in the OECD

Energy Transformation

NZ Refinery intake was 252 PJ in 2016 ▼ 2.1% from 2015 levels

This produced
70 PJ of petrol
84 PJ of diesel
27 PJ of fuel oil
53 PJ of Aviation Fuel

149 PJ of electricity was generated in 2016 ▼ 0.5% from 2015 levels

85% of the electricity generated was renewable, a 35 year high
This was due to high hydro generation

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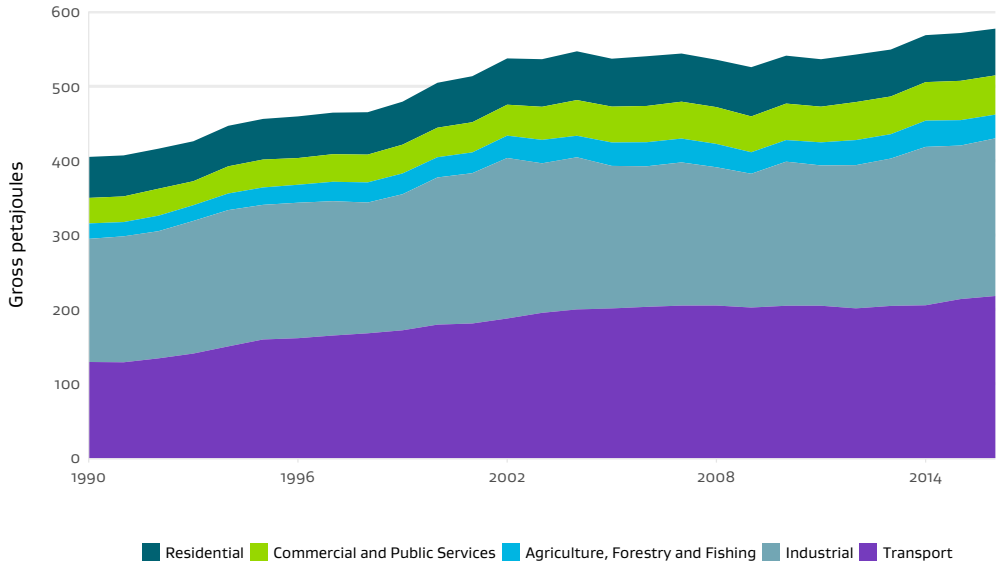
Energy Demand

Consumer energy demand up 1.0% from 2015 levels, led by higher Industrial and Transport demand

Figure A.1: Consumer energy demand by sector



Consumer energy demand continues to rise, up 5.9 PJ for the fifth consecutive year in a row.

Industrial demand was a major contributor to growth in consumer energy demand, up 2.7% (5.5 PJ) in 2016. Most of this increase came from higher demand in the Chemicals sector, where Methanex returned to near full capacity after experiencing mechanical issues in 2015. Energy use in the Chemicals sector rose 14% over the year, and also drove a 8.9% increase in non-energy use of gas.[1] Excluding the Chemicals sector, demand by all other Industrial sectors stayed at similar levels to recent years.

Transport energy demand was up 1.9% (4.1 PJ) driven by growth in land transport demand. Both petrol and diesel use for land transport increased over the year, up 2.4% and 2.6% respectively. Diesel use for land transport has been trending up for many years and continues to grow alongside growth in the New Zealand economy.

Demand by the Agriculture, Forestry and Fishing sector offset the increases in consumer energy demand, falling by 6.5% (2.2 PJ) in 2016 and down for all fuel types. The fall in this sector was driven by lower electrical irrigation demand due to higher rainfall, and less heating demand due to warmer temperatures.

1 Non-energy use refers to the use of fuels to produce non-energy products. This mainly consists of natural gas being used to produce methanol and urea, and oil being used to produce products such as bitumen for roading.

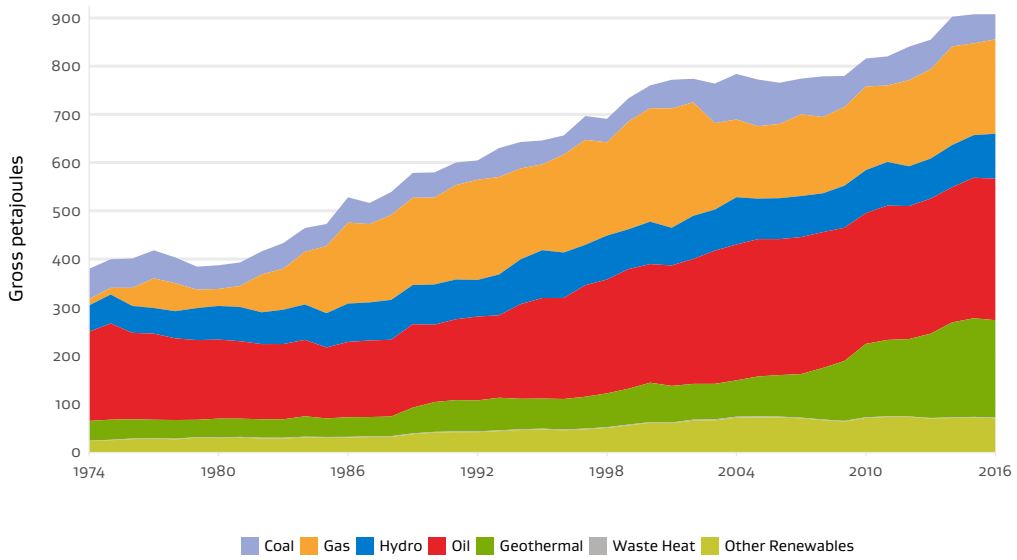
Energy Supply

Primary energy supply remained unchanged from 2015 levels at 908 PJ

Supply = Production + Imports – Exports – Stock change

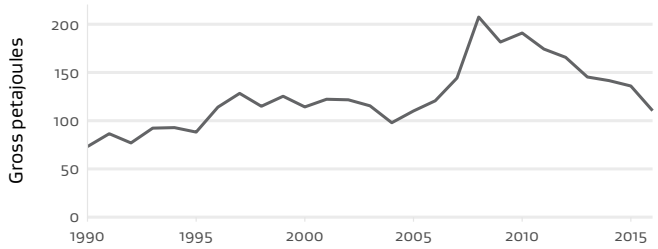
Energy supply growth was flat as higher imports and lower exports were offset by a fall in energy production.

Figure A.2: Total primary energy supply by fuel



Exports fell 19% to their lowest level since 2005

Figure A.3: Energy exports



The fall in exports was due to a 15% fall in the production of tradable commodities.

Crude oil exports fell 22% due to a 15% fall in production over the year. Production was down in 2016 with Maari experiencing a shutdown at the end of the year. At the same time, fields experience natural decline which means production with fall further unless discoveries are made or contigent resources are developed.

Coal exports fell to their lowest level since 1998 alongside continued soft international coking coal prices that has seen overall production fall in New Zealand. Production of bituminous coal (used for coking), 98% of which is exported, fell 14% over the year its 3rd consecutive annual fall.

National energy production fell 2.4% because of large falls in coal and crude oil production

New Zealand produced enough energy to meet

78%

of its energy requirements

Energy production fell 17.5 PJ to 719 PJ in 2016. This was due to falls in coal and crude oil production explained in the previous section. In contrast gas production increased 4.6% in 2016 because of higher demand from the Chemicals sector.

Higher imports saw New Zealand's energy self-sufficiency fall to 78%

Energy imports rose 5.4% over the year mainly because of higher volumes of diesel being imported into the country. Oil imports reached their highest level on record, up 5.4% or 3.2 million barrels, driven by a 41% increase in diesel imports. Increased imports saw New Zealand's self-sufficiency fall from 81% to 78%. Self-sufficiency indicates the proportion of New Zealand's energy requirements that can be met by domestic production.

Energy Transformation

The conversion of primary energy to other forms of energy fell 5.0%

Electricity generation fell 0.5% because of warmer and wetter weather. The share of electricity generation from renewables reached a 35 year high at 85%. This was due to strong hydro inflows resulting in a 5.6% increase in hydro generation, and lower electricity usage in periods of typically high demand during the year reducing the need for coal- and gas- fired generation.

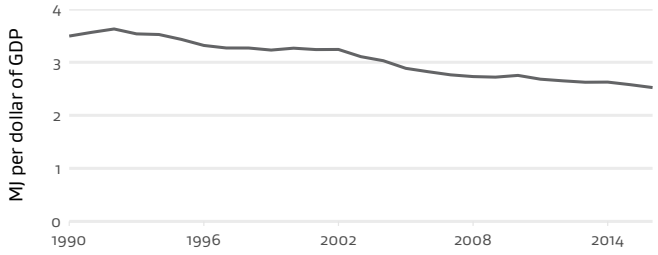
Fuel used for other transformation, including coal used for steel manufacturing, was relatively flat (down 0.1 PJ) as a result of steady production at the Glenbrook steel mill during the year.

Output by the Marsden Point refinery fell 0.4% to 240 PJ (or 40 million barrels). This was driven by a fall in diesel output (down 9.5%) with output of other fuels up compared to 2015.

Energy Indicators

National energy intensity has improved by an average of 1.2% p.a. since 1990[2]

Figure A.4 National energy intensity

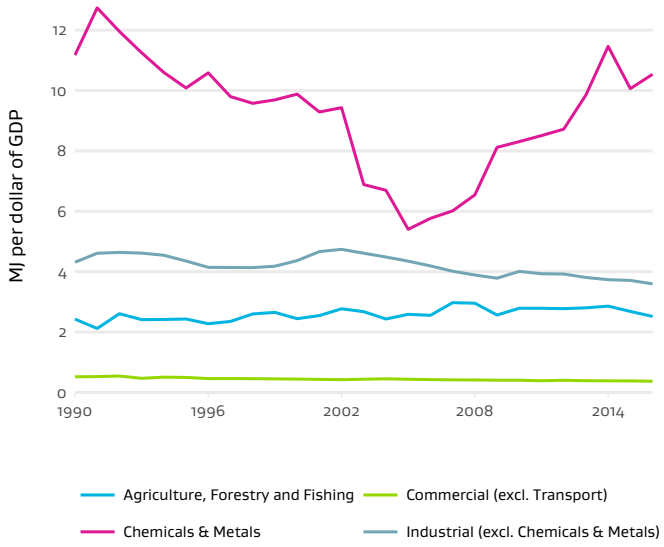


New Zealand's energy intensity is

20%

higher than the OECD average

Figure A.5: Energy intensity for specific sectors



2 National energy intensity is calculated as total energy used in the economy divided by total GDP of the economy.

Energy intensity is an indicator of how much energy is being used to produce a dollar of Gross Domestic Product (GDP). This indicator improves if New Zealand uses less energy to produce a dollar of GDP, so a continued fall in this indicator shows improvement over time.

The improving trend has been mainly driven by higher economic growth in the Commercial sector, a sector that is much less energy intensive than other sectors. In 2016, the Commercial sector used 0.37 MJ/dollar of GDP, 8.1% of what is used by the Industrial sector (excluding Chemicals and Metals) for every dollar of GDP created. Although energy intensity has been improving over time New Zealand still has the 7th highest energy intensity in the OECD – 20% higher than the OECD average.[3]

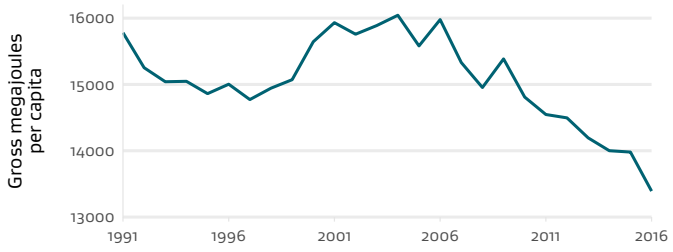
The Commercial sector has risen to account for 62% of GDP, compared to 57% in 1990. This shift towards a more service-based economy has meant that the products and services we provide as a country take less energy to produce.

Another contributing factor has been the improving trend in energy intensity for each sector. Energy intensity for the commercial sector has improved over time 1.3% p.a. on average since 1990 because GDP for the Commercial sector has increased at twice the rate of its energy use. The intensity of energy use in the industrial [4] sectors has also improved over time. Energy use in this sector has been relatively flat since the 2008 recession while GDP for the sector has been increasing. As a result, the industrial sector's energy intensity has improved by an average of 0.7% since 1990. Improvements in energy intensity may be due to compositional changes within sectors, energy efficiency, or a combination of the two.

Residential energy demand fell despite continued population growth

Residential energy use fell 2.2% in 2016. Electricity accounts for 70% of residential energy demand, and the fall in this sector was driven by households using less electricity particularly in periods when demand typically peaks in the year — autumn and winter. Average residential electricity use per ICP[5] was down 2.8% from 2015 levels, and has been trending down since 2009. The downward trend in energy use per ICP may be due to energy efficiency improvements, demographic changes, weather variations, or a combination of these factors.

Figure A.6: Residential energy use per capita



3 Latest data available from the International Energy Agency https://www.iea.org/

4 The Chemical and Metals sectors have been separated out from the Industrial sector as they have a small number of very heavy energy users.

5 An Installation Control Point (ICP) is a customer connection.

B. ENERGY BALANCES

INTRODUCTION

New Zealand's energy production derives from both renewable and non-renewable sources. New Zealand imports and exports fossil fuels, which generate export revenue, but also results in a dependency and vulnerability to energy commodity prices that vary according to international supply and demand factors outside of New Zealand's control.

The energy balance tables reflect how energy supply and demand by sector varies by energy fuel type. Domestic energy supply is derived from either indigenous production or imported from overseas sources. In turn, fuel types can be transformed into different forms of energy, at the cost of losses and inefficiencies which vary by transformation process. Supply, demand, losses and inefficiencies are reflected in balanced energy supply and demand tables.

Both the energy supply and demand dimensions of the energy balance tables are derived from surveys spanning different sources. An imbalance exists between the value of consumer energy calculated from supply, and the value of consumer energy observed from statistical measure.

Interpretation of Energy Balance Tables

Supply

Total primary energy is the amount of energy available for use in New Zealand. Much of it is converted into other forms of energy before it is used. By convention, fuel used for international transport is excluded from total primary energy. Indigenous gas production does not include gas that is flared, reinjected, or LPG extracted. The primary energy figures presented are actual data, except for some that go into electricity generation as detailed under energy transformation.

Energy transformation

Includes generation of electricity (including cogeneration), oil production (including refinery operations and the manufacture of synthetic fuel from natural gas – Methanex ceased methanol to petrol production in April 1999) and other transformation, primarily steel production.

In the Energy Transformation section of the balance tables, "energy in" is shown as negative values and "energy out" as positive values in the appropriate fuel columns. Transformation of energy from one form to another always results in conversion losses, particularly in thermal electricity generation, as much energy is lost as heat.

Transformation losses in electricity generation are derived from the net electricity generated, with the actual fuel input being used where available and the conversion factors shown in Table B.1 used otherwise. Fuel input to biogas, hydro, wind and waste heat are fully estimated. Quarterly figures for electricity generation are made up of actual data from major generators and the Electricity Authority. Estimates are made where actual data are unavailable at the time of publishing.

Liquid biofuel production (bioethanol and biodiesel) appears as renewable energy supply in the energy balance tables. As bioethanol and biodiesel are generally blended with motor petrol and diesel before consumption, liquid biofuel also appears in Energy Transformation under Fuel Production.

Losses and own use in the energy balances include losses before and after transformation, losses and own use in production, transmission and distribution losses, electricity industry own use free of charge, and oil industry losses and own use (which includes distribution tankage losses, stocks, accounts adjustment and own consumption). Transformation losses are excluded.

Non-energy use is primary energy used for purposes other than combustion, e.g. bitumen used in road construction, and natural gas used as chemical feedstock in the production of methanol and ammonia/urea.

Table B.1: Default Electrical Transformation Factors[a]

Fuel	Default Efficiency
Biogas	30%
Coal	30%
Gas (Single Cycle)[b]	30%
Geothermal[c]	15%
Hydro	100%
Oil	30%
Waste Heat	15%
Wind	100%
Wood	25%

a Default efficiencies are only used where real data is unavailable.

b For combined cycle plants, the assumed efficiency is 55%. Currently, however, actual fuel input data are collected for all combined cycle plants.

c Geothermal is predominantly based on real plant steam data and uses a 15% efficiency where these are unavailable.

Treatment of Solar Photovoltaic Panels

Estimates of the amount of electricity generated using solar photovoltaics (PV) are included in the energy balance tables in this edition of Energy in New Zealand. The total primary energy supply of solar is the sum of the direct use of solar thermal (i.e. for hot water heating), and the amount of solar energy directly converted into electricity via PV panels. Solar PV electricity generation is estimated using data on the total installed capacity of grid-connected solar PV installations in New Zealand , and then converted to output using an assumed capacity factor of 14% (i.e. the solar panels produce their full output 14% of the time). Consumption of solar thermal is included in the demand section of the energy balance table under Renewables – Solar, whereas the consumption of electricity generated by solar PV panels appears under Electricity. Solar PV consumption by sector is apportioned using data from the Electricity Authority.

Demand

Consumer energy is the amount of energy consumed by final users. It excludes energy used or lost in the process of transforming energy into other forms and in bringing the energy to the final consumers. For example, natural gas is a primary energy source (see Total Primary Energy Supply), some of which is transformed into electricity, of which some is lost in transmission to consumers.

Consumer energy statistics can be either calculated from supply-side data or observed from usage data.

Consumer energy (calculated) forms the top half of the energy balance tables and is calculated as TPES less energy transformation less non-energy use.

Consumer energy (observed) forms the bottom half of the energy balance tables and it represents reported demand in the agriculture, forestry and fishing; industrial; commercial; transport and residential sectors. With the exception of domestic/national use of energy for on-road, rail, sea and air transport in the transport sector, these sectors follow the Australia New Zealand Standard Industrial Classification 2006 definitions.

Annual figures presented for consumer energy (observed) are actual data except for thermal fuels used for cogeneration in the industrial and commercial sectors and biogas, wastes and wood. Estimates of on-site cogeneration demand are included in electricity end use.

Where the energy end-use is not available or confidential, the “unallocated” category is used.

International transport includes international sea and air transport. It excludes coastal shipping, national air transport and all land transport.

Statistical differences shows the difference between “consumer energy (calculated)” and “consumer energy (observed)”. This difference is shown at the bottom of the energy balance tables.

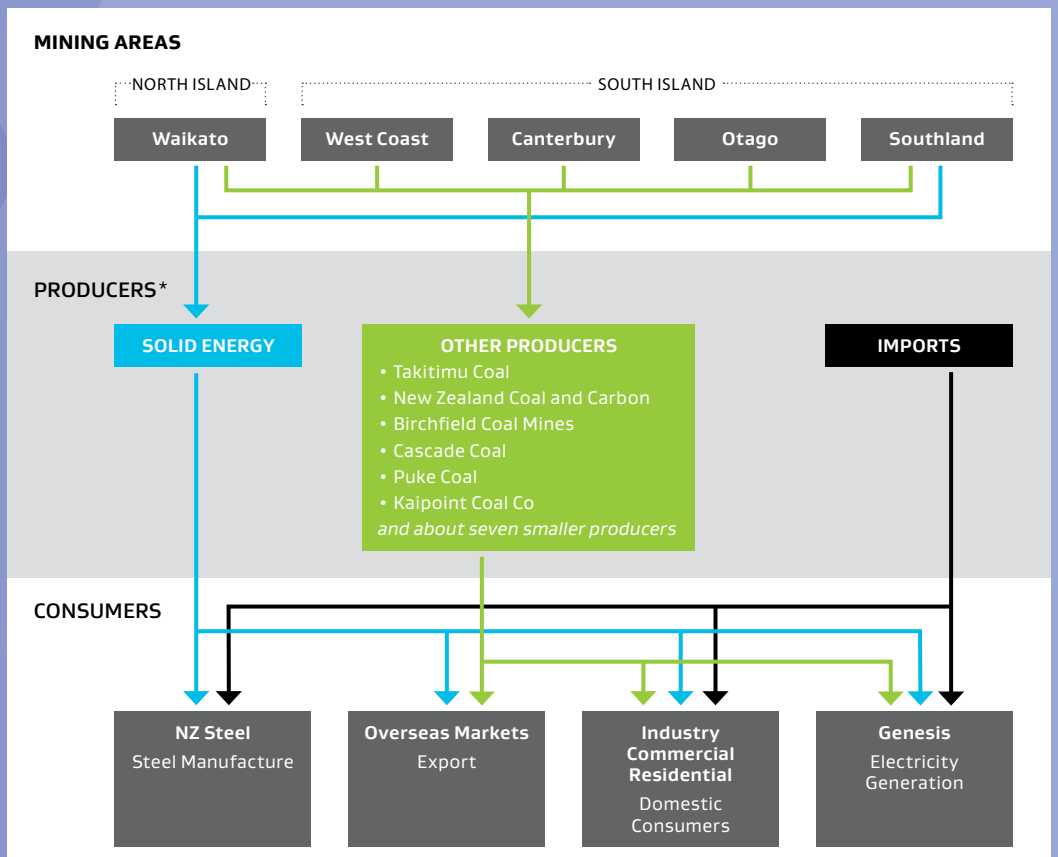
Table B.2: Energy Supply and Demand Balance, Calendar Year 2016

	Converted into Petajolues using Gross Calorific Values	COAL			OIL									NATURAL GAS	RENEWABLES								ELECTRICITY	WASTE HEAT	TOTAL
		Bituminous & Sub-bitum.	Lignite	Total	Crudes/ Feed-stocks/ NGL	LPG	Petrol	Diesel	Fuel Oil	Av. Fuel/ Kero	Others	Total		Total	Hydro	Geothermal	Solar	Wind	Liquid Biofuels	Biogas	Wood	Total	Total	Total	
SUPPLY	**Indigenous Production**	68.13	4.78	**72.91**	74.16	8.33						**82.49**		**196.79**	93.26	201.84	0.55	8.32	0.13	2.71	58.27	**365.08**		**1.41**	**718.68**
	+ Imports	10.16	0.00	**10.16**	245.19	1.20	44.16	47.51	-	9.84	5.90	**353.80**													**363.96**
	– Exports	37.83	-	**37.83**	66.27	1.22	-	-	5.10	-	-	**72.58**													**110.41**
	– Stock Change	-6.94	0.10	**-6.85**	-1.56	0.00	2.03	2.23	4.60	-0.61	2.05	**8.74**		**0.97**											**2.86**
	– International Transport						0.00	1.88	11.26	48.56	-	**61.70**													**61.70**
	TOTAL PRIMARY ENERGY	**47.40**	**4.69**	**52.09**	**254.64**	**8.30**	**42.13**	**43.40**	**-20.95**	**-38.10**	**3.85**	**293.27**		**195.82**	**93.26**	**201.84**	**0.55**	**8.32**	**0.13**	**2.71**	**58.27**	**365.08**		**1.41**	**907.68**
	ENERGY TRANSFORMATION	**-26.28**	**-0.29**	**-26.58**	**-252.55**	**-0.00**	**69.83**	**83.74**	**26.82**	**53.64**	**6.56**	**-11.96**		**-56.36**	**-93.26**	**-194.19**	**-0.19**	**-8.32**	**-0.13**	**-2.38**	**-4.66**	**-303.12**	**141.44**	**-1.41**	**-257.99**
	• Electricity Generation	-4.84	-	**-4.84**				-0.02	-			**-0.02**		**-37.76**	-93.26	-192.49	-0.19	-8.32		-1.37		**-295.62**	**148.97**		**-189.28**
	• Cogeneration	-7.24	-0.25	**-7.49**										**-12.88**		-1.70				-1.01	-4.66	**-7.37**	**7.77**	**-1.41**	**-21.38**
	• Fuel Production				-252.47		69.79	83.87	26.81	53.59	13.80	**-4.62**		**-**					-0.13			**-0.13**			**-4.75**
	• Other Transformation	-11.70	-	**-11.70**																					**-11.70**
	• Losses and Own Use	-2.50	-0.04	**-2.54**	-0.08	-0.00	0.04	-0.11	0.01	0.05	-7.24	**-7.33**		**-5.72**									**-15.30**		**-30.89**
Non-energy Use											**-10.41**	**-10.41**		**-58.15**											**-68.56**
CONSUMER ENERGY (calculated)		**21.12**	**4.40**	**25.51**	**2.09**	**8.30**	**111.96**	**127.14**	**5.87**	**15.54**	**-**	**270.90**		**81.31**		**7.65**	**0.36**	**-**	**-**	**0.33**	**53.62**	**61.96**	**141.44**	**-**	**581.12**
DEMAND	**Agriculture, Forestry and Fishing**	**1.49**	**0.02**	**1.52**		**0.08**	**1.53**	**15.97**	**1.38**	**-**		**18.97**		**1.61**		**0.60**						**0.60**	**9.23**		**31.93**
	• Agriculture	1.48	0.02	**1.51**		0.08	1.42	11.29	-	-		**12.80**		**1.61**		0.60						**0.60**	**8.80**		**25.31**
	• Forestry and Logging	0.01	-	**0.01**			0.01	3.32	-	-		**3.33**		**0.00**									**0.33**		**3.66**
	• Fishing	-	-	**-**			0.10	1.37	1.38	-		**2.85**		**-**									**0.10**		**2.95**
	Industrial	**19.80**	**3.78**	**23.59**		**3.31**	**0.41**	**15.20**	**1.02**	**-**		**19.93**		**65.74**		**4.51**				**0.05**	**45.50**	**50.06**	**52.72**		**212.03**
	• Mining	-	-	**-**			0.00	2.74	-	-		**2.74**		**0.13**									**1.30**		**4.17**
	• Food Processing	13.71	3.76	**17.48**			-	-	-	-		**-**		**15.46**									**9.07**		**42.00**
	• Textiles	0.08	-	**0.08**										**0.56**									**0.35**		**0.99**
	• Wood, Pulp, Paper and Printing	0.57	0.02	**0.59**										**5.56**									**9.76**		**15.91**
	• Chemicals	0.00	-	**0.00**										**39.18**									**2.90**		**42.08**
	• Non-metallic Minerals	3.06	-	**3.06**										**1.52**									**1.04**		**5.62**
	• Basic Metals	0.01	-	**0.01**			-	-	-	-		**-**		**2.43**									**23.23**		**25.68**
	• Mechanical/Electrical Equipment	0.00	-	**0.00**										**0.28**									**0.62**		**0.90**
	• Building and Construction	-	-	**-**			0.04	4.52	0.03	-		**4.59**		**0.49**									**1.43**		**6.50**
	• Unallocated	2.35	-	**2.35**		3.31	0.36	7.94	0.99	-		**12.61**		**0.13**		4.51				0.05	45.50	**50.06**	**3.03**		**68.18**
	Commercial	**0.68**	**0.55**	**1.23**		**1.48**	**0.45**	**4.82**	**0.04**	**-**		**6.79**		**8.12**		**2.25**				**0.28**		**2.53**	**34.10**		**52.77**
	Transport	**0.00**	**-**	**0.00**		**0.31**	**110.01**	**89.72**	**4.11**	**13.57**		**217.73**		**0.02**						**-**		**-**	**0.22**		**217.97**
	Residential	**0.18**	**0.16**	**0.34**		**3.22**	**0.05**	**0.12**	**-**	**-**		**3.39**		**6.36**		**0.30**	**0.36**				**8.12**	**8.78**	**44.02**		**62.90**
CONSUMER ENERGY (observed)		**22.16**	**4.52**	**26.68**	**-**	**8.41**	**112.45**	**125.83**	**6.55**	**13.57**	**-**	**266.82**		**81.83**	**-**	**7.65**	**0.36**	**-**		**0.33**	**53.62**	**61.96**	**140.30**	**-**	**577.60**
Statistical Differences		**-1.05**	**-0.12**	**-1.17**	**2.09**	**-0.11**	**-0.48**	**1.30**	**-0.68**	**1.96**	**-**	**4.08**		**-0.53**		**-**	**-**	**-**		**-**	**-**	**-**	**1.14**	**-**	**3.53**

C. COAL

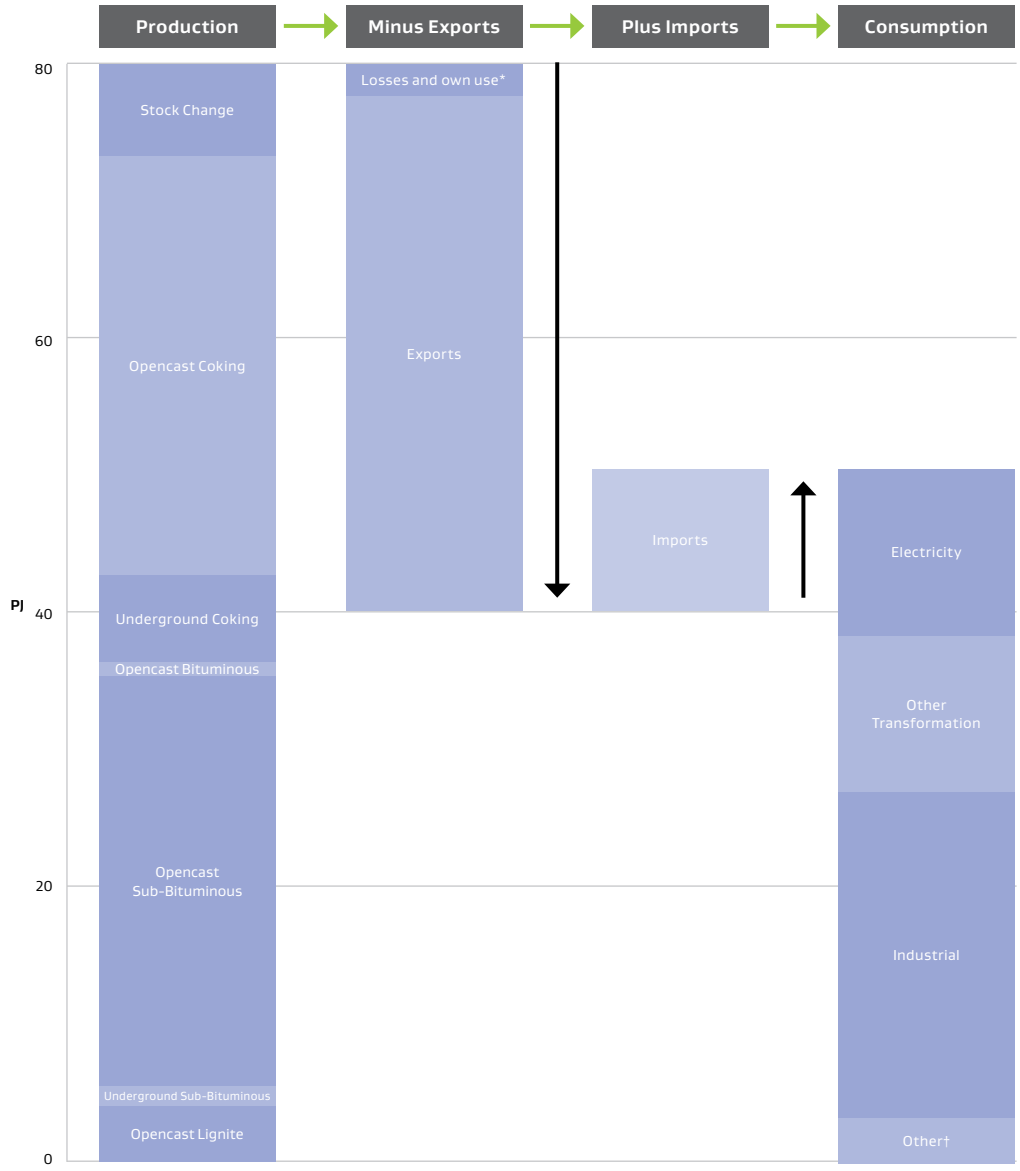
INTRODUCTION

This section contains information about coal production (supply) and sales to consumers (demand). Information on coal is presented for the 2016 calendar year. Background information on New Zealand's coal industry can be found on the New Zealand Petroleum and Minerals website: http://www.nzpam.govt.nz/cms/investors/our-resource-potential/minerals/coal



Note:
Company names are listed without the suffixes Limited and New Zealand Limited where applicable.

Figure C.2: Coal Energy Flow Diagram for 2016



* Includes use at production sites and distribution losses.

† Includes commercial, residential, agriculture and transport.

Coal Supply

Total coal supply fell 14% to 52 PJ (2.5 million tonnes) as a result of falling production destined for both the North Island and international markets.

Coal production at a

25

year low

Coal production fell 15% because of decreases in production in the North Island and West Coast

New Zealand produced 73 PJ (3.0 million tonnes) of coal in 2016, the lowest annual production since 1991 and a 15% fall from 2015. Coal production can be split into three geographic areas with different economic drivers.

North Island – for the most part coal produced in the North Island is used in the North Island, and in 2016 production fell 26%. The falling trend in this area has been driven by less coal being used for electricity generation.

West Coast – coal produced on the West Coast is mainly for export to international markets. Production in this area fell 14%, its third annual fall in a row. West Coast production has been falling alongside falling international coal prices.

Rest of the South Island – production in these remaining areas are mainly for domestic use. In contrast to falling production in other areas, production in the South Island outside of the West Coast rose 10% over the year. This continues an upward trend in production in this area over time. Coal is an important fuel for industry in the South Island because unlike the North Island there is no natural gas source. A large portion of coal in these areas is used in the manufacture of dairy products.

Closures of mines at the end of 2015 impacted 2016 production levels. The underground Huntly East mine was closed, while the Strongman, Cascade and Escarpment opencast mines were put into care and maintenance primarily in response to market conditions.

Solid Energy produced 68% of national production in 2016, but has been operating under voluntary administration since August 2015. The company's assets have recently been sold to other coal companies, a process that was completed in August 2017.

Exports fell 12% because of lower production on the West Coast

In 2016, New Zealand exported 38 PJ (1.2 million tonnes) of coal and imported 10 PJ (0.5 million tonnes). Coal exports fell for the fourth consecutive year in a row, and are now at their lowest level in 18 years. This is mainly been due to international coal prices falling to low levels in 2012. Prices began to trend up at the end of 2016 but remain volatile. Coal is only exported from the West Coast, where most of it goes to the India and Japanese markets. New Zealand exports mostly Bituminous coal (a coking coal) but does export smaller amounts of thermal and specialist coals.

Figure C.3 Coal production by geographic area

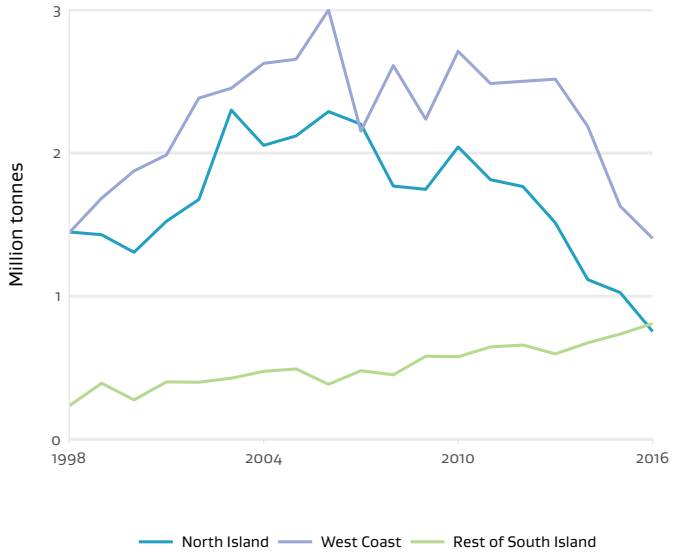
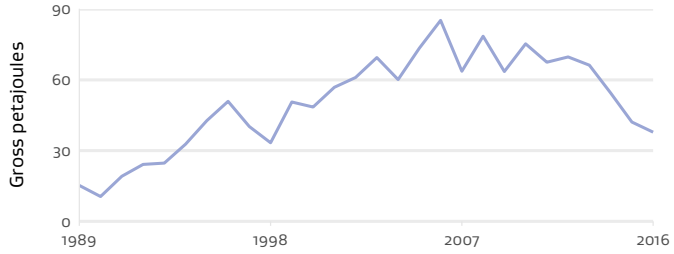


Figure C.4: Bituminous coal exports



Coal Use

Coal use has historically been dominated by electricity generation. In recent years, falling use of coal for electricity generation has seen the Industrial sector become the dominant user.

Coal used in electricity generation fell 60% because of wetter weather

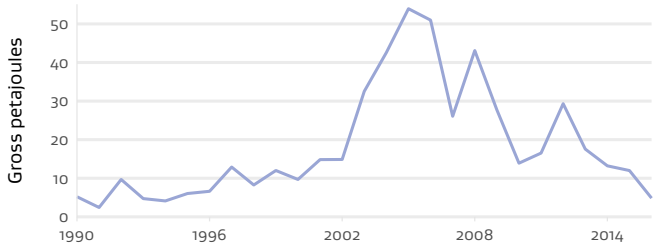
In 2016 the amount of coal used for electricity fell to its lowest level since 1994. There are several factors for the continued fall in coal being used for electricity generation, including:

- There has been strong supply of renewables for electricity generation. New geothermal generation has come online in the last decade that reduces the need for baseload gas generation. In 2016 there was particularly strong hydro inflows which saw the share of electricity generation from renewable sources reach a 35 year high.
- Genesis Energy's closure of two of its four coal/gas Huntly Rankine units in recent years, and running the remaining units predominantly on gas.

The two remaining Huntly Rankine units are the only major electricity plant that can be run on coal. They are important for New Zealand's security of electricity supply requirements in a dry year to meet winter energy and peak demand requirements. Although these units haven't been running on coal very often in recent years, a dry year could see coal use rise above historical lows.

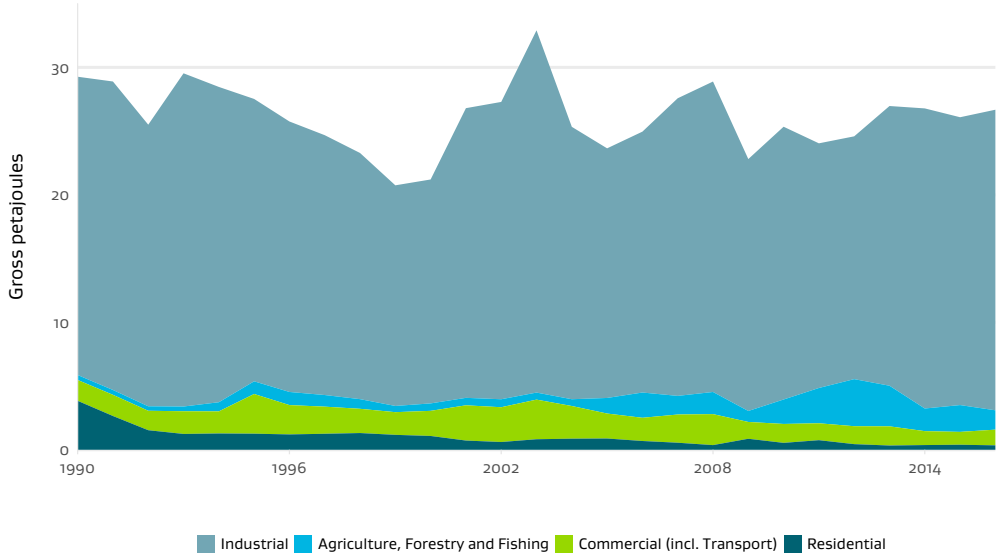
Other transformation (including coal used as a reductant in steel manufacturing) remained at a similar level to recent years, down 1.2% from 2015.

Figure C.5 Coal used for electricity generation



Coal consumption up alongside higher production in the South Island

Figure: C.6 Coal consumption by sector



Coal consumption has been relatively steady in recent years, up 2.3% to 27 PJ (1.3 million tonnes) from 2015. The rise in coal consumption sits alongside growing production in the South Island. The industrial sector contributed the most to the rise in consumption, up 4.4% over the period. Just under half of New Zealand's coal use in 2016 was used in the Industrial sector, primarily to generate heat for industrial processes.[6] Industrial coal use is primarily for meat, dairy, and cement, lime and plaster manufacturing.

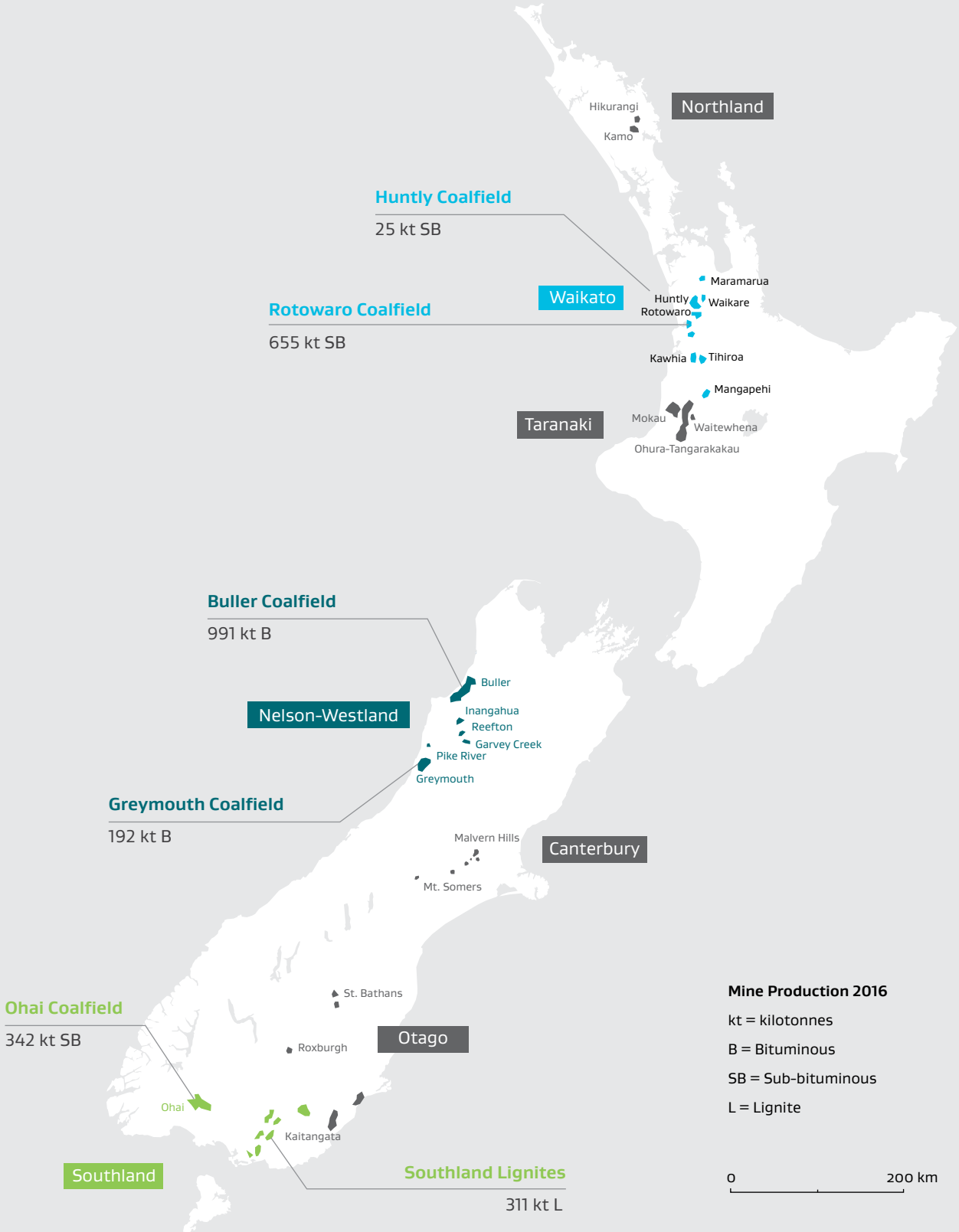
Resources

New Zealand has extensive coal resources, mainly in the Waikato and Taranaki regions of the North Island, and the West Coast, Otago and Southland regions of the South Island. It has been estimated that national in-ground resources of all coal are over 15 billion tonnes, although 80% of this is lignite in the South Island. Sub-bituminous and bituminous in-ground resources are around 4 billion tonnes, but economic reserves are much smaller.

More information on the New Zealand coal industry is available on the New Zealand Petroleum and Minerals website: http://www.nzpam.govt.nz/cms/investors/our-resource-potential/minerals/coal.

6 For more data on process heat in New Zealand, see http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-efficiency-environment/process-heat-in-new-zealand/data

Figure: C.7 Location of New Zealand coal resources and coal production in 2016



D. OIL AND GAS

INTRODUCTION

This section contains information on New Zealand's oil and gas industry, presented for the 2016 calendar year. Oil and gas reserves are presented first, followed by oil and gas supply and demand.

More information on oil and gas exploration in New Zealand can be found on the New Zealand Petroleum and Minerals website: http://www.nzpam.govt.nz/cms/investors/our-resource-potential/petroleum

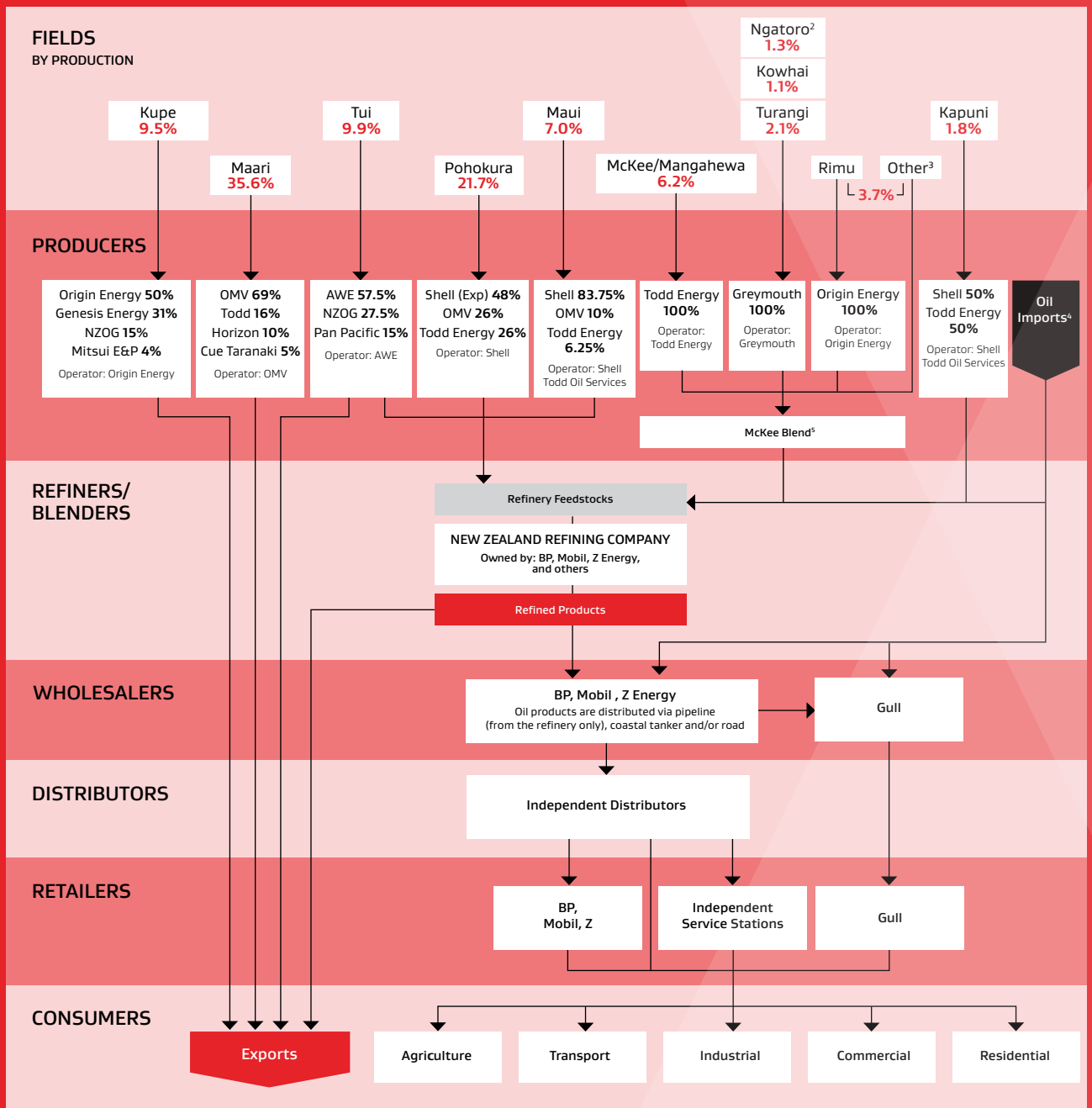
Percentage changes in this section are calculated based on petajoules. This controls for differences in the energy content of different oil product types, and gas produced from different fields.

Liquified petroleum gas (LPG) data is presented in the Oil section.

Oil and Gas

OIL

Figure D.1: Oil market summary for the 2016[1]



Company names are listed without the suffixes "Limited" and "New Zealand Limited" where applicable and subsidiaries are listed as the parent company. The companies are: AWE is Australian Worldwide Exploration Limited, Chevron is Chevron NZ (includes Caltex New Zealand Limited), Greymouth is Greymouth Petroleum Holdings Limited, Mitsui E&P is Mitsui E&P Australia Pty, ExxonMobil is ExxonMobil New Zealand Holdings (includes Mobil Oil New Zealand Limited), NZOG is New Zealand Oil and Gas, OMV is OMV New Zealand Limited (Österr Mineralöl Verwaltung), Origin Energy is Origin Energy New Zealand Ltd and Contact Energy (51% owned by Origin), Shell is Shell NZ Limited (includes Shell Exploration NZ Limited, Shell (Petroleum Mining) Energy Petroleum Holdings Limited, Energy Petroleum Investments Ltd, Energy Petroleum Taranaki Ltd and Taranaki Offshore Petroleum Company), TWN comprises the Tariki, Waihapa and Ngaere fields.

Notes:

1 Ownership as at 31 December 2016. Tamarind Management ownership of AWE share of Tui took effect in early 2017.

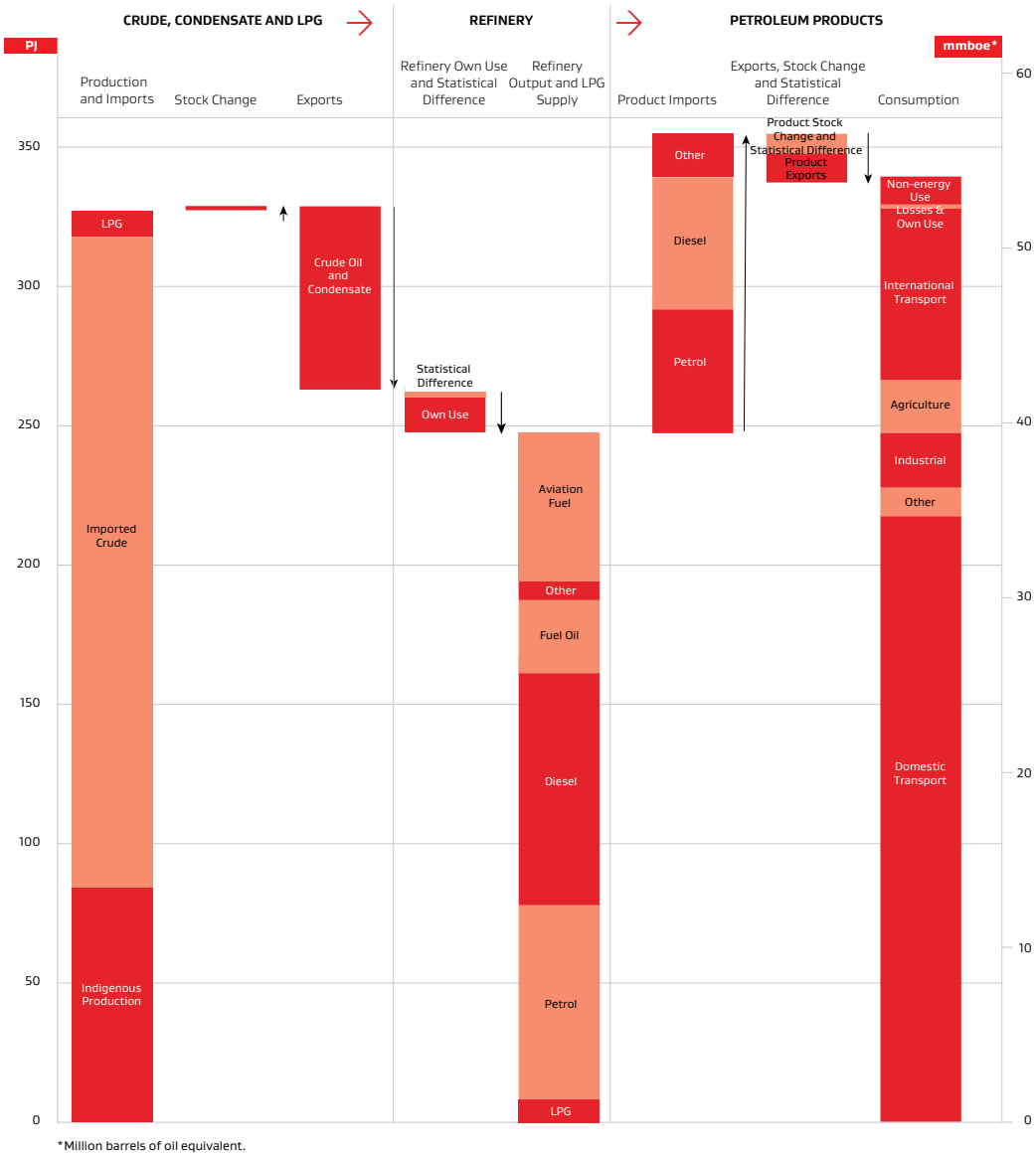
2 Kaimiro, Ngatoro and Windsor fields were combined as a single permit area in 2010. All these fields are included here, as is Moturoa.

3 Includes Cheal, Sidewinder, Copper Moki, TWN, Surrey, Onaero and Puka fields, and Radnor well. Cheal and Sidewinder are owned by Tag Oil Limited. Surrey and Onaero are owned and operated by Greymouth Petroleum. Copper Moki is owned by New Zealand Energy Corp. TWN is jointly owned by New Zealand Energy Corp and L&M Energy, and operated by New Zealand Energy Corp. Puka is owned by Kea Petroleum Holdings and MEO Australia and operated by Kea Petroleum Holdings.

4 Crude and refined product are imported by the four large oil companies. Refined product is imported by Gull Petroleum.

5 Source: Shell NZ Limited.

Figure D.2: Oil Energy Flow Summary for 2016



*Million barrels of oil equivalent.

Oil supply

Production of crude oil fell 15.1% because of diminishing production from existing fields

Indigenous production of crude oil was down 15.1% for 2016, a 10 year low. This was influenced by a two month shutdown of the Maari field at the end of 2016 after a crack was discovered in the well head platform. The remaining reduction can be attributed to inter-year variability and long term field decline across many fields. Production from existing fields continues to trend down over time. New Zealand indigenous production of crude oil, condensate, naphtha, and natural gas liquids peaked in 2008 at 128.3 PJ. Since then production has fallen 42% to 74.2 PJ. This is symptomatic of natural field exhaustion and no further major fields having been identified since Tui entered production in 2007.

Exports are down 22% because of lower levels of production

Overall exports fell to 72.6 PJ because of lower production. The reduction in exports is a result of the reduction in output from Maari combined with long term field decline overall.

Oil production at its

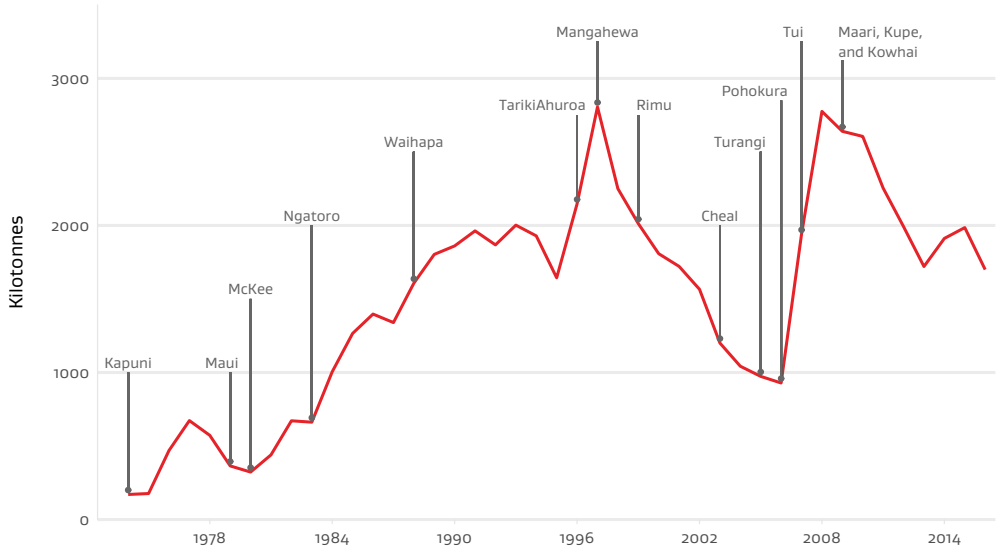
lowest level

in a decade

Oil imports up 5% because of higher demand for diesel

Despite increased consumption of diesel, domestic refinery output of diesel decreased 9.5% (8.8 PJ). Increased demand for diesel was met by higher imports, up 41% (13.8 PJ) from 2015 levels.

*Figure D.3: New Zealand annual oil production**



*Field names indicate when the field started producing

Oil use

Oil consumption grew 2.2% because of higher domestic transportation

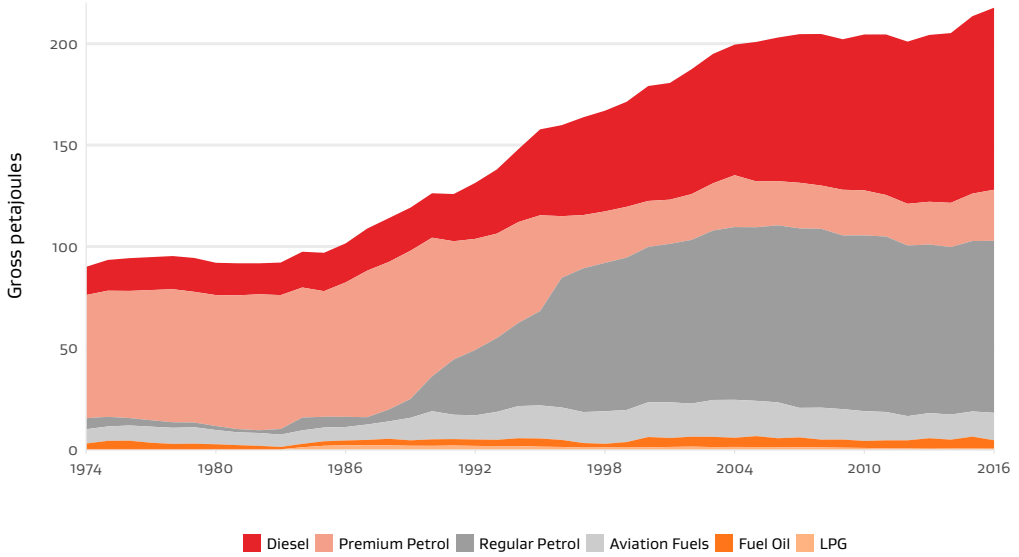
Overall consumption was up 5.6 PJ in 2016 driven mainly by gains in the domestic transport sector, which was up 2.0% (4.2 PJ). The industrial sector grew by 7.5% (1.4 PJ), almost all of which was an increase in diesel consumption.

Diesel consumption continues to grow, up 2.7% (3.3 PJ) alongside light and heavy commercial vehicle growth. Premium petrol consumption also increased, up 7.9% in the past year. However, it is difficult to attribute this movement to any longer term trend.

Jet fuel consumption also continues to increase, up 9.3% (1.1 PJ), driven by strong demand from international flights. The stronger demand for jet fuel has seen increased refinery output of jet fuel, up 7.9% (3.9 PJ), and increased imports of jet fuel, up 236% (6.6 PJ).

Figure D.4: Oil imports by region of origin

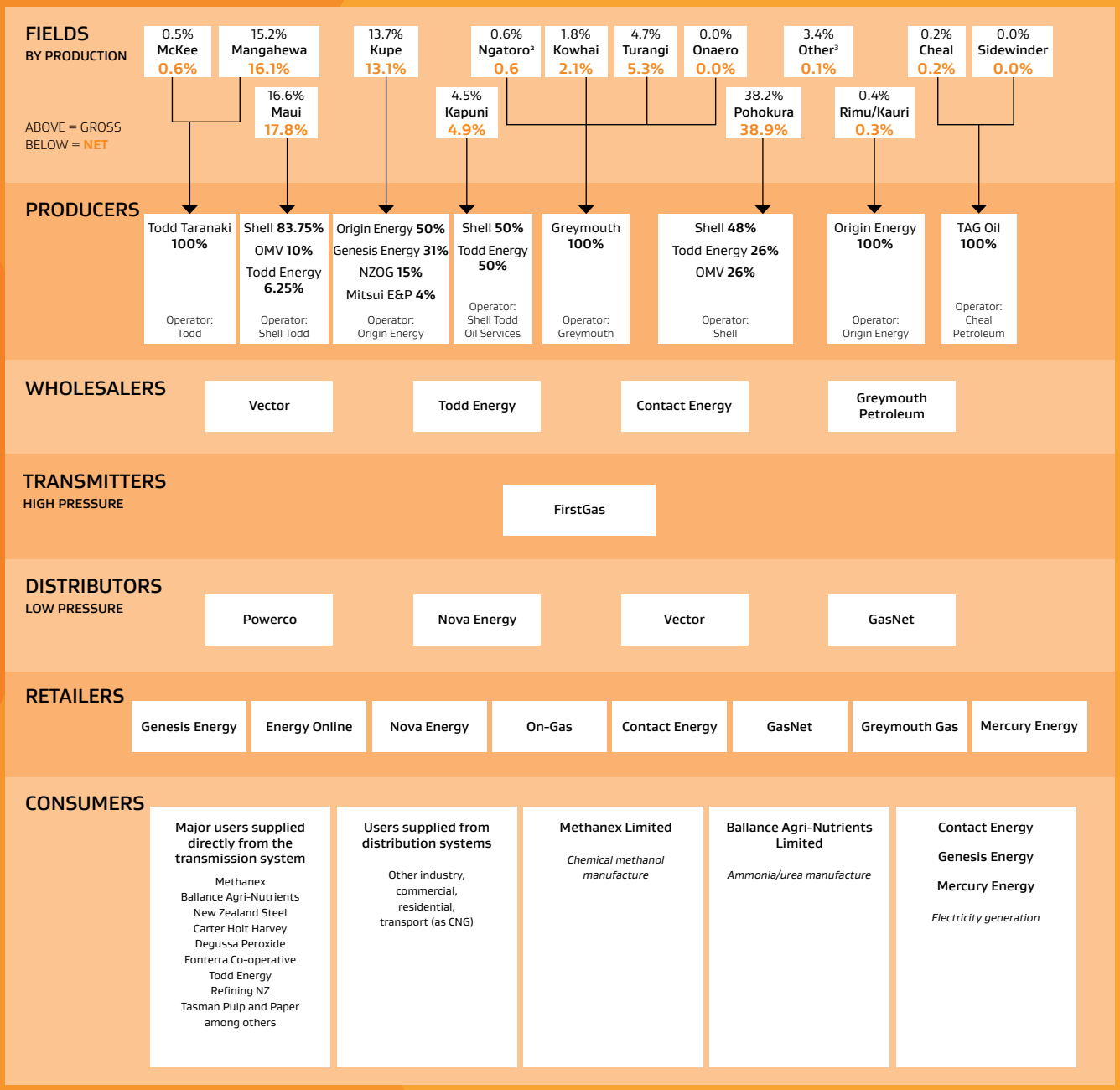
Figure D.5: Oil products consumed for domestic transportation



Oil and Gas

GAS

Figure D.6: Natural Gas Industry Summary for 2016



Company names are listed without the suffixes "Limited" and "New Zealand Limited" where applicable. AWE is Australian Worldwide Exploration Limited, Greymouth is Greymouth Petroleum Limited, Mitsui E&P is Mitsui E&P New Zealand Limited, NZOG is New Zealand Oil & Gas Limited, OMV is OMV New Zealand Limited, Contact Energy is Contact Energy Limited, Origin Energy is Origin Energy New Zealand Ltd and Contact Energy (51% owned by Origin), Pan Pacific is Pan Pacific Petroleum, Shell is Shell NZ Limited (includes Shell Exploration NZ Limited, Shell (Petroleum Mining) Co Limited, Energy Petroleum Holdings Limited, Energy Petroleum Investments Ltd, Energy Petroleum Taranaki Ltd, Energy Finance New Zealand Limited and Taranaki Offshore Petroleum Company), TWN comprises the Tariki, Waihapa and Ngaere fields, Todd Energy is Todd Energy Limited and includes Nova Gas, Vector is Vector Limited and includes OnGas, Wanganui Gas is Wanganui Gas Company Limited. Nova Energy is Nova Energy Limited.

Notes:

1 Gas ownership as at year end 2016; excludes LPG. Does not show changes in ownership that occurred after 31 Dec 2016.

2 Includes Kaimiro, Windsor and Goldie wells.

3 Includes Maari, Tui, TWN, Copper Moki, Puka and Surrey fields. Maari is owned by OMV, Todd, Horizon, and Cue Taranaki and operated by OMV. Tui is owned by AWE, NZOG and Mitsui E & P and operated by AWE. TWN is owned by New Zealand Energy Corp and L & M Energy and operated by New Zealand Energy Corp. Copper Moki is owned by New Zealand Energy Corp. Surrey is owned and operated by Greymouth. Puka is owned by Kea Petroleum Holdings and MEO Australia and operated by Kea Petroleum Holdings.

Figure D.7: Natural Gas Flow Summary for 2016

* Includes transport, agriculture, forestry and fishing.

Gas use

Gas use increased in 2016 largely because of bounce back in consumer demand and non-energy use from the Chemical Manufacturing sector. However, gas use for electricity generation fell to historical lows.

Gas consumption rose 3.8% because of increased demand from the Chemical Manufacturing sector

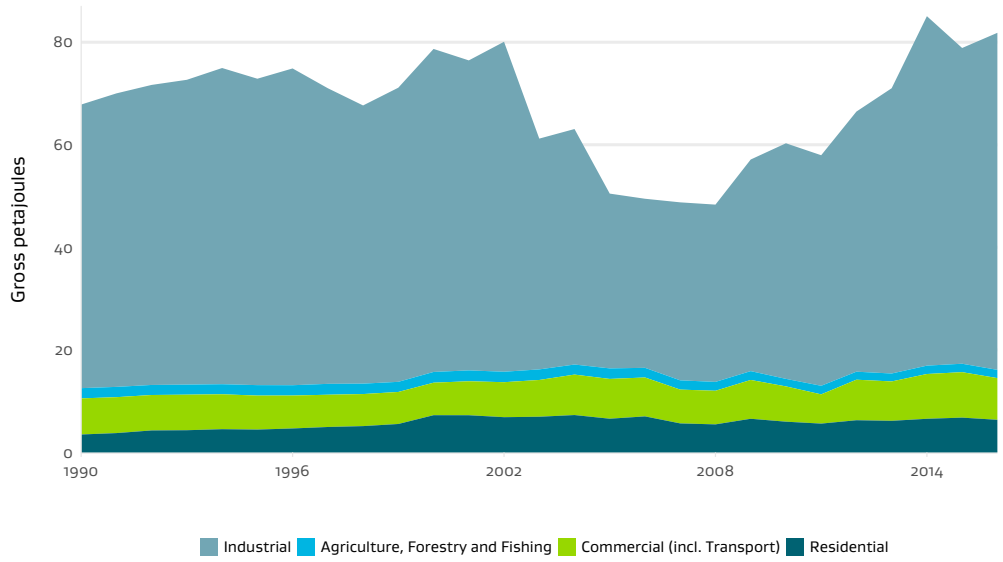
Gas consumption rose 3.0 PJ in 2016. The Chemical manufacturing sector was the major contributor to the rise, up 15.1%(5.1 PJ). Consumption bounced back in 2016 with Methanex returning to near full capacity after experience mechanical issues in 2015.

The long term trend in Commercial, Industrial and Residential sectors is largely one of growth. The industrial sector has been growing rapidly since 2006, primarily being driven by growth in chemical manufacture. The Food Processing industry grew by approximately 50% between 2009 and 2010 and has been largely level since then. In contrast, gas consumption has been declining in the Agriculture, Forestry, and Fishing sector.

Non-energy use of gas rose 16% after Methanex returned to normal production levels

Movements in gas use this year were heavily influenced by Methanex production, with non-energy also bouncing back, up 8.0 PJ in 2016.

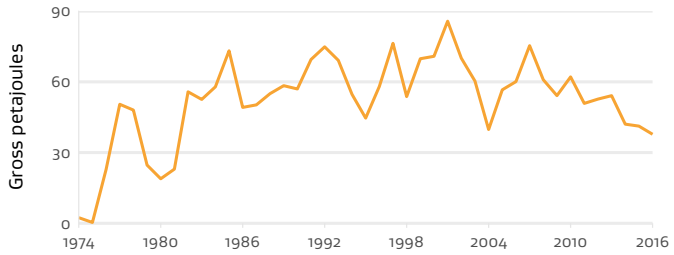
Figure D.8: Gas consumption by sector



Gas used to fuel electricity plants fell to a 35 year low because of wetter weather

Gas fuel input for electricity plant fell 8.4% (3.5 PJ) to a 35 year low. Fuel input for cogeneration also fell by 15.4% (2.3 PJ). The reduction in gas fuel input is a result of greater volume of hydro being available because rainfall levels were higher than normal. The long term trend for gas consumption in electricity generation and cogeneration has been one of decline since 2001. More detail about this decline is discussed in the electricity section.

Figure D.9: Gas used for electricity generation



Gas supply

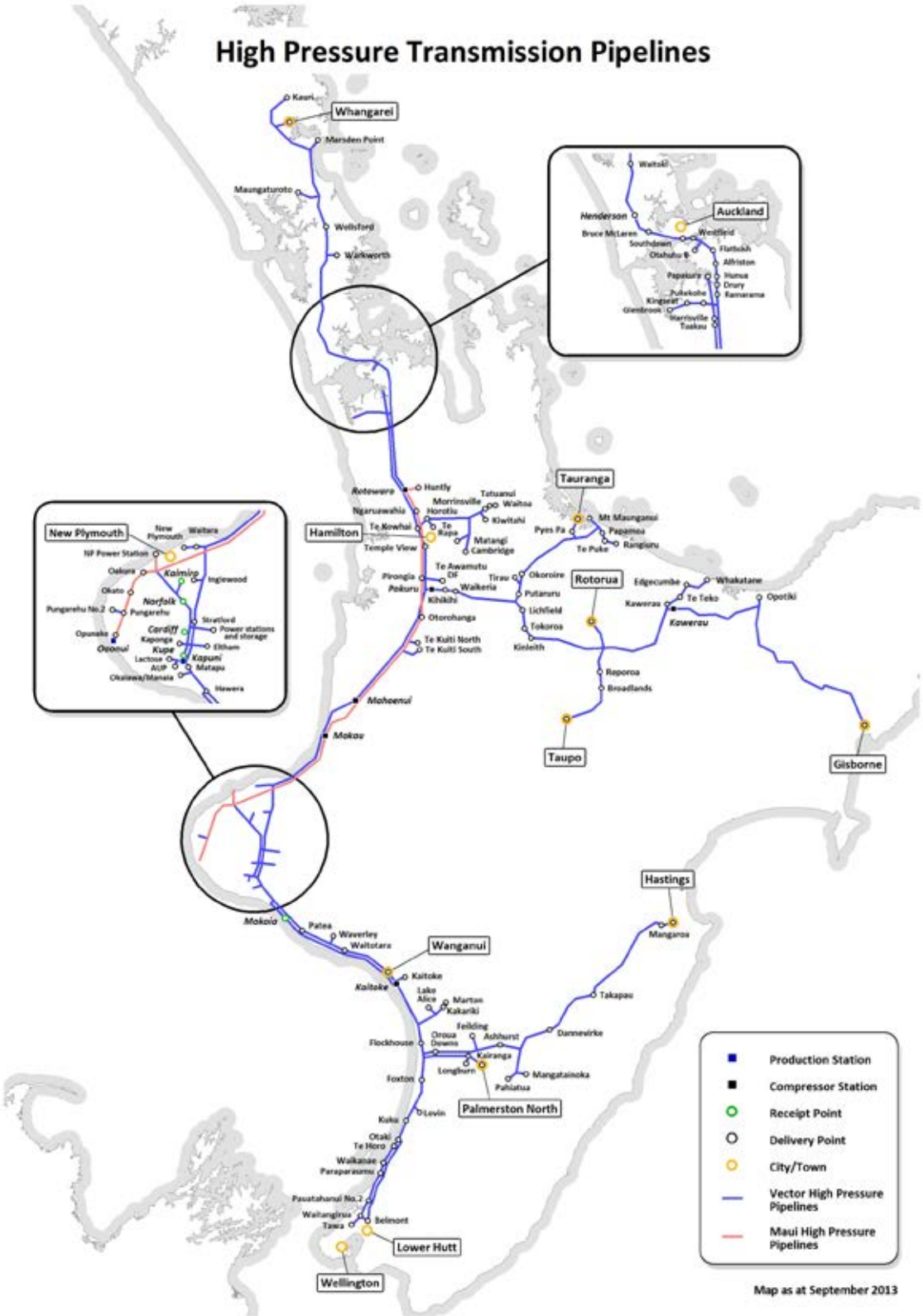
Natural gas production rose 5.2% (9.4 PJ) mostly due to higher production at Mangahewa

Mangahewa production rose 31% (7.3 PJ) and Pohokura rose 11% (7.2 PJ). In New Zealand all natural gas is produced and consumed in the North Island, and 86% of it comes from just four fields (Pohokura, Maui, Mangahewa, and Kupe).

86%

of gas produced comes from Pohokura, Maui, Mangahewa, and Kupe

Figure D.10: New Zealand Natural Gas Transmission Pipeline



Oil, Gas, and LPG Reserves

Reserves are the estimated total amounts of oil and gas that are able to be recovered from a known petroleum reservoir. Ultimate recoverable reserves are the total economically recoverable reserves before any oil or gas is produced. Remaining reserves are ultimate recoverable reserves, less production to date. The most certain reserves figures are presented as "proved" (1P), followed by "proved plus probable" (2P), then "proved plus probable plus possible" (3P).

At the end of 2016 remaining recoverable reserves (2P) were:

- 2,020 PJ for natural gas.
- 440 PJ for oil and condensate
- 70 PJ for LPG

Ultimate recoverable reserves (2P) for 2016 were:

- 8,577 PJ for natural gas
- 3,340 PJ for oil and condensate
- 246 PJ for LPG

Table D.1: Oil and Condensate Reserves – as at 1 January 2017

Field	Type	Ultimate Recoverable (1P)			Ultimate Recoverable (2P)			Remaining Reserve (1P) as at 1 January 2017			Remaining Reserve (2P) as at 1 January 2017		
		Mm^3	mmbbls	PJ	Mm^3	mmbbls	PJ	Mm^3	mmbbls	PJ	Mm^3	mmbbls	PJ
Pohokura	Condensate	9.5	59.5	330.6	9.9	62.1	345.2	2.8	17.6	97.8	3.2	20.2	112.3
Maari	Crude Oil	6.5	40.9	243.2	7.1	44.7	265.5	1.2	7.9	46.5	1.8	11.6	68.8
Turangi	Condensate	1.3	8.1	40.7	2.2	14.1	70.6	0.8	4.9	24.8	1.7	10.9	54.6
Mangahewa	Condensate	1.4	8.6	55.1	1.9	11.6	74.3	0.7	4.2	26.7	1.1	7.2	45.9
Kupe	Condensate	3.0	19.1	105.5	3.3	20.9	115.0	1.3	8.2	45.3	1.6	9.9	54.8
Maui	Condensate	35.6	223.6	1274.5	35.8	225.4	1284.9	0.6	3.7	21.0	0.9	5.5	31.4
Cheal	Crude Oil	0.7	4.2	25.3	1.0	6.4	38.0	0.2	1.3	7.6	0.5	3.4	20.3
Tui	Crude Oil	6.3	39.9	217.3	6.6	41.4	225.3	0.1	0.4	2.1	0.3	1.9	10.1
Kowhai	Condensate	0.4	2.4	14.6	0.5	3.2	19.7	0.2	1.0	6.4	0.3	1.9	11.5
McKee	Crude Oil	7.6	47.5	287.8	7.6	47.9	290.2	0.0	0.1	0.4	0.1	0.5	2.8
Waihapa/ Ngaere	Crude Oil	4.0	24.9	148.1	4.0	25.4	150.9	0.2	1.0	6.0	0.2	1.5	8.8
Ngatoro	Crude Oil	1.7	10.5	51.3	1.9	11.6	56.9	0.1	0.8	3.8	0.3	1.9	9.4
Kapuni	Condensate	10.5	66.1	360.5	10.6	66.7	363.4	0.0	0.0	0.0	0.1	0.5	2.9
Radnor	Crude Oil	0.0	0.3	1.3	0.1	0.4	2.1	0.0	0.2	0.9	0.1	0.4	1.7
Copper Moki	Crude Oil	0.1	0.6	3.4	0.1	0.7	4.0	0.0	0.2	1.1	0.0	0.3	1.7
Surrey	Crude Oil	0.0	0.2	1.1	0.0	0.2	1.2	0.0	0.0	0.2	0.0	0.1	0.3
Tariki	Crude Oil	0.3	1.9	10.8	0.3	1.9	10.8	0.0	0.0	0.0	0.0	0.0	0.0
Kauri/ Manutahi	Crude Oil	0.3	2.1	12.2	0.3	2.1	12.3	0.0	0.0	0.3	0.0	0.1	0.4
Rimu	Crude Oil	0.2	1.5	9.0	0.2	1.5	9.5	0.1	0.3	2.1	0.1	0.4	2.5
Moturoa	Crude Oil	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total†		**89.3**	**562.0**	**3192.7**	**93.5**	**588.2**	**3340.2**	**8.2**	**51.8**	**292.9**	**12.4**	**78.1**	**440.4**
All Fields#		**92.4**	**581.4**	**3294.5**	**93.5**	**588.2**	**3340.2**	**11.4**	**71.6**	**405.6**	**12.4**	**78.1**	**440.4**

† Arithmetic total.

The All Fields 1P values were estimated based on probabilistic summation using a Monte Carlo simulation. Arithmetic summation of 1P values will return a number with a much lower probability of occurring (0.1^n). 2P values may be totalled safely using arithmetic summation since they are the mid-point of the probability distribution.

Table D.2: Natural Gas Reserves – as at 1 January 2017

Field	Ultimate Recoverable (1P)			Ultimate Recoverable (2P)			Remaining Reserve (1P) as at 1 January 2017			Remaining Reserve (2P) as at 1 January 2017		
	Mm^3	Bcf	PJ	Mm^3	Bcf	PJ	Mm^3	Bcf	PJ	Mm^3	Bcf	PJ
Pohokura	33699.2	1190.1	1395.1	35660.3	1259.3	1476.3	16227.7	573.1	671.8	18188.8	642.3	753.0
Mangahewa	8588.3	303.3	334.5	11870.5	419.2	462.4	4136.9	146.1	161.1	7419.1	262.0	289.0
Turangi	5712.5	201.7	233.6	10130.0	357.7	414.3	3827.6	135.2	156.5	8245.0	291.2	337.2
Kupe	8291.4	292.8	335.8	10612.3	374.8	429.8	4935.8	174.3	199.9	7256.8	256.3	293.9
Maui	104045.9	3674.3	4109.8	105509.8	3726.0	4167.6	2741.4	96.8	108.3	4237.6	149.6	167.4
Kowhai	1600.8	56.5	64.4	2152.8	76.0	86.5	681.3	24.1	27.4	1233.3	43.6	49.6
McKee	5340.6	188.6	218.8	6323.2	223.3	259.0	455.9	16.1	18.7	1438.5	50.8	58.9
Kapuni	38718.1	1367.3	1014.4	39644.1	1400.0	1038.7	0.0	0.0	0.0	925.9	32.7	24.3
Ngatoro	1394.1	49.2	42.5	1756.0	62.0	53.6	181.8	6.4	5.5	543.7	19.2	16.6
Radnor	196.2	6.9	6.9	341.3	12.1	11.9	152.9	5.4	5.4	298.0	10.5	10.4
Cheal	123.5	4.4	6.0	156.4	5.5	7.6	15.9	0.6	0.8	48.8	1.7	2.4
Waihapa/ Ngaere	858.8	30.3	34.0	875.0	30.9	34.7	37.1	1.3	1.5	53.3	1.9	2.1
Copper Moki	34.0	1.2	1.7	35.7	1.3	1.7	3.7	0.1	0.2	5.4	0.2	0.3
Tariki	1453.1	51.3	64.4	1453.1	51.3	64.4	0.0	0.0	0.0	0.0	0.0	0.0
Kauri	789.6	27.9	32.8	813.8	28.7	33.9	53.1	1.9	2.2	77.2	2.7	3.2
Sidewinder	107.6	3.8	4.5	107.6	3.8	4.5	0.0	0.0	0.0	0.0	0.0	0.0
Rimu	140.8	5.0	5.9	143.6	5.1	6.0	14.3	0.5	0.6	17.2	0.6	0.7
Surrey	8.4	0.3	0.3	9.5	0.3	0.4	0.5	0.0	0.0	1.6	0.1	0.1
Total(1)	**211620.9**	**7473.3**	**7927.0**	**228163.6**	**8057.5**	**8576.9**	**33689.9**	**1189.7**	**1369.2**	**50265.2**	**1775.1**	**2020.4**
All Fields(2)	**225781.7**	**7973.4**	**8264.0**	**228163.6**	**8057.5**	**8576.9**	**48534.3**	**1714.0**	**1776.4**	**50265.2**	**1775.1**	**2020.4**

*Includes LPG

† Arithmetic total.

The All Fields 1P values were estimated based on probabilistic summation using a Monte Carlo simulation. Arithmetic summation of 1P values will return a number with a much lower probability of occurring (0.1^n). 2P values may be totalled safely using arithmetic summation since they are the mid-point of the probability distribution.

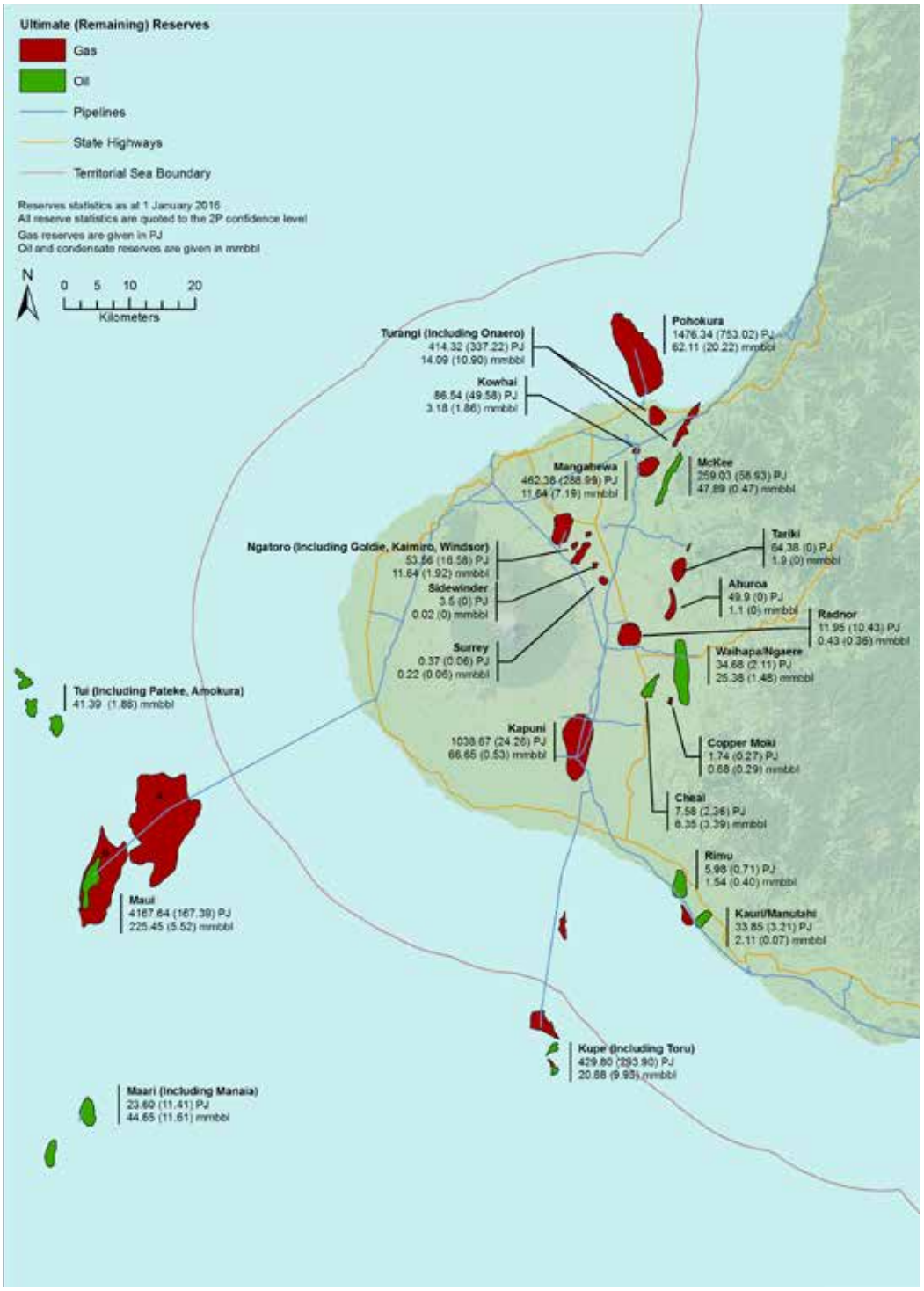
Table D.3: LPG Reserves – as at 1 January 2017

Field	Ultimate Recoverable (1P)		Ultimate Recoverable (2P)		Remaining Reserve (1P) as at 1 January 2017		Remaining Reserve (2P) as at 1 January 2017	
	kt	PJ	kt	PJ	kt	PJ	kt	PJ
Kupe	1394.0	69.6	1783.2	89.0	837.3	41.8	1226.5	61.2
Maui	3267.2	150.5	3316.0	152.8	83.0	3.8	131.8	6.1
McKee/Mangahewa	42.9	2.1	77.2	3.8	23.4	1.1	57.7	2.8
Kauri	20.7	1.0	20.7	1.0	0.0	0.0	0.0	0.0
Rimu	10.4	0.5	10.4	0.5	0.0	0.0	0.0	0.0
Total†	**4704.1**	**222.2**	**5176.4**	**245.6**	**943.7**	**46.8**	**1416.0**	**70.1**
All Fields#	**4776.7**	**226.3**	**5176.4**	**245.6**	**1073.2**	**50.8**	**1416.0**	**70.1**

† Arithmetic total.

The All Fields 1P values were estimated based on probabilistic summation using a Monte Carlo simulation. Arithmetic summation of 1P values will return a number with a much lower probability of occurring (0.1^n). 2P values may be totalled safely using arithmetic summation since they are the mid-point of the probability distribution.

Figure D.11: Taranaki oil and gas fields



At current levels of gas use, remaining natural gas reserves would be exhausted in 11 years

A total of 196 PJ of gas was used across energy transformation, non-energy use, and consumption in the 2016 year. If gas used was held at this amount each year remaining recoverable reserves of natural gas would be exhausted in 11 years. However, it is important to consider that the gas market has many levers that allow significant extension of this period. There are always additional resources being identified. Remaining reserves of gas are constantly being redefined based on knowledge of actual field dimensions and composition. Economic factors also come into play as reserves of commodities that were once uneconomical to extract become more appealing as demand increases, supply declines, and price makes extraction feasible.

All reserves figures are estimates generated through models of the physical dimensions and chemical composition of the various fields. These models gradually change over time as more information becomes available about the size, shape, and composition of the fields.

New Zealand oil and gas exploration expenditure falls 62% alongside low crude oil prices

Between 2008 and 2014 US shale oil production grew dramatically. Combined with continued strong production from the OPEC countries, this led to a global oversupply of crude oil, which forced prices down from around $120/barrel to $50/barrel.[7]

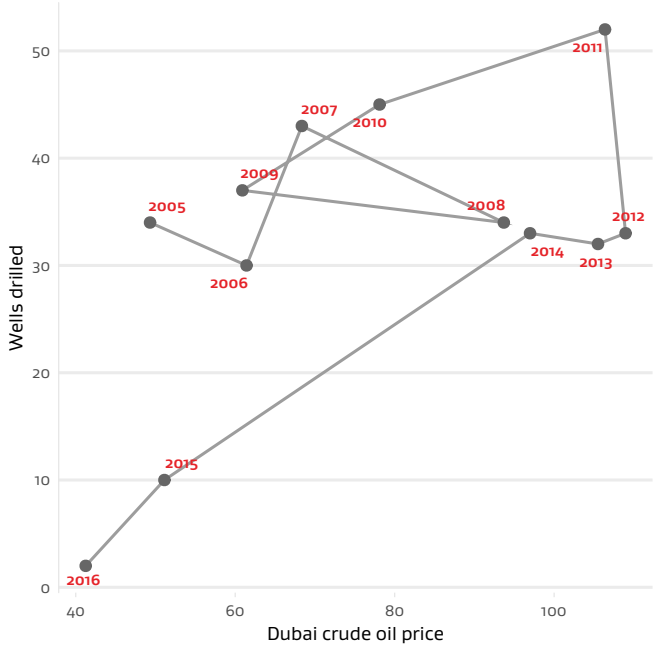
The lower price of crude reduced the appetite for further investment which saw significant reductions in exploration investment. According to the International Energy Agency (IEA), global investment in the energy sector fell 12 percent in 2016.[8] New conventional oil projects were at a 70 year low, with oil discoveries declining to 2.4 billion barrels in 2016, compared to an average of 9 billion barrels per year over the past 15 years.[9]

New Zealand exploration has experienced a similar downturn in recent years with a single exploration well drilled in 2016, down from 3 in 2015 and 22 in 2014 and. Total expenditure on wells amounted to $95m in 2016, down from $253m (down 62%) in 2015, and $1,124m in 2014. Figure D.12 shows how the total number of wells drilled annually[10] has changed since 2005 as the Dubai crude oil price has changed. Significant reductions in the price since 2014 have coincided with a large falling off in well drilling activity.

Exploration permits have also declined significantly with only one exploration permit granted in 2016, down from nine in 2015. Deferral of drilling programmes makes economic sense in the current climate of reduced oil prices.[11] Oil prices are cyclical and most companies believe there will be a return to higher prices as global supplies fall.

Further data are also available on 3P reserves, LPG reserves, contingent resources, oil and gas initially in place, system deliverability, and activity data at: http://www.med.govt.nz/sectors-industries/energy/energy-modelling/publications/energy-in-new-zealand-2015.

Figure D.12 Wells drilled over time and Dubai crude oil price



7 https://www.iea.org/newsroom/news/2017/july/commentary-witnessing-the-ongoing-transformation-of-the-oil-and-gas-industry.html

8 https://www.cnbc.com/2017/07/10/watchdog-warns-of-oil-and-electricity-shortages-as-investment-falls.html

9 https://www.iea.org/newsroom/news/2017/april/global-oil-discoveries-and-new-projects-fell-to-historic-lows-in-2016.html

10 This includes exploration, appraisal and development wells.

11 http://www.radionz.co.nz/news/regional/296521/low-oil-price-hits-exploration-sector

Table D.4: National Summary of Activity and Expenditure (All Petroleum Exploration and Mining Permits/Licenses)

National Totals – Activity Statistics Combined for PPPs, PEPs, PMPs and PMLs	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Exploration Wells									
Appraisal Wells									
Development Wells									
Total Wells Drilled	**28**	**17**	**21**	**16**	**33**	**34**	**30**	**43**	**34**
Exploration Well Metres Made									
Appraisal Wells Metres Made									
Development Wells Metres Made									
Total Metres Made	**55,164**	**48,541**	**36,958**	**35,201**	**78,237**	**87,533**	**112,369**	**99,854**	**51,037**
Exploration Well Expenditure ($NZDm)									
Appraisal Well Expenditure ($NZDm)									
Development Well Expenditure ($NZDm)									
Total Well Expenditure ($NZDm)									
2-D Seismic Acquired (km)	3219	7518	141	2,455	5,466	3,764	13,240	14,424	25,749
2-D Seismic Reprocessed (km)	1,254	1,504	9,927	10,829	23,808	14,707	30,627	20,019	11,411
3-D Seismic Acquired (km^2)	453	50	483	444	39	3,120	2,360	935	991
3-D Seismic Reprocessed (km^2)	0	0	566	961	410	247	2,147	407	432
Acquisition Expenditure									
Reprocessing Expenditure									
Total Seismic Expenditure ($NZDm)									
PEP & PPP National Expenditure ($NZDm)	173	203	186	159	280	186	133	200	314
PMP/PML National Expenditure ($NZDm)	189	128	218	195	182	553	574	1,359	963
Expenditure, All Permits – National Total ($NZDm)	**361**	**331**	**404**	**354**	**462**	**739**	**707**	**1,559**	**1,277**
PPPs Granted									
PEPs Granted	4	14	29	18	29	5	16	19	15
PMPs Granted	0	1	1	0	2	5	2	2	0
Total Permits Granted	**4**	**15**	**30**	**18**	**31**	**10**	**18**	**21**	**15**
Permits surrendered									
Permits expired									
Permits revoked									
Total Permits Ended	**0**	**0**	**14**	**10**	**6**	**14**	**25**	**20**	**13**
Number of PEPs & PPPs at Granted Status	53	59	82	86	105	104	79	76	89
Number of PMPs and PMLs at Granted Status	10	11	12	12	14	19	21	23	23

PEPs = Petroleum exploration permits.
PPPs = Petroleum prospecting permits.
PMPs = Petroleum mining permits (production permits).
PMLs = Petroleum mining licences (production permits).

Table D.4: National Summary of Activity and Expenditure (All Petroleum Exploration and Mining Permits/Licenses) – continued

National Totals – Activity Statistics Combined for PPPs, PEPs, PMPs and PMLs	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Exploration Wells					18	22	3	1
Appraisal Wells					5	1	2	0
Development Wells					9	10	5	1
Total Wells Drilled	**37**	**45**	**52**	**33**	**32**	**33**	**10**	**2**
Exploration Well Metres Made					43104	51572	10955	6410
Appraisal Wells Metres Made					17482	2943	3308.6	0
Development Wells Metres Made					32842	44660	13363	4600
Total Metres Made	**64,596**	**76,026**	**63,669**	**72,177**	**93,428**	**99,176**	**27,628**	**11,010**
Exploration Well Expenditure ($NZDm)					$206.78	$468.69	$17.57	$17.94
Appraisal Well Expenditure ($NZDm)					$93.82	$114.28	-$0.52	$0.00
Development Well Expenditure ($NZDm)					$358.15	$540.93	$235.59	$77.43
Total Well Expenditure ($NZDm)					**$658.76**	**$1,123.90**	**$252.64**	**$95.37**
2-D Seismic Acquired (km)	12,058	9,751	8,353	220	315	15,524	22,455	9,148
2-D Seismic Reprocessed (km)	6,989	21,512	7,911	6,387	5,917	11,299	14,783	10,229
3-D Seismic Acquired (km^2)	1,151	204	6,864	164	6,825	5,743	6,699	7,638
3-D Seismic Reprocessed (km^2)	457	1,244	1,214	9,484	1,113	212	2,706	21,299
Acquisition Expenditure					$66.12	$95.52	$106.04	$247.24
Reprocessing Expenditure					$3.95	$2.76	$3.44	$3.78
Total Seismic Expenditure ($NZDm)					**$70.07**	**$98.28**	**$109.48**	**$251.01**
PEP & PPP National Expenditure ($NZDm)	$191	$246	$159	$212	$313	$449	$166	$280
PMP/PML National Expenditure ($NZDm)	$1,202	$1,095	$1,084	$1,267	$1,265	$1,616	$888	$903
Expenditure, All Permits – National Total ($NZDm)	**$1,393**	**$1,341**	**$1,243**	**$1,479**	**$1,577**	**$2,065**	**$1,055**	**$1,189**
PPPs Granted				1	0	3	2	2
PEPs Granted	9	10	3	16	11	15	9	1
PMPs Granted	2	1	0	1	0	1	0	1
Total Permits Granted	**11**	**11**	**3**	**18**	**11**	**19**	**11**	**4**
Permits surrendered					12	9	15	12
Permits expired					3	2	2	3
Permits revoked					0	0	2	0
Total Permits Ended	**21**	**11**	**14**	**13**	**15**	**11**	**19**	**15**
Number of PEPs & PPPs at Granted Status	71	70	73	56	52	59	51	42
Number of PMPs and PMLs at Granted Status	24	23	23	24	24	25	25	25

PEPs = Petroleum exploration permits.
PPPs = Petroleum prospecting permits.
PMPs = Petroleum mining permits (production permits).
PMLs = Petroleum mining licences (production permits).

E. RENEWABLES

INTRODUCTION

Renewable energy sources discussed in this section include hydro, wind, geothermal, solar, woody biomass, biogas and liquid biofuels. Information on renewable energy is presented for the 2016 calendar year.

Detailed information is available on the renewable energy sources utilised by large electricity generators. However, information on the direct use of renewable energy and use for distributed generation is more difficult to obtain, given that the input energy source (e.g. geothermal or solar) is often used without being purchased and hence it is not well recorded. Where actual information on the direct use of renewable energy is not available, estimates have been made based on research and the knowledge of experts in this field.

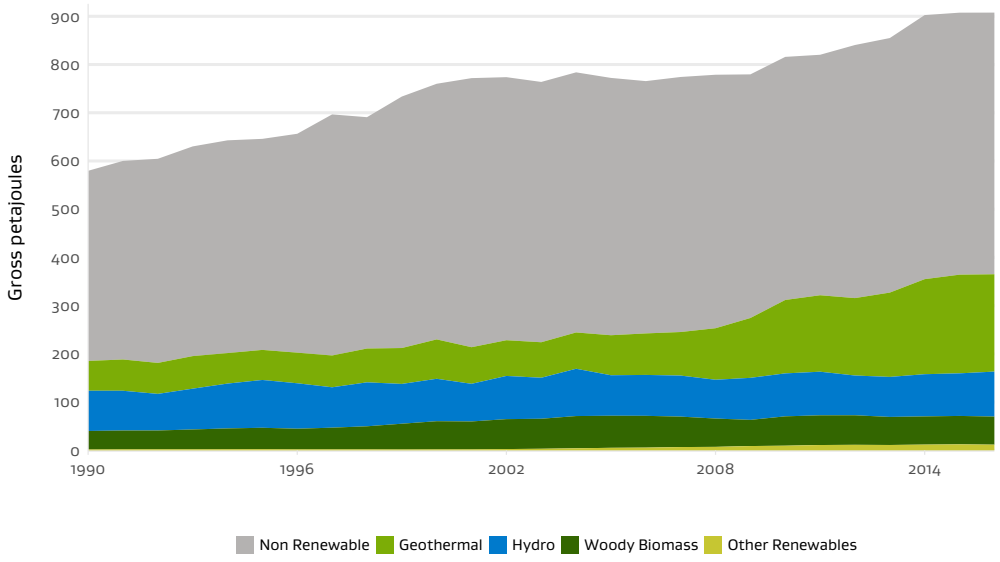
Renewable supply

Renewable energy supply rose to 40.2% because of higher electricity generation from hydro

The contribution of renewable sources to primary energy supply rose to 365 PJ, up 0.8 PJ over the year. This represented 40.2% of primary energy supply. Hydro and geothermal energy were the largest contributors to renewable energy supply. Hydro was particularly high, up 5 PJ because of historically high levels of rainfall. Please read the electricity section for more detail.

New Zealand had the fourth highest renewable primary energy supply in the OECD after Iceland, Norway and Sweden based on the latest data available from the International Energy Agency.[12]

Figure E.1 Renewable fuels in total primary energy supply



12 Comparisons based on the latest data from the IEA.

Renewable use

Renewable electricity generation rose to a 35 year high

In 2016, a total of 84.8% of electricity generation came from renewable resources, increasing from 80.8% in 2015. This was the highest level in 35 years, and the record high was due to high rainfall and hydro generation in 2016. Latest figures show New Zealand's renewable electricity percentage was the third highest in the OECD.

The electricity renewable percentage has been trending up over time. The number of wind and geothermal developments started to increase rapidly from the mid-2000s onwards. This was due to a number of contributing factors including:

- The continual development of the electricity market;
- The downgrading of Maui natural gas reserves which lead to a sharp drop in production in 2003;
- Declining costs of renewable technologies along with much lower operating costs compared to generation using fossil fuels.

Additionally, declining electricity demand over the period 2010–2015 meant that already committed new geothermal generation displaced existing baseload gas-fired generation in the electricity market. Subsequently, in late 2015 two gas-fired combined cycle plants were retired: Contact's 400 MW Otahuhu power station as well as Mercury's 140 MW Southdown plant.

Solar PV generation continues to grow quickly

Total solar generation, including both PV and thermal, remains a small proportion of total primary renewable energy at 0.2%. However the use of solar photovoltaic (PV) panels to generate electricity is growing rapidly in New Zealand, albeit from a low base. The total generation from small solar PV panels in 2016 was estimated to be 51.7 GWh, up 52% over the year. Installed capacity at the end of December 2016 was 47.0 MW.

Most consumption of renewable energy is from wood biomass

In 2016, an estimated 62.0 PJ of renewable energy was used for direct-use heat applications around New Zealand. Woody biomass makes up 86% of that, with most of the remainder coming from geothermal direct use. A new and improved industrial wood use data collection methodology was used for 2016, which showed that the overall level was very similar to previous years' estimates, continuing a flat trend.

Direct use of woody biomass was 53.6 PJ in 2016. Woody biomass is used mainly in the timber industry, which burns residue wood to provide process heat. Wood is also burned to heat many private homes in New Zealand, with the 2013 Census reporting that over 36% of New Zealand households use wood to heat their homes.

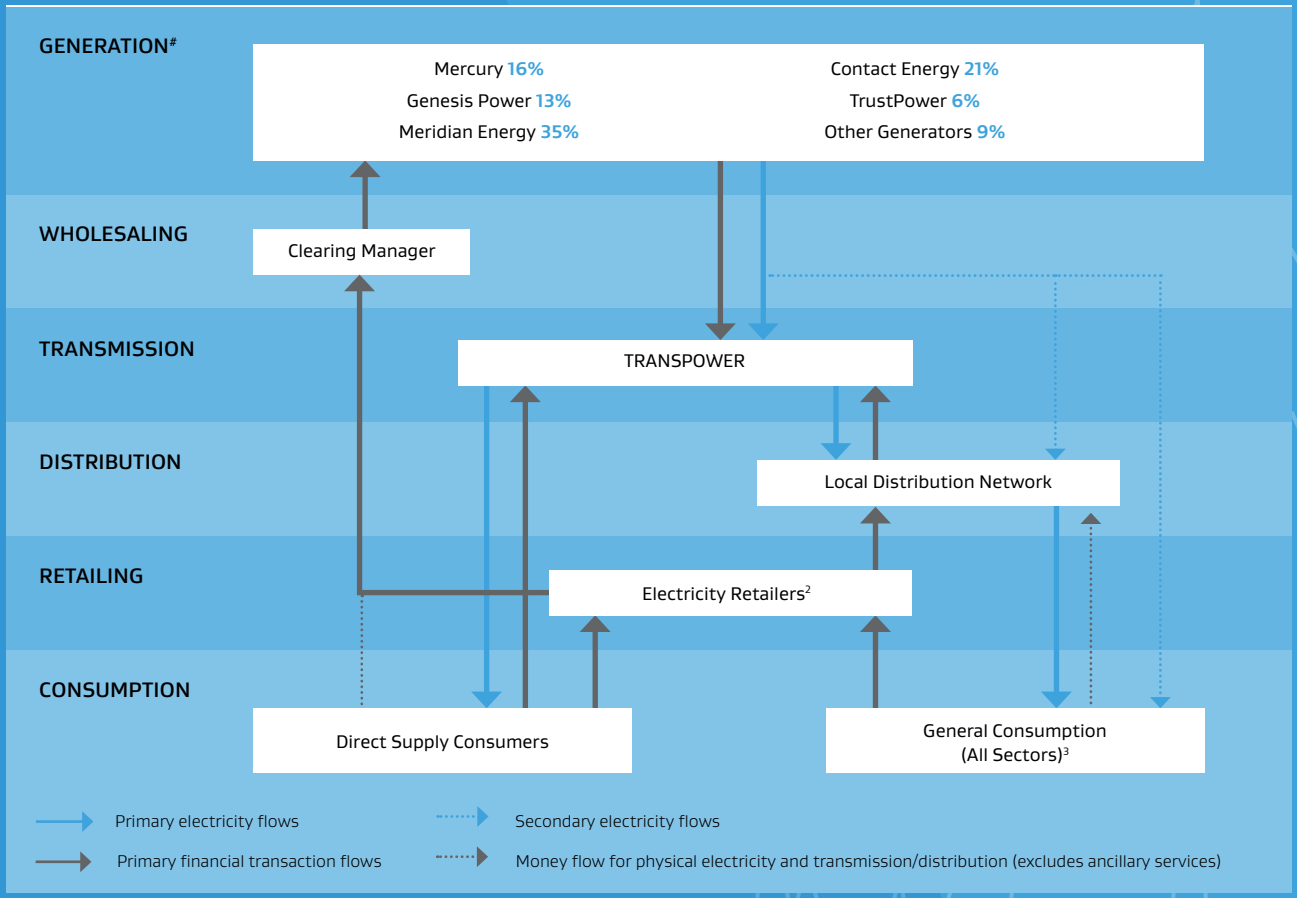
Direct use of geothermal energy was 7.7 PJ in 2016. Geothermal energy is used directly as a heat source in small quantities in the central North Island in the timber and tourism industries. It is also used in small quantities for domestic heating.

F. ELECTRICITY

INTRODUCTION

This section contains information about electricity generation/ supply, transmission and distribution, and consumption. Figures are for the 2016 and are expressed in Net Gigawatt hours (GWh) unlike other sections which are presented in Gross Petajoules (PJ).

Figure F.1: Electricity Industry Summary for 2016*



Company names are listed without the suffixes "Limited" and "New Zealand Limited" where applicable.

"Primary" refers to the most common or typical way that electricity or money flows through the Electricity Industry

"Secondary" refers to flows of money or electricity which do occur, but are not typical of most participants in the industry.

As an example, all customers in the "The Lines Company" distribution network area pay distribution charges directly to the local distribution network as shown by the red dotted line between the 'General Consumption' box and 'Local Distribution Network' box. This is not typical nationwide as most consumers pay their lines charges through their retailer as shown by the dense red line between 'General Consumption' and 'Electricity Retailers' which partly continues onto the 'Local Distribution Network'.

The thickness of the lines in Figure G.1a in no way indicates the physical amount of money or electricity which passes through or is used by a particular participant or group of participants.

Notes to Figure G.1a:

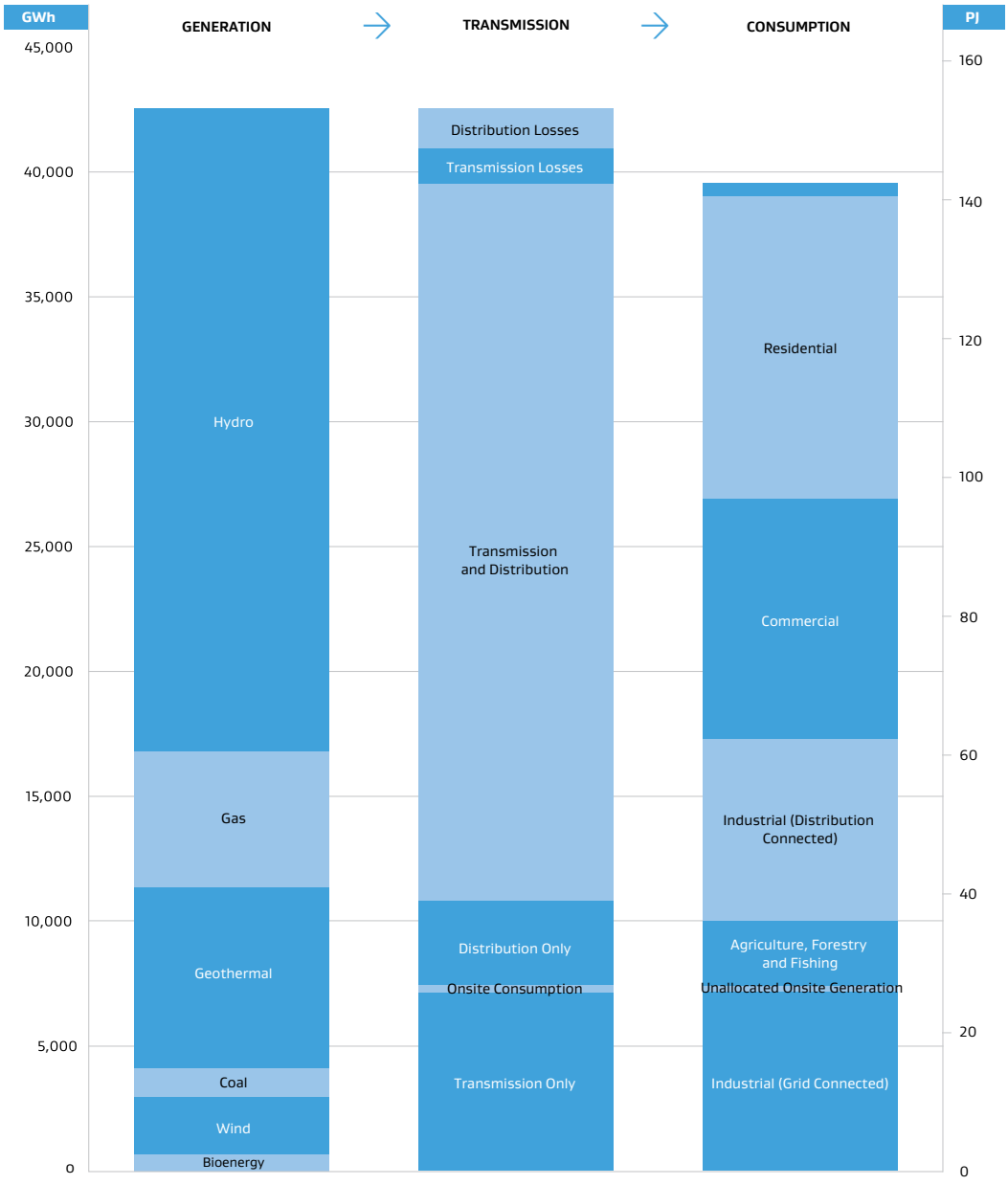
1. Embedded (distributed) generators can choose to sell their electricity directly to retailers trading on the same grid exit point.

2. Electricity retailers include Contact Energy (and subsidiary Empower), Genesis Energy (and subsidiary Energy Online), Meridian Energy (and subsidiary Powershop), Mighty River Power (through its brands and subsidiaries of Mercury Energy, Bosco Connect and Tiny Mighty Power), TrustPower, Pulse Energy, Opunake Hydro – and Todd Energy owned, Bay of Plenty Energy and Auckland Gas which trade together as Nova Energy in most markets in which they retail.

3. Sectors are defined in table G.6a

Both the Commerce Commission and Electricity Authority have key roles in the electricity market. The Commerce Commission has regulatory oversight of distribution and transmission pricing while the Electricity Authority has regulatory oversight of the retail and wholesale markets, and transmission contracts. The Electricity Authority also has contracts with service providers for market operation services such as that of the Clearing Manager.

Figure F.2: Electricity Flow Diagram for the 2016 Year



Electricity use

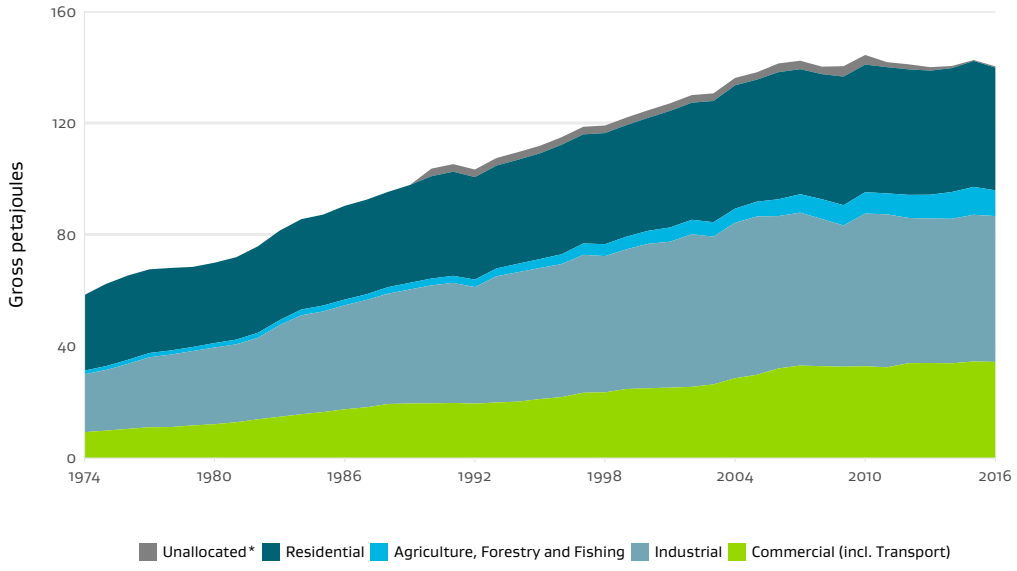
Electricity demand fell 1.6% due to warmer and wetter weather

Weather seemed to be influencing demand, most noticeably resulting in lower demand from the Residential and Agriculture, Forestry, and Fishing sectors:

- Residential electricity demand decreased 2.6% (321 GWh) over the year as result of warmer than normal temperatures in autumn and winter. Warmer temperatures would have reduced the need for electricity for heating purposes at the coldest time of the year, when household electricity use peaks.
- Demand by the Agriculture, Forestry, and Fishing sector was down 7.7% (213 GWh) in 2016 as higher rainfall in the year reduced the need for irrigation. This fall followed a 2015 peak in electricity use for this sector because of increased electrical irrigation in that year.

Looking more broadly at long-term residential electricity demand trends, residential electricity demand per ICP[13] continues to decline. This is an indicator of electricity demand per household and shows that despite continued population growth (up 1% from 2015)[14] the amount of electricity households are using is decreasing over time. It continues a downward trend that began in 2009.

Figure F.3 Electricity consumption by sector



*Unallocated includes Unallocated Demand and Unallocated Onsite Generation

13 Installation Control Point –this is an indication of the number of households.

14 http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/DwellingHouseholdEstimates_HOTPJun17qtr.aspx

Electricity supply

Electricity generation decreased 0.9% alongside lower electricity demand

Renewable electricity generation rose to

85%,

a 35 year high

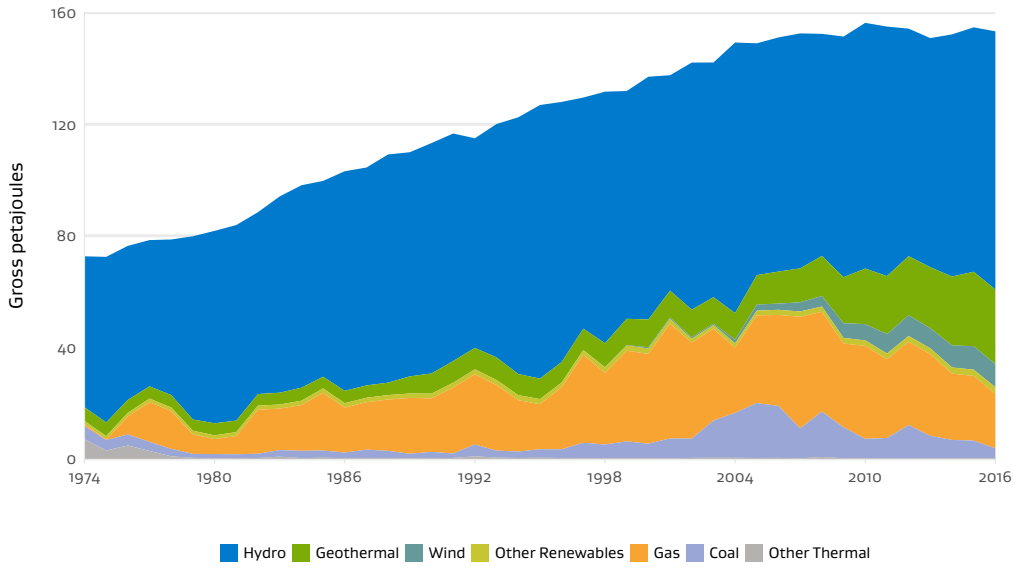
Generation mirrored the fall in electricity demand, but a wetter year saw generation from renewable sources rise to 85%, a 35 year high. High rainfall led to higher storage levels in 2016, and as a result hydro generation rose 5.6% to a 12 year high. Geothermal generation rose by 0.2% from 2015 levels, however wind generation fell 1.6% over the same period.

High hydro generation saw coal- and gas-fired generation fall to record lows. Generation from coal fell 44% to 987 GWh to a 20 year low, and generation from gas decreased 16% to 5,438 GWh to a 21 year low. Retirement of thermal plants in the last decade as well as the growth of geothermal and wind generation has seen generation from thermal sources fall to historical lows.

Two gas plants closed at the end of 2015 – Contact Energy's MW Otahuhu B combined cycle gas turbine (404 MW capacity), and Mercury's Southdown combined cycle cogeneration power station (170 MW capacity). As at June 2015, Genesis Energy had retired two of the four coal/gas Rankine units at the Huntly Power Station. The two remaining units continue to be offered to the market. Given the recent decommissioning of existing thermal plants, these Huntly units are important for future security of supply in helping to meet winter electricity demand in a dry year and peak demand requirements.

Solar photovoltaic (PV) is growing quickly as a generation source from a low base, up 52% over the year. At the end of 2016 there were 12,698 solar PV connections in New Zealand.[15]

Figure F.4: Electricity generation by fuel



15 Electricity Authority (2017), Installed distributed generation trends

MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

New Zealand Government