MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Energy and Building Trends

New Zealand Energy Sector Greenhouse Gas Emissions

2015 Calendar Year Edition

New Zealand Government

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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ISSN 1179-3996 (print) ISSN 1179-4011 (online)

May, 2017

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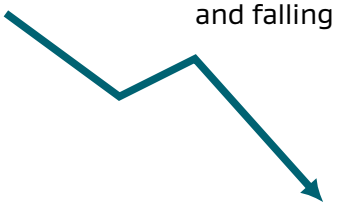
Highlights for 2015

Electricity generation emissions were the lowest in **17** years

Road transport emissions have increased **78%** above 1990 levels

New Zealand's energy emissions intensity is low and falling



Transport produces **45%** of all energy sector emissions

Introduction

This publication presents information on greenhouse gas emissions from the energy sector for the calendar years 1990 to 2015. Energy sector emissions are responsible for approximately 40% of New Zealand's total gross emissions. Total gross emissions include agriculture, energy, industrial processes and waste sector emissions, but exclude emission reductions from land use change and forestry.

Emissions are presented as carbon dioxide equivalent (CO_2-e) of the direct greenhouse gases – carbon dioxide, methane and nitrous oxide – based on updated global warming potentials (see Technical Notes on page 12). This publication updates the annual series and includes revised numbers for 1990 to 2015 where improved data or methodologies have been applied.

New Zealand is a signatory to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol first commitment period. As an 'Annex I' country under the UNFCCC, New Zealand is committed to produce a national inventory of greenhouse gas sources and sinks.

New Zealand ratified the Paris Agreement on 4 October 2016 and submitted our Nationally Determined Contribution to the UNFCCC. New Zealand's current target is to reduce greenhouse gas emissions by 30% below 2005 levels by 2030. This target is equivalent to 11% below 1990 levels by 2030.

The energy sector emissions data presented in this publication are provisional estimates. For official emissions data, refer to New Zealand's Greenhouse Gas Inventory which will be published by the Ministry for the Environment and submitted to the UNFCCC secretariat on 26 May 2017. In addition to energy sector emissions, New Zealand's Greenhouse Gas Inventory includes emissions from agriculture, industrial processes, solvent and other product use, waste and land use change and forestry.

2015 Snapshot

Emissions from transport continued to dominate in 2015, contributing over 45% of total emissions in the energy sector, slightly up on the previous year. In fact, as shown in figure 1, transport emissions were greater than manufacturing, electricity and fugitive emissions combined. By fuel type, liquid fuels are responsible for the majority of emissions (figure 2). Over three quarters of liquid fuel emissions come from the transport sector.

Figure 1: Emissions by sector for 2015 (Mt CO_2-e)

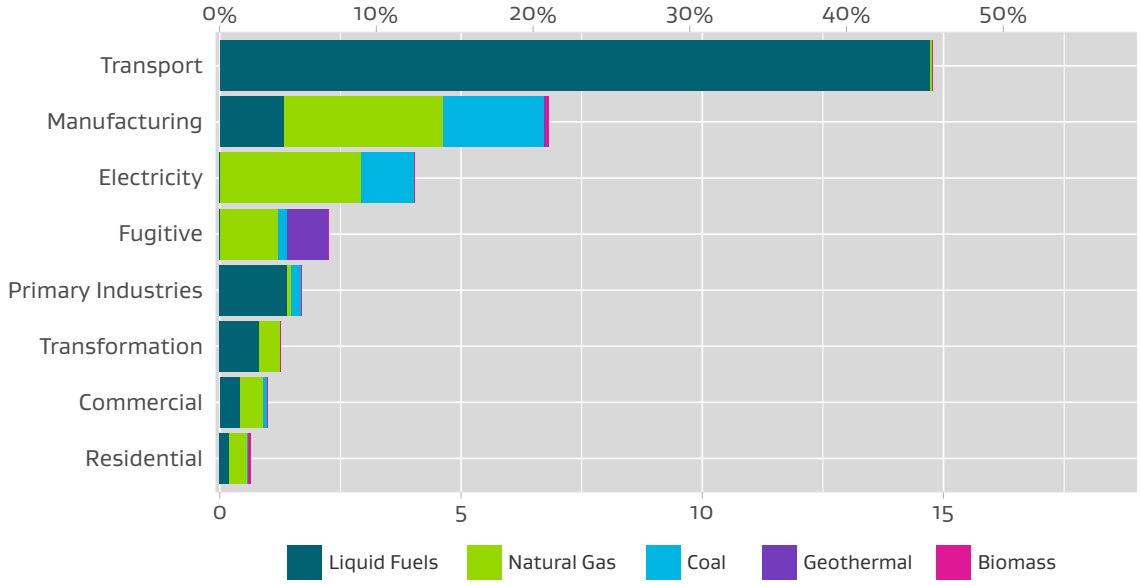
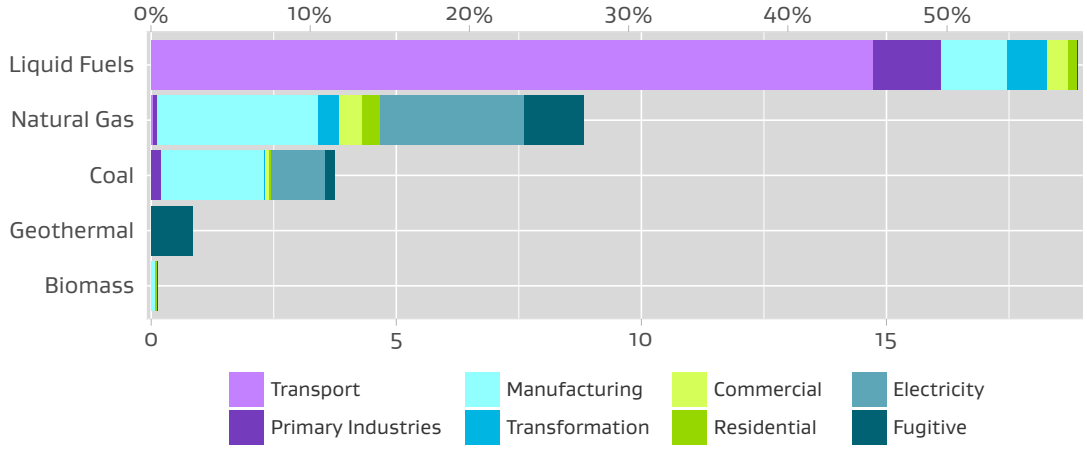


Figure 2: Emissions by fuel type for 2015 (Mt CO_2-e)



Emissions intensity

New Zealand's emissions increased between 1990 and 2015 on the back of strong economic and population growth. During this time, the emissions intensity of the energy sector relative to gross domestic product (GDP) decreased by over 30% (figure 3). This shows that the economy has grown faster than any increase in emissions.

Figure 4 compares international energy sector emissions intensity; It shows that New Zealand is well below the global average and compares favourably with our major trading partners. This is despite New Zealand having one of the highest car ownership rates in the OECD, along with a sparse population, that results in relatively high transport emission per capita.

See page 12 for technical notes.

Figure 3: Energy sector emissions intensity (kt CO_2-e/NZ$m GDP, constant 09/10 prices)

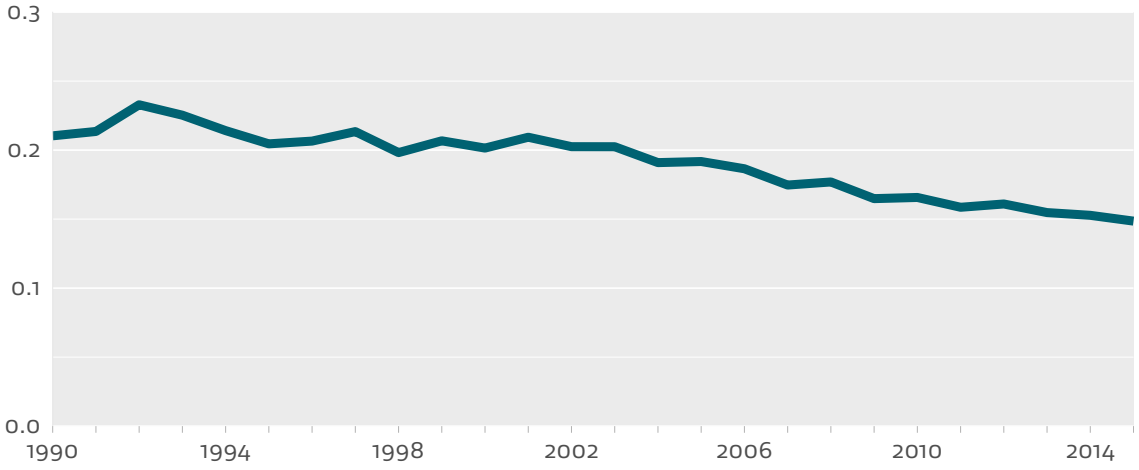
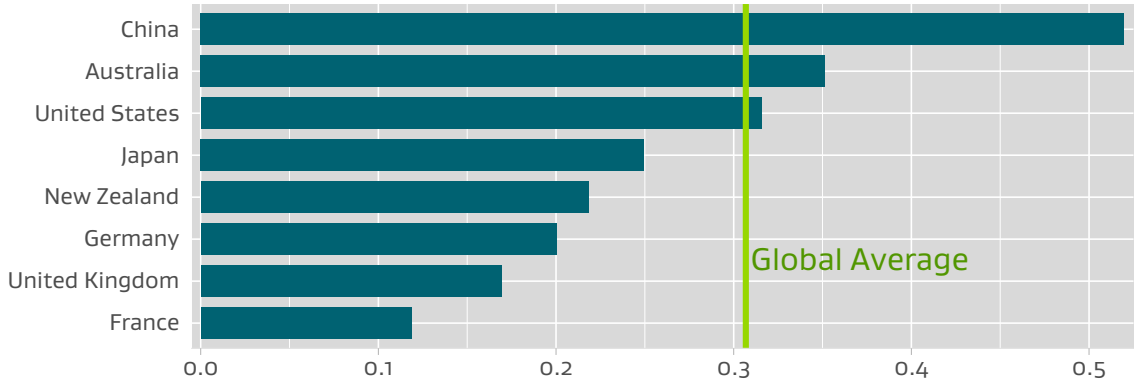


Figure 4: Comparison of energy sector emissions intensity for 2014 (kt CO_2/$m GDP)



Emissions by fuel type

New Zealand's total energy sector emissions were 32.5 Mt CO_2-e in 2015, up 0.6% from 2014. Since 1990, the base year for Kyoto Protocol obligations, New Zealand's energy sector emissions have grown by 37%, with an average increase of 1.3% per annum. Over the same period New Zealand's GDP roughly doubled.

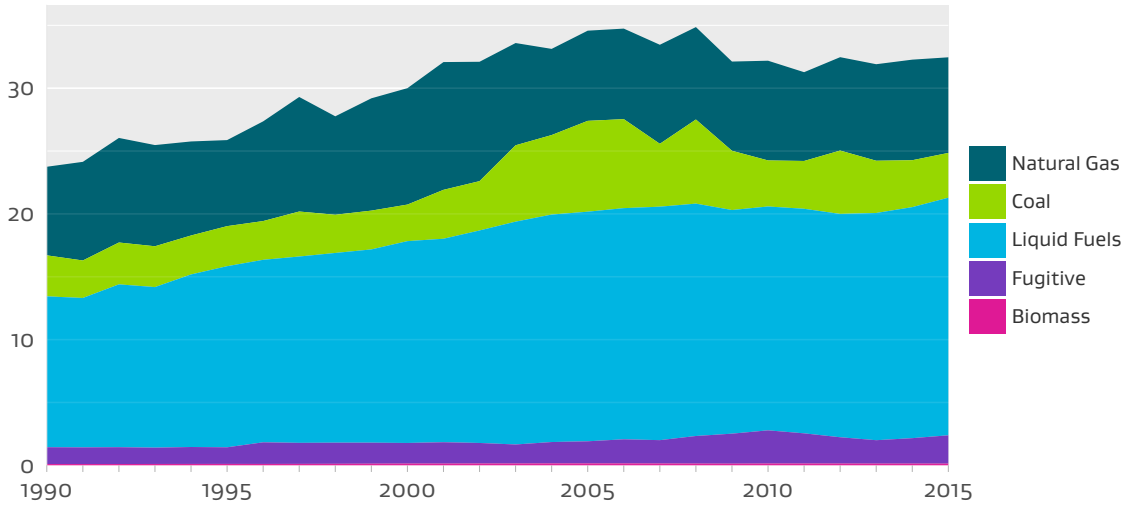
In 2015, higher electricity generation from geothermal, hydro and wind saw a reduced need for generation from natural gas and coal. Together with reductions from the manufacturing sector, this resulted in a significant decrease in emissions from gas combustion.

Emissions from liquid fuel combustion, driven by the transport, continue to dominate the energy sector and account for over 58% of total emissions. The doubling of liquid fuel emissions between 1990 and the early 2000s is largely responsible for the rise in New Zealand's energy sector emissions since 1990.

Natural gas combustion emissions increased up to 2001 as the chemicals industry (manufacturing synthetic petrol and methanol) and electricity generators took advantage of the relatively cheap Maui and Kapuni gas contracts. In the late 1990s, synthetic gasoline production stopped in New Zealand and by 2003 rising gas prices led to the closure of Methanex's methanol plant at Motunui and it's Waitara Valley plant in 2008. Emissions from natural gas combustion have since increased. In 2012, both trains at Motunui were restarted, followed by the Waitara Valley plant in late 2013.

Fugitive emissions increased 11% from 2014, driven mainly by additional geothermal electricity generation.

Figure 5: Energy sector emissions by fuel type (Mt CO_2-e)



Emissions by subsector

Between 2014 and 2015, total energy sector emissions increased by 0.6%. A sizeable increase in transport emissions was partially offset by decreases in emissions from manufacturing and electricity generation. The 4.5% decrease in emissions from electricity generation (excluding geothermal – see Fugitive emissions, page 11) was mostly due to coal-fired generation decreasing from 1,831 GWh in 2014 to 1,756 GWh in 2015. Full information on electricity is on page 9.

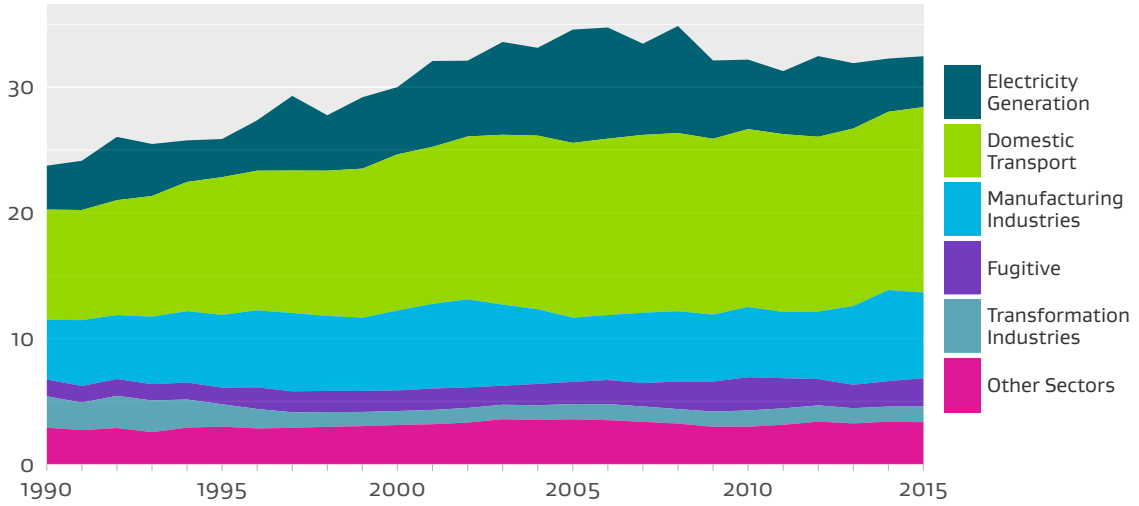
Transport emissions have increased 68% since 1990 and now account for over 45% of all energy sector emissions. This trend continued in 2015. Further information by transport mode is on page 7.

Transformation Industries includes all energy transformation other than electricity generation (e.g. oil refining). The large drop was due to the cessation of synthetic gasoline production in the late 1990s.

Manufacturing sector emissions decreased by 6% from 2014, driven primarily by the chemicals subsector. A sector-by-sector breakdown of manufacturing industries is on page 8.

Definitions of the sectors described above can be found on page 12.

Figure 6: Energy sector emissions by subsector (Mt CO_2-e)



Transport

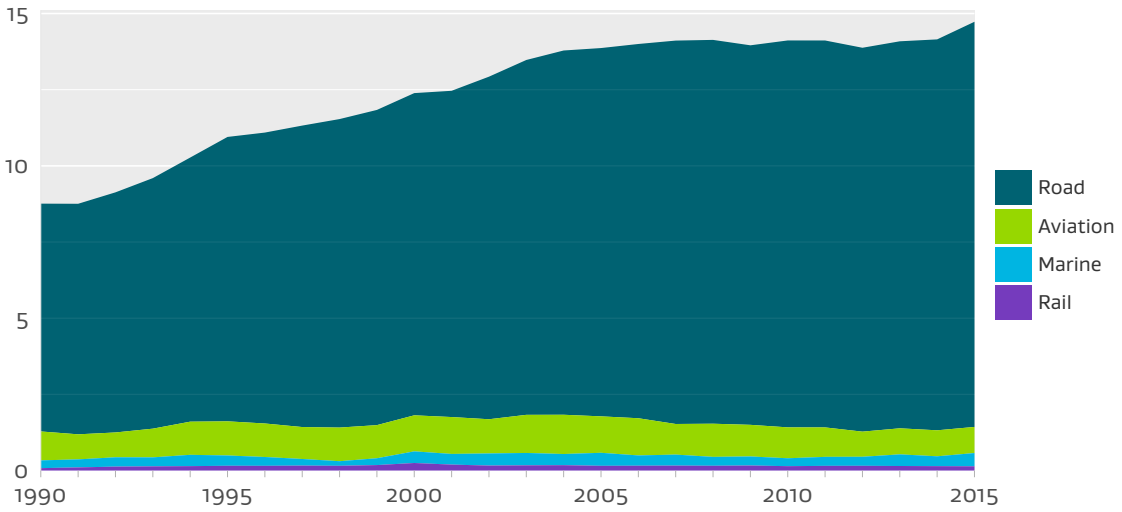
Domestic transport includes all transport where the journey begins and ends in New Zealand. Off-road use is accounted for in the sector in which the activity occurs. For example, emissions from fuel used by a tractor on a farm are included under agriculture energy emissions.

Emissions from fuel combusted by international aviation and sea-going vessels are reported only as a memo item in New Zealand's Greenhouse Gas Inventory, as recommended in the Intergovernmental Panel on Climate Change (IPCC) guidelines.

Road transport emissions constitute by far the largest share of domestic transport emissions. Road transport emissions in 2015 were up 78% over 1990 levels, accounting for 13.3 Mt CO_2-e or 41% of all energy sector emissions. After several years of subdued activity following the global financial crisis, road transport emissions increased by 3.6% compared to 2014, a return to growth levels not seen since 2003. Increased consumption of both petrol and diesel contributed to the rise in emissions.

Aviation emissions have remained relatively stable over the last four years, but the relative contribution to total transport emissions continues to decline and is now at less than 6%.

Figure 7: Domestic transport emissions by mode (Mt CO_2-e)



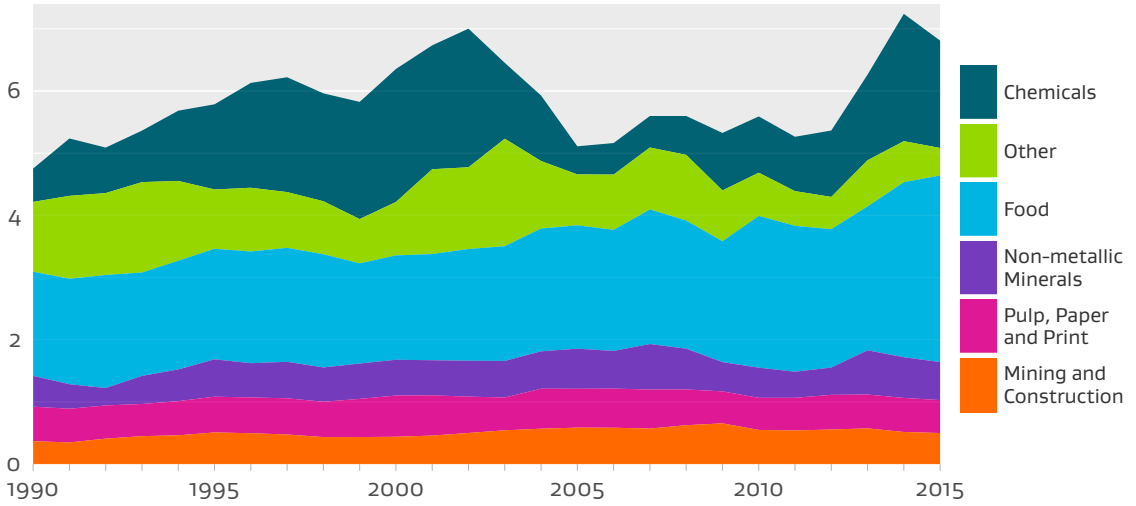
Manufacturing

Manufacturing includes emissions from fuels combusted in factories, plants or mills, as well as for electricity generation where the primary purpose is to support an onsite manufacturing activity. This does not include emissions from chemical processes such as hydrogen, steel or cement production as these emissions are considered industrial process emissions according to IPCC guidelines. Emissions from methanol production are reported under chemical manufacturing in this report and in New Zealand's Greenhouse Gas Inventory.

Emissions from the food processing industries have made up most of New Zealand's manufacturing emissions since 2003. These emissions are largely the result of coal and gas used to raise heat for dairy processing.

Emissions from the chemicals sector have been increasing since 2011 as Methanex returned its methanol production to full capacity. However, an increase in the number of shutdown days saw a decline in emissions in 2015. Figure 8 shows a distinct drop in emissions from the chemicals sector in 2003, when methanol production fell in the midst of rising natural gas prices.

Figure 8: Manufacturing emissions by subsector (Mt CO_2-e)



Electricity generation

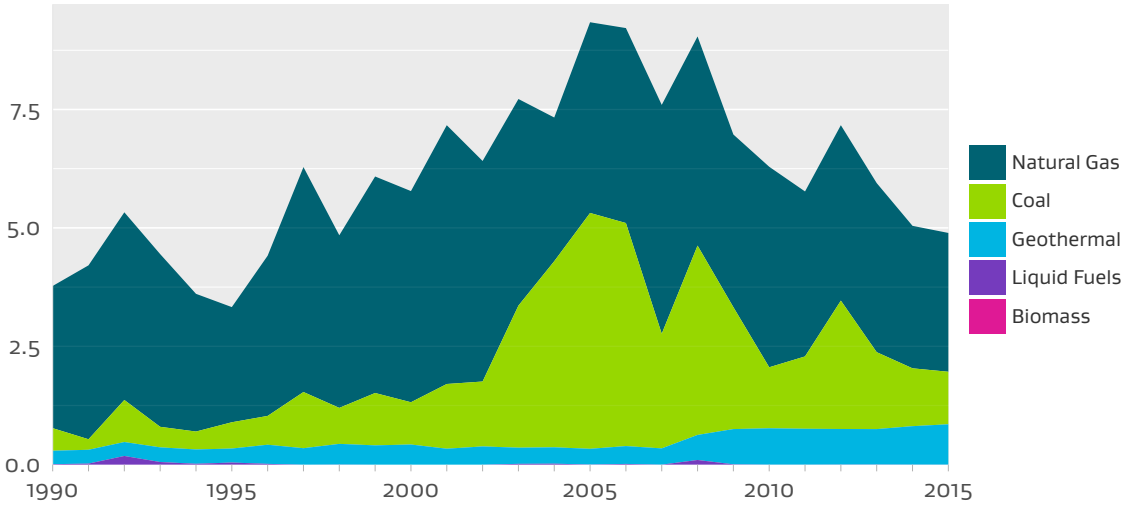
Emissions from electricity generation, including geothermal fugitive emissions, were 4.89 Mt CO_2-e in 2015. Combustion emissions fell 4.5% over the year with less coal and gas-fired generation, and higher levels from geothermal, hydro and wind. Emissions from coal-fired generation continued to decline, and now represent less than 23% of New Zealand's emissions from electricity generation.

In late 2015 two gas-fired combined cycle plants were closed: Contact's 400 MW Otahuhu power station as well as Mercury's 140 MW Southdown plant. Genesis Energy has put two Huntly coal and gas-fired units into long-term storage, one of which is in the process of being decommissioned. These older and less efficient technologies are being pushed out of the market by cheaper and cleaner technologies, such as geothermal and wind. These renewable energy sources increase baseload electricity generation meaning that less thermal baseload generation is required.

The emissions intensity of New Zealand's electricity generation is low by international standards due to the high proportion of demand met by hydro generation. While this provides a strong base in good hydro years, electricity emissions remain sensitive to rainfall in the key catchment areas. For 2015, the approximate emissions intensities for generation by fuel type were as follows:

Coal — 630 kg CO_2-e/MWh
Natural gas — 455 kg CO_2-e/MWh
Geothermal — 115 kg CO_2-e/MWh.

Figure 9: Electricity generation emissions by fuel type (Mt CO_2-e)



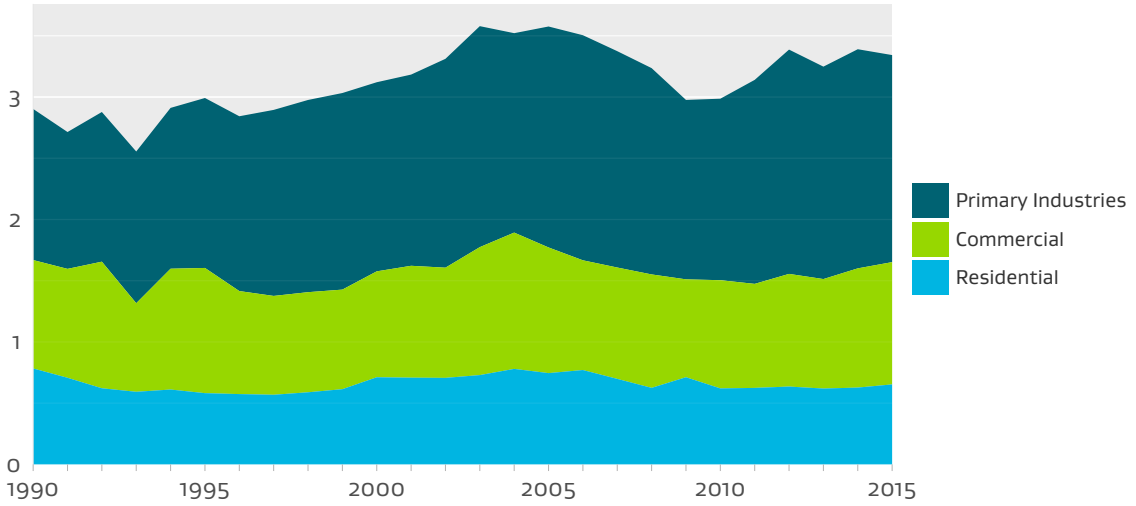
Other sectors

For the purposes of the National Greenhouse Gas Inventory, Other Sectors includes the residential, commercial and agriculture, forestry and fisheries sectors. This includes fuel combustion for stationary energy, such as space heating in the commercial sector, and off-road mobile combustion, such as on-farm vehicles in the agricultural sector.

Despite the number of dwellings increasing by around 40% since 1990, emissions allocated to the residential sector have decreased by 17%. Similarly, notwithstanding strong commercial sector growth, associated emissions increased by a modest 13%. This is the result of a shift toward electricity as a primary energy source for both subsectors. Switching from primary fuels—such as gas or coal—to electricity, causes a decrease in emissions from those consumers.

Emissions from the primary industries sector have increased 37% since 1990, in line with increased production. A significant portion of these emissions come from mobile combustion of liquid fuels, such as off-road vehicles on farms. Note that these are combustion emissions only. Emissions resulting from enteric fermentation and manure management are not energy-related emissions, so are reported elsewhere according to IPCC guidelines.

Figure 10: Other sectors emissions (Mt CO_2-e)



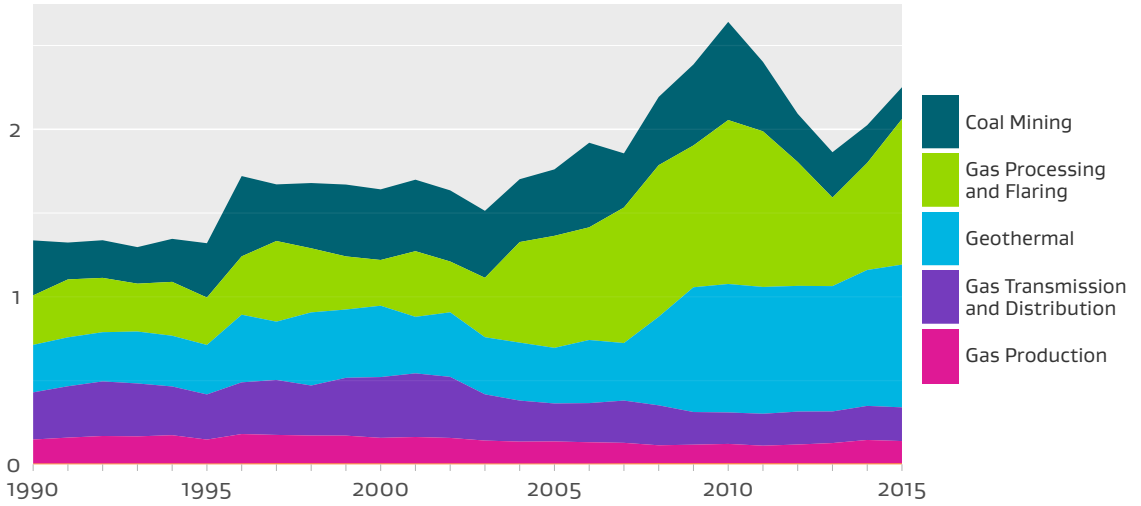
Fugitive emissions

Fugitive emissions are those which arise from the production, processing, transmission and storage of fuel, and from non-productive combustion. These emissions have risen 21% over the last two years, with the largest increase coming from natural gas processing and flaring, followed by geothermal. Processing and flaring emissions started increasing around 2003, partly due to the decline in methanol production which resulted in an increase in emissions vented from the Kapuni gas treatment plant. Previously, carbon dioxide-rich natural gas from the Kapuni gas treatment plant had been used for methanol production. During 2012 and 2013, methanol production increased causing natural gas processing emissions to decrease.

In addition, flaring of natural gas at offshore oil fields has increased significantly since 2006. Some offshore oil fields are permitted to flare natural gas if it is not economically viable for a dedicated pipeline to be built to transport the gas onshore. Combusting the natural gas results in lower emissions than simply venting it due to the higher global warming potential of methane relative to carbon dioxide.

Geothermal electricity generation is another significant and increasing source of fugitive emissions. These emissions are considered fugitive as they are the result of the extraction process rather than combustion.

Figure 11: Fugitive emissions (Mt CO_2-e)



Technical notes

Carbon Dioxide Emission Factors are used to calculate the amount of CO_2 emitted per unit of fuel combusted. Other emission factors that do not involve combustion or the use of fuel are expressed in terms of emissions per unit of production, or some other kind of activity. Oxidation factors are used to account for incomplete combustion. Carbon dioxide emission factors, both before and after oxidation, are presented in the detailed data tables at: www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/greenhouse-gas-emissions

Non-Carbon Dioxide Emissions are highly dependent on the conditions of combustion. For example, a litre of diesel used for industrial heating produces a different level of methane emissions than the same amount used in a vehicle. Consequently, methods for calculating non-carbon dioxide emissions differ by sector.

Carbon Dioxide Equivalent Emissions (CO_2-e) emissions are calculated based on the ratio of the radiative forcing of one kilogram of greenhouse gas emitted to the atmosphere to that of one kilogram of carbon dioxide over a given time horizon. This report uses the global warming potentials from the Fourth Assessment Report of the IPCC: Methane (CH_4) = 25, Nitrous oxide (N_2O) = 298. Previous editions of this report used values of 21 and 310 respectively, which were specified in the Second Assessment Report of the IPCC.

Biomass Carbon Dioxide Emissions are not included in this publication, but methane and nitrous oxide emissions from biomass combustion are. This is because any carbon dioxide emissions from woody biomass are captured in the 'Land Use, Land Use Change and Forestry' (LULUCF) category, while carbon dioxide emissions from biogas emissions are accounted for in the 'Waste' category.

International GDP data was sourced from the World Bank (PPP, constant 2011 international $).

International CO_2 data was sourced from the Carbon Dioxide Information Analysis Center.

Sector Definitions

Domestic Transport: includes emissions from fuels combusted for domestic road, rail, air or waterborne transport. Emissions from off-road vehicle use are included in the sector where the activity takes place.

Electricity Generation: includes emissions from thermal combustion plants whose primary business activity is electricity generation. Plants that generate electricity to support another primary business activity are included in the manufacturing sector.

Manufacturing Industries: includes emissions from fuels combusted in plants, factories or mills, and fuel combusted for electricity generation where the primary purpose is to support the manufacturing activity. Emissions from methanol production are reported in the manufacturing sector in this report and in *New Zealand's Greenhouse Gas Inventory*.

Transformation Industries: includes emissions from fuels combusted by energy-producing industries during conversion processes, e.g. petroleum refining, synthetic petrol production, and oil and gas extraction and processing.

Other: includes primary industries (agriculture, forestry and fishing), commercial and residential.

Fugitive: includes emissions which arise from the production, processing, transmission and storage of fuels, from non-productive combustion, and from geothermal electricity generation.

Voluntary Corporate Greenhouse Gas Emissions Reporting: Information and emissions factors for individuals and organisations wishing to calculate greenhouse gas emissions from their activities can be found in the Ministry for the Environment's annual publication *Guidance for Voluntary Corporate Greenhouse Gas Reporting*.

Industrial Process Emissions

are those which arise from chemical reactions in which carbon dioxide is a by-product, rather than the result of fuel combustion. Examples of industrial processes in New Zealand include the production of iron, steel, aluminium, hydrogen, cement, lime, urea and methanol. Industrial process emissions are not included in this report, with the exception of emissions resulting from methanol production which are reported as energy-related emissions in the manufacturing sector.

Data Revisions

This edition includes a number of small revisions to time series due to improvements in data collection and emission factors. These improvements are made in order to better align with IPCC guidelines and are often the result of Expert Review Team recommendations.

Revisions may be due to the inclusion of emissions that were not captured in past reports, such as waste oil combustion in the manufacturing sector or gas leakage at the point of consumption.

They may also be due to the development of more accurate country-specific or site-specific emission factors. As IPCC default emission factors are generally conservative, establishing a local emission factor normally results in a decrease in estimated emissions.