MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

MARKETS – EVIDENCE AND INSIGHTS

ENERGY IN NEW ZEALAND 23

2022 CALENDAR YEAR EDITION

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

Energy in New Zealand 2023 provides annual information on and analysis of New Zealand's energy sector. It is part of the suite of publications produced by the Markets team in the Ministry of Business, Innovation & Employment (MBIE).

The 2023 edition includes information up to the end of the 2022 calendar year.

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

www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/

Prepared by:
Markets

Evidence and Insights

Ministry of Business, Innovation & Employment

PO Box 1473, Wellington 6140

New Zealand

Email: energyinfo@mbie.govt.nz

Important

Use of this publication in paper or electronic form implies acceptance of the conditions of its release, which are that if the information is made available to others, its source must be acknowledged as the Ministry of Business, Innovation & Employment 2023 or by reference to the publication title and date.

Although every attempt has been made to ensure the information is accurate, neither the Crown nor any Minister, employee or agent of the Crown:

- warrants the accuracy, completeness or usefulness for any particular purpose of the information contained in this publication in paper or electronic form; or
- accepts any liability for any loss or damage, however caused, from the reliance on or use of that information, or arising from the absence of information or any particular information in this publication in paper or electronic form.

Acknowledgements

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

Authorship

This publication was prepared by the Markets team within the Evidence and Insights Branch of the Ministry of Business, Innovation and Employment.

Availability

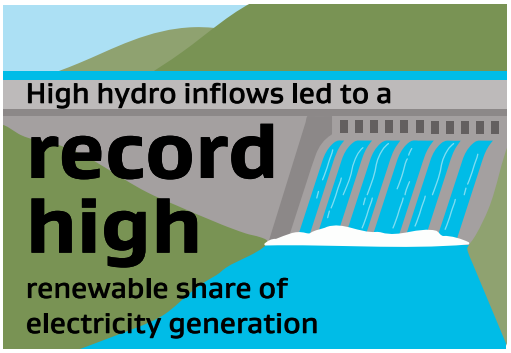
A free electronic version of this publication can be downloaded from: https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/

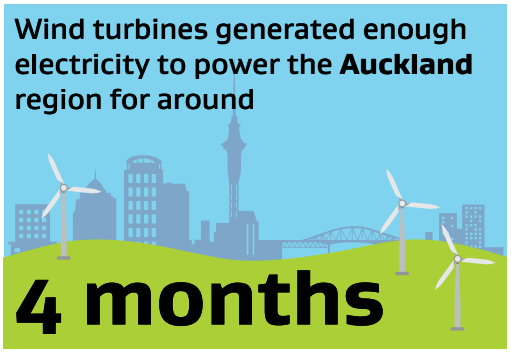
Print: ISSN 2537-9372 Online: ISSN 2324-5913

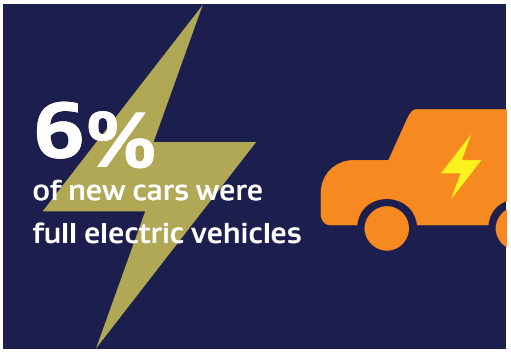
August 2023

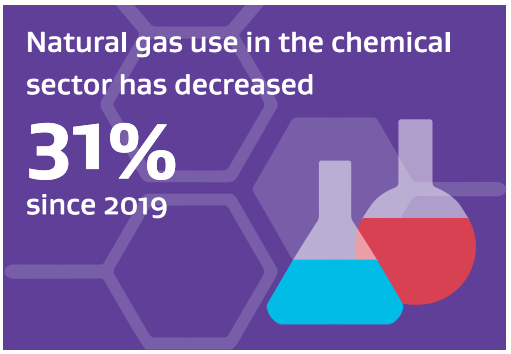
Contents

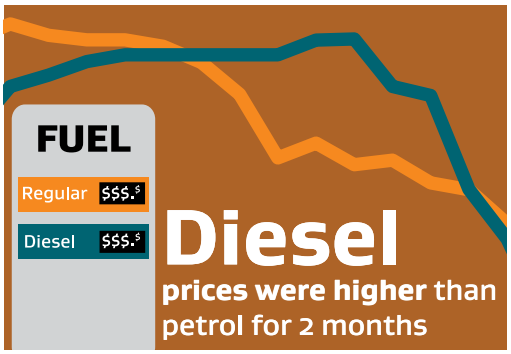
Quick facts for 2022

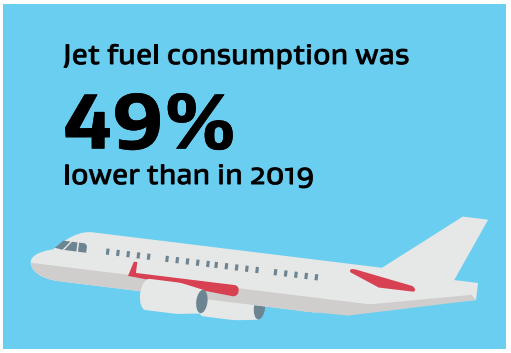


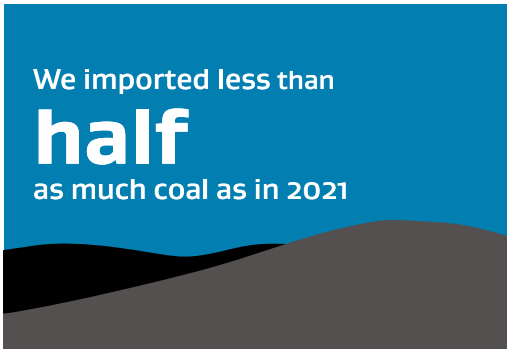












A. Energy Overview

This report presents comprehensive information on and analysis of New Zealand's energy supply and demand for the 2022 calendar year.

Overview

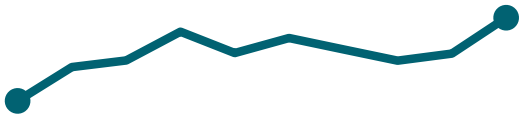
At a glance

National self-sufficiency

74%

▲ 1.4 pp on 2021
▼ 1.5 pp on 2019

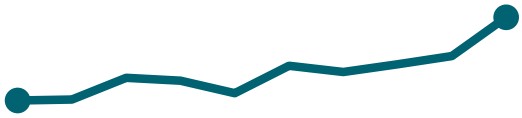
Share of electricity generated from renewable sources



87%

▲ 5.0 pp on 2021
▲ 4.4 pp on 2019

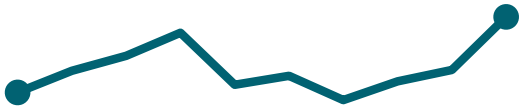
Share of primary energy supply from renewable sources



44%

▲ 2.7 pp on 2021
▲ 3.8 pp on 2019

Share of final energy consumption from renewable sources



30%

▲ 1.8 pp on 2021
▲ 2.7 pp on 2019

National energy consumption

543 PJ

▼ 0.15% on 2021
▼ 6.5% on 2019

National average energy intensity

1.96 MJ/$

▼ 2.7% on 2021
▼ 13% on 2019

High hydro inflows increased our renewable electricity generation

The share of renewable electricity generation in 2022 was one of the highest in recent decades, as autumn and winter rain ensured hydro inflows remained high.

Renewable sources generated 95 per cent of electricity in the fourth quarter of 2022 — the highest quarterly share from renewables since 1980. Overall, 87 per cent of electricity generated in 2022 came from renewable sources. Hydroelectric generation accounted for 60 per cent of all electricity for 2022 (up 4.4 percentage points on 2021), while coal-fired electricity accounted for only 2.9 per cent (down 4.1 percentage points on 2021). As a result, the amount of coal imported for the year was 61 per cent lower than in 2021, as electricity generation is one of the main uses of imported coal.

Closing Marsden Point Oil Refinery changed the mix of imported oil

The Marsden Point Oil Refinery stopped refining operations on 31 March 2022, transitioning to a dedicated fuel import terminal. As part of this change, Refining New Zealand rebranded as Channel Infrastructure.

With the closure of refining operations in New Zealand, the amount of imported crude oil decreased to zero from April 2022. Crude oil is refined into oil products such as petrol, diesel and aviation fuel. This is the first time that New Zealand has not imported any crude oil for more than a quarter since statistical records began in 1974. As a result, the country switched to importing mainly refined oil products, which were previously produced by the refinery. This saw the amount of imported refined oil products more than double from 2021 levels.

While closing the refinery changed the type of oil that New Zealand imports, it did not significantly change the amount of oil imported. New Zealand has always relied on imported oil, even if the refining was done in New Zealand, as the Marsden Point Oil Refinery was designed to run on heavier, foreign crude oil.

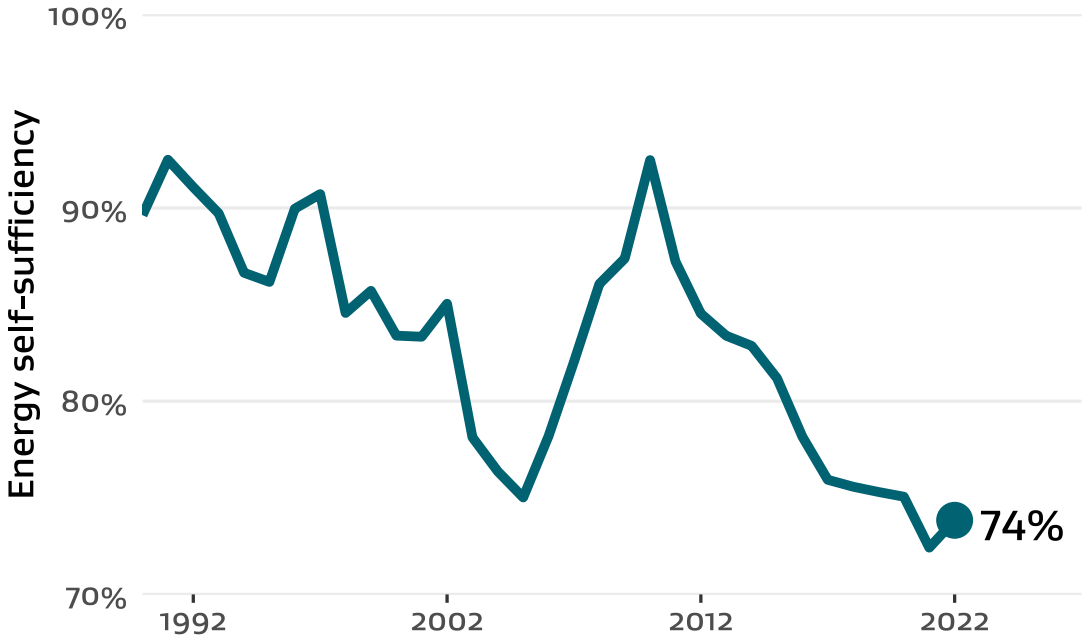
New Zealand's self-sufficiency increased from 2021, but continues to trend downwards

New Zealand relies on a combination of domestically produced and imported fuels to meet its energy needs. We can measure this reliance using a self-sufficiency indicator[1], which shows how well we can meet our own energy supply needs through domestic production.

New Zealand's energy self sufficiency for 2022 was 74 per cent (Figure A.1). This means that New Zealand was able to meet 74 per cent of its energy supply requirements for the year through domestic production. This continues a trend of decreasing energy self-sufficiency over time as domestic production is decreasing while demand increases, leading to a steady increase in the total primary supply required.

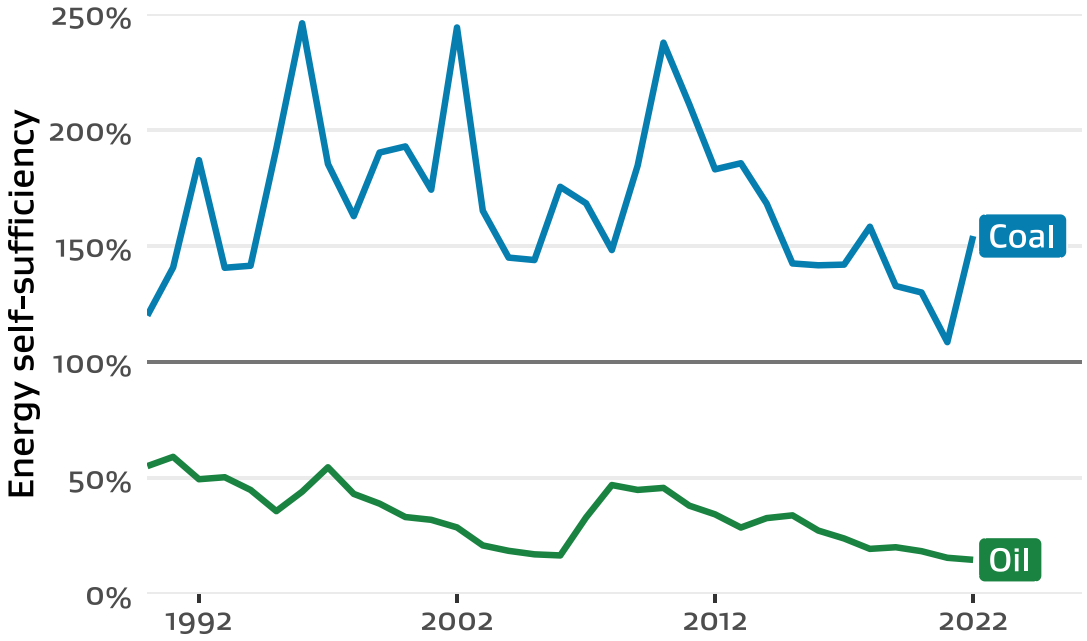
1 For more information about New Zealand's energy indicators, see https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-indicators/

Figure A.1 New Zealand's energy self-sufficiency, from 1990 to 2022



The key contributors to New Zealand's energy self-sufficiency are coal and oil — the two fuels which New Zealand trades internationally. New Zealand has historically been a net exporter of coal (that is, we produce more than we need), and a net importer of oil. This means that our coal self-sufficiency tends to be greater than 100 per cent, while our oil self-sufficiency tends to be less than 100 per cent. Our coal self-sufficiency increased to 154 per cent in 2022 due to a decrease in the amount imported, but oil self-sufficiency decreased to 12 per cent, a record low (Figure A.2).

Figure A.2 New Zealand's energy self-sufficiency for coal and oil, from 1990 to 2022



Our energy consumption remains lower than levels measured before COVID-19

Total energy consumption for 2022 was 543 petajoules (PJ), about the same as observed for 2020 and 2021. Historically, energy consumption has gradually increased year-on-year, peaking at 581 PJ in 2019. However, restrictions on activity and movement as part of the response to the coronavirus (COVID-19) pandemic resulted in a dip in energy consumption in 2020. We are yet to see energy consumption return to the levels measured before COVID-19.

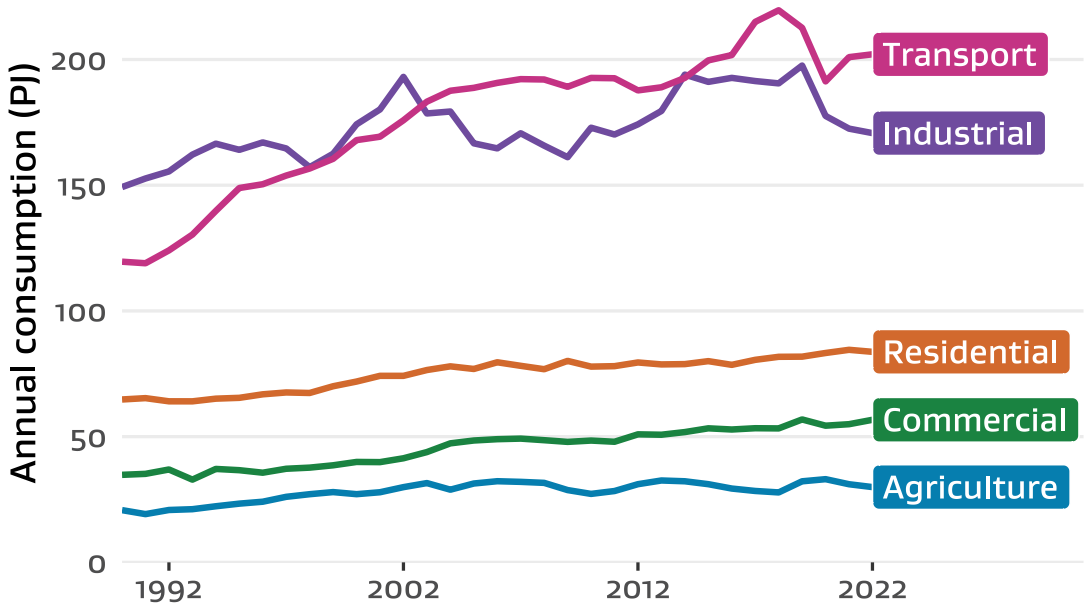
Consumption by sector has changed slightly since last year (Figure A.3). Energy use in the agriculture, forestry and fishing sector fell by 8.3 per cent compared to 2021, driven mainly by a decrease in the use of electricity and natural gas. In contrast, energy consumption in the commercial sector increased by 3.7 per cent, driven by increasing petrol and diesel use.

While overall energy consumption in the industrial sector has stayed relatively constant, the use of natural gas dropped by 9.0 per cent compared to 2021 levels. This can be attributed to the following sectors: wood, pulp and paper; food processing; and chemical product.

This resulted in a drop in overall energy consumption in the food processing and chemical product sectors. In contrast, overall consumption in the wood, pulp and paper sector increased, with solid biofuel use increasing by 17 per cent to cover the reduction in natural gas use.

Energy consumed from renewable sources accounted for 30 per cent of the total final consumption in 2022, the highest value ever recorded. The share of renewable energy in the total final consumption has steadily increased across most sectors, helped by the large share of renewable electricity generation for the year. The exceptions are the agriculture and transport sectors — two sectors which rely heavily on oil for their energy needs.

Figure A.3 New Zealand's energy consumption by sector, from 1990 to 2022



New Zealand's energy intensity continues to improve

Energy intensity gives an indication of the relationship between energy use and economic growth. It is calculated as energy use divided by gross domestic product (GDP) and tells us the amount of energy required to produce each dollar of GDP. A fall in the indicator — where less energy is required to produce each dollar of GDP — is viewed as an improvement.

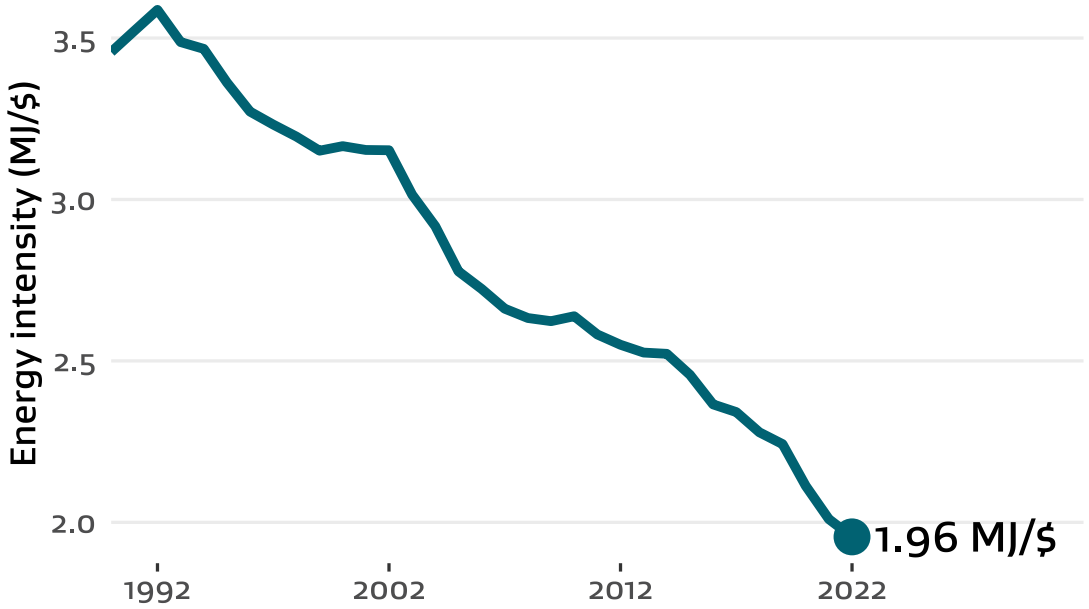
If energy intensity decreases, it is usually for one of two reasons.

1. Energy users within a sector are finding ways to use energy more efficiently, increasing the energy efficiency of the sector.

2. Activity shifts from more energy-intensive sectors to less energy-intensive sectors, resulting in a lower overall energy intensity.

National energy intensity dropped to a record low of 1.96 megajoules per dollar (MJ/$) this year, a 2.7 per cent decrease on 2021 values (Figure A.4). Energy intensity has improved by an average of 1.7 per cent every year between 1990 and 2022. This year's decrease has been driven by changes in energy use in key sectors. Energy consumption decreased in the agriculture sector (which is relatively energy-intensive), while consumption increased in the commercial sector (which is relatively less energy-intensive).

Figure A.4 New Zealand's national energy intensity, from 1990 to 2022



B. Energy Balances

New Zealand's energy production comes from both renewable and non-renewable sources. The energy balance tables show how energy supply and demand by sector varies by energy type.

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

Both the energy supply and demand sections of the energy balance tables are calculated from surveys that span different sources. An imbalance exists between demand calculated from reported supply data, and demand observed from reported consumption data.

Energy supply

Total primary energy supply (TPES) 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 TPES. International transport includes international sea and air transport but excludes coastal shipping, national air transport, and all land transport.

Indigenous natural gas production does not include natural gas that is flared, reinjected, or extracted as liquefied petroleum gas (LPG). The primary energy figures presented are actual data, except for some that go into electricity generation as detailed under energy transformation.

Energy transformation

Energy transformation includes:

› generation of electricity, including cogeneration

› oil production, including refining operations and the manufacture of synthetic fuel from natural gas (Methanex stopped the production of methanol to petrol in April 1999)

› 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 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.

Conversion losses in electricity generation are calculated using the net electricity generated, with the actual input being used where available. The efficiency factors shown in Table B.1 are used otherwise. Input to electricity generation from 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.

Table B.1 Default electrical transformation efficiency factors

Fuel	Default efficiency
Biogas	30%
Coal	30%
Natural gas (combined cycle)	55%
Natural gas (single cycle)	30%
Geothermal	15%
Hydro	100%
Oil	30%
Waste heat	15%
Wind	100%
Wood	25%

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—electricity used on-site at power stations

› oil industry losses and own use — 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. For example, bitumen used in road construction, and natural gas used as chemical feedstock in the production of methanol and ammonia or urea.

How we treat 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 TPES of solar is the sum of the direct use of solar thermal (for hot water heating), and the amount of solar energy directly converted into electricity using PV panels.

Solar PV electricity generation is estimated using data on the total installed capacity of grid connected solar PV installations in New Zealand. This is converted to output using an assumed annual capacity factor of 14 per cent — the solar panels produce their full output 14 per cent of the time. The capacity factor is then scaled using data on sunshine hours from the National Institute of Water and Atmospheric Research (NIWA) to introduce seasonal variation. 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 allocated using data from the Electricity Authority.

Consumer energy 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, 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. It is calculated as TPES less energy transformation less non-energy use.

› **Consumer energy (observed)** forms the bottom half of the energy balance tables. It represents reported demand in the agricultural, industrial, commercial, transport, and residential sectors. With the exception of domestic 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. 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.

Statistical differences

Statistical differences show the difference between ‘consumer energy (calculated)’ and ‘consumer energy (observed)’. This difference is shown at the bottom of the energy balance tables.

Energy Balance Table

2022		Electricity	Renewables								Waste Heat	Natural Gas
Converted into Petajoules using Gross Calorific Values		Total	Hydro	Geothermal	Solar	Wind	Liquid Biofuels	Biogas	Solid Biofuels	Total	Total	Total
SUPPLY	Indigenous Production	-	94.58	204.89	1.36	10.31	0.21	3.71	47.36	362.42	1.02	143.22
	+ Imports	-	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.00
	- Exports	-	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00	0.00
	- Stock Change	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
	- International Transport	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL PRIMARY ENERGY	**-**	**94.58**	**204.89**	**1.36**	**10.31**	**0.21**	**3.71**	**47.48**	**362.55**	**1.02**	**142.66**
	ENERGY TRANSFORMATION	**143.72**	**-94.58**	**-197.58**	**-1.00**	**-10.31**	**-0.21**	**-3.40**	**-14.12**	**-321.21**	**-1.02**	**-46.44**
	Electricity Generation	152.33	-94.58	-196.33	-1.00	-10.31	0.00	-2.61	0.00	-304.84	0.00	-29.56
	Cogeneration	7.55	0.00	-1.25	0.00	0.00	0.00	-0.79	-14.12	-16.16	-1.02	-12.38
	Fuel Production	0.00	0.00	0.00	0.00	0.00	-0.21	0.00	0.00	-0.21	0.00	0.00
	Other Transformation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Losses and Own Use	-16.15	0.00	0.00	00.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.50
Non-energy Use		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-35.26**
CONSUMER ENERGY (calculated)		**143.72**	**0.00**	**7.30**	**0.36**	**0.00**	**0.00**	**0.31**	**33.37**	**41.34**	**0.00**	**60.95**
DEMAND	**Agriculture, Forestry and Fishing**	**8.72**	**-**	**0.45**	**0.00**	**-**	**-**	**0.00**	**0.00**	**0.45**	**-**	**1.01**
	Agriculture	8.29	-	0.45	0.00	-	-	0.00	0.00	0.45	-	1.01
	Forestry and Logging	0.25	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.00
	Fishing	0.18	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.00
	Industrial	**50.59**	**-**	**4.27**	**0.00**	**-**	**-**	**0.05**	**25.80**	**30.12**	**-**	**47.92**
	Mining	1.56	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.18
	Food Processing	10.74	-	0.00	0.00	-	-	0.00	0.00	0.00	-	17.20
	Textiles	0.33	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.38
	Wood, Pulp, Paper and Printing	5.22	-	0.00	0.00	-	-	0.00	25.80	25.80	-	1.00
	Chemicals	1.93	-	0.00	0.00	-	-	0.00	0.00	0.00	-	23.77
	Non-metallic Minerals	0.90	-	0.00	0.00	-	-	0.00	0.00	0.00	-	2.29
	Basic Metals	22.56	-	0.00	0.00	-	-	0.00	0.00	0.00	-	2.44
	Mechanical/ Electrical Equipment	0.67	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.25
	Building and Construction	1.63	-	0.00	0.00	-	-	0.00	0.00	0.00	-	0.31
	Unallocated	5.06	-	4.27	0.00	-	-	0.05	0.00	4.32	-	0.09
	Commercial	**33.66**	**-**	**2.38**	**0.00**	**-**	**-**	**0.26**	**0.00**	**2.64**	**-**	**7.45**
	Transport	**0.70**	**-**	**0.00**	**0.00**	**-**	**-**	**0.00**	**0.00**	**0.00**	**-**	**0.00**
	Residential	**48.28**	**-**	**0.21**	**0.36**	**-**	**-**	**0.00**	**7.44**	**8.01**	**-**	**6.79**
CONSUMER ENERGY (observed)		**141.94**	**-**	**7.30**	**0.36**	**-**	**-**	**0.31**	**33.24**	**41.21**	**-**	**63.16**
Statistical Differences		**1.78**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.13**	**0.13**	**0.00**	**-2.21**

Oil								Coal				TOTAL
Crudes/ Feedstocks/ NGL	LPG	Petrol	Diesel	Fuel Oil	Av. Fuel/ Kero	Others	**Total**	Bituminous	Sub-bitum.	Lignite	**Total**	
34.23	7.72	0.00	0.00	0.00	0.00	0.00	**41.95**	37.13	23.82	5.04	**65.98**	**614.60**
37.90	1.29	88.31	134.55	2.58	28.85	15.48	**308.96**	1.19	14.48	0.00	**15.66**	**324.75**
35.34	1.53	4.36	1.96	3.38	0.80	0.54	**47.92**	37.19	0.97	0.00	**38.15**	**86.07**
-9.52	-0.01	-1.98	-0.87	2.93	0.27	1.45	**-7.73**	-1.27	2.04	0.00	**0.77**	**-6.39**
0.00	0.00	0.00	3.87	1.71	21.71	0.00	**27.29**	0.00	0.00	0.00	**0.00**	**27.29**
46.31	**7.50**	**85.93**	**129.59**	**-5.44**	**6.07**	**13.48**	**283.43**	**2.40**	**35.29**	**5.04**	**42.72**	**832.38**
-45.39	**0.00**	**14.79**	**19.73**	**5.30**	**5.85**	**0.39**	**0.67**	**-0.29**	**-24.77**	**-0.04**	**-25.10**	**-249.38**
0.00	0.00	0.00	-0.09	0.00	0.00	0.00	**-0.09**	0.00	-7.71	0.00	**-7.71**	**-189.87**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	-7.43	-0.04	**-7.47**	**-29.48**
-45.39	0.00	13.65	18.46	3.60	5.93	0.71	**-3.03**	0.00	0.00	0.00	**0.00**	**-3.24**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	-9.52	0.00	**-9.52**	**-9.52**
0.00	0.00	1.13	1.36	1.70	-0.08	-0.32	**3.79**	-0.29	-0.12	0.00	**-0.41**	**-17.27**
-	**-**	**-**	**-**	**-**	**-**	**-13.62**	**-13.62**	**-**	**-**	**-**	**-**	**-48.88**
0.91	**7.50**	**100.72**	**149.32**	**-0.13**	**11.91**	**0.26**	**270.48**	**2.11**	**10.51**	**5.00**	**17.62**	**534.12**
-	**0.12**	**1.35**	**15.32**	**0.00**	**0.00**	**-**	**16.79**	**0.04**	**1.47**	**0.00**	**1.51**	**28.47**
-	0.12	1.29	11.32	0.00	0.00	-	**12.73**	0.04	1.47	0.00	**1.51**	**23.99**
-	0.00	0.00	1.82	0.00	0.00	-	**1.83**	0.00	0.00	0.00	**0.00**	**2.08**
-	0.00	0.05	2.18	0.00	0.00	-	**2.23**	0.00	0.00	0.00	**0.00**	**2.41**
-	**3.74**	**0.09**	**19.27**	**0.59**	**0.00**	**-**	**23.69**	**2.26**	**11.48**	**4.85**	**18.59**	**170.90**
-	0.00	0.00	4.87	0.00	0.00	-	**4.87**	0.00	0.78	0.00	**0.78**	**7.39**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.51	9.72	4.50	**14.74**	**42.68**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.15	0.05	0.00	**0.20**	**0.90**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.05	0.15	0.00	**0.20**	**32.22**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.00	0.00	0.00	**0.00**	**25.71**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	1.19	0.76	0.13	**2.07**	**5.26**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.00	0.02	0.21	**0.24**	**25.24**
-	0.00	0.00	0.00	0.00	0.00	-	**0.00**	0.00	0.00	0.00	**0.00**	**0.92**
-	0.00	0.02	7.48	0.00	0.00	-	**7.50**	0.00	0.00	0.00	**0.00**	**9.44**
-	3.74	0.07	6.92	0.59	0.00	-	**11.32**	0.37	0.00	0.00	**0.37**	**21.15**
-	**1.78**	**2.22**	**8.27**	**0.47**	**0.00**	**-**	**12.73**	**0.15**	**0.32**	**0.07**	**0.53**	**57.01**
-	**0.14**	**84.23**	**102.10**	**0.71**	**15.03**	**-**	**202.20**	**0.00**	**0.00**	**0.00**	**0.00**	**202.90**
-	**3.79**	**14.18**	**2.68**	**0.00**	**0.00**	**-**	**20.65**	**0.01**	**0.11**	**0.03**	**0.15**	**83.88**
-	**9.56**	**102.07**	**147.64**	**1.77**	**15.03**	**-**	**276.06**	**2.46**	**13.37**	**4.95**	**20.78**	**543.17**
0.91	**-2.06**	**-1.36**	**1.68**	**-1.90**	**-3.11**	**0.26**	**-5.58**	**-0.35**	**-2.86**	**0.05**	**-3.16**	**-9.05**

C. Electricity

New Zealand generates and consumes around 43,500 gigawatt hours (GWh) of electricity a year. Most of our electricity comes from renewable sources such as hydroelectricity, with the overall share of renewable electricity generation exceeding 80 per cent in most years.

In 2022, the total electricity generated included contributions from the following sources.

› Hydroelectric — 60 per cent

› Geothermal — 18 per cent

› Natural gas — 9.9 per cent

› Wind — 6.5 per cent

› Coal — 2.9 per cent

New Zealand's industrial sector consumed around 34 per cent of all electricity consumed in the country in 2022. This was mainly led by the metal manufacturing and food processing sectors. The residential sector consumed a similar amount of electricity at 34 per cent.

Electricity

At a glance

Share of electricity generated from renewable sources

87%

▲ 5.0 pp on 2021
▲ 4.4 pp on 2019

Total electricity generation

43,476 GWh

▲ 0.47% on 2021
▼ 0.77% on 2019

Total electricity consumption

39,429 GWh

▼ 1.3% on 2021
▼ 3.2% on 2019

Number of Installation Control Points (ICP)

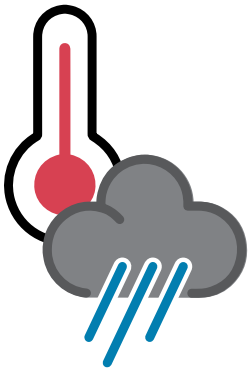
2,149,923

▲ 0.85% on 2021
▲ 3.6% on 2019

Total generation capacity

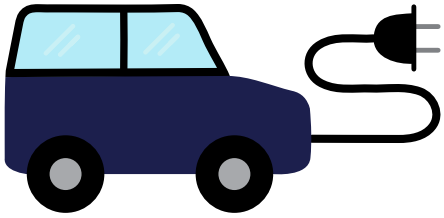
9,790 MW

▲ 0.31% on 2021
▲ 4.4% on 2019



The **wettest and warmest winter on record** led to above average hydro lake inflows and snow storage in the 2nd half of the year

Industrial electricity demand **dropped 1.3%**, and **residential** electricity demand **dropped 1.9%**



The **number of EVs** in New Zealand **doubled** over 18 months

2022 saw **record electricity generation** from both wind and geothermal

The warmest and wettest winter on record led to a high share of renewable electricity generation

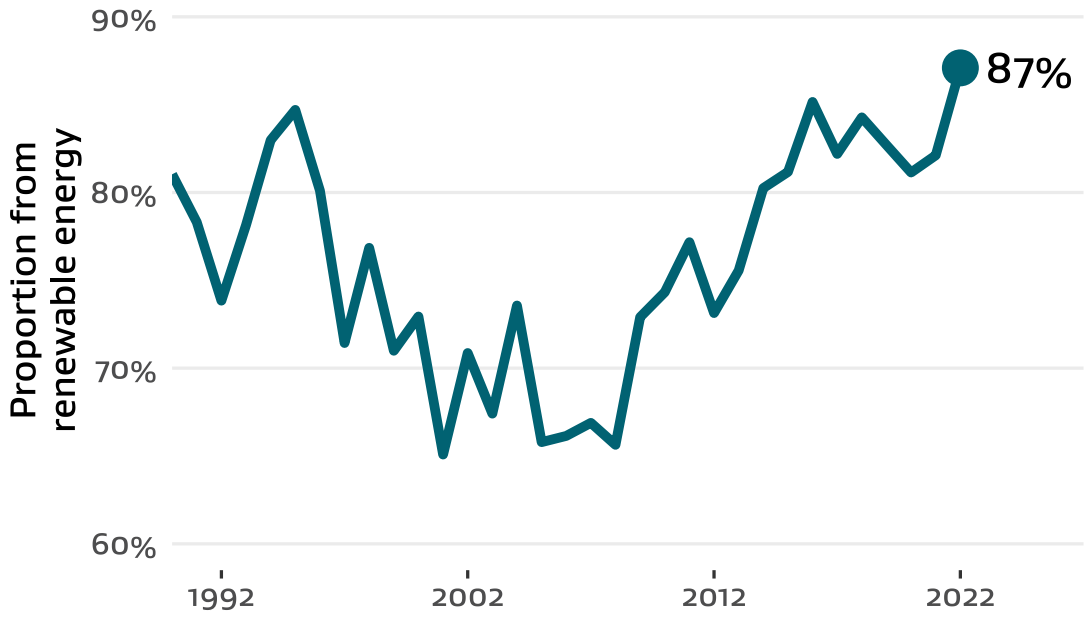
New Zealand generated 43,476 GWh in 2022, a 0.47 per cent increase from 2021. New Zealand generated 0.77 per cent less electricity in 2022, compared to 2019 (before the COVID-19 pandemic). The annual electricity generation from hydro increased by 8.4 per cent in 2022 compared to 2021, while generation from non-renewable sources decreased by 28 per cent.

In 2022 New Zealand again experienced its warmest year on record. It was also New Zealand's eighth wettest year on record. The primary driver was La Niña weather conditions, marked by ocean temperatures in the Pacific that were cooler than average.

The 2022 winter was the wettest and warmest on record. There was heavy rainfall in parts of the country, notably in August when there was widespread flooding across the top of the South Island. The wet weather also helped hydro lake inflows and snow storage surpass historical averages in the second half of the year.

The share of renewable generation rose to a record high of 95 per cent in the last three months of 2022 — this is the highest quarterly share of renewable generation in 43 years. Overall in 2022, renewable sources accounted for 87 per cent of electricity generation (Figure C.1).

Figure C.1 Share of renewable electricity generation, from 1990 to 2022



A record amount of electricity was generated from wind and geothermal in 2022

Energy company, Mercury commissioned the Waipipi and Turitea Wind Farms in 2021, adding a capacity of 223 megawatts (MW). This contributed to the highest annual wind generation on record. Electricity generated from wind increased by 8.4 per cent in 2022 compared to 2021.

Geothermal electricity generation in New Zealand operates as baseload generation. Baseload generation refers to power plants that do not change their electricity generation output quickly. These plants are less flexible with meeting electricity demand and take a long time to start up and shut down. Geothermal electricity generation is not affected by weather conditions that can affect hydro, wind, and solar generation. In 2022, electricity generation from geothermal sources increased by 0.81 per cent, reaching a record high of 8,033 GWh. This is because every plant, including the recently built Ngāwhā OEC4, was operating at capacity.

More wind farms and windy conditions increase wind generation

New Zealand is on the belt of the Roaring Forties. This means that we typically experience higher wind speeds than other parts of the world.

The Southern Annular Mode (SAM) is a proxy for measuring the strength and position of the belt of westerly winds that encircle the Southern Ocean and bring storms to New Zealand. For 76 per cent of the time in 2022 the SAM was positive, the highest annual percentage since 1979[2]. A positive SAM phase is typically associated with an increase in windiness and storm activity over the Southern Ocean.

Additional renewable capacity is entering the market, while thermal plants are retired

Developers made additional investments into renewable electricity generation in 2022. In addition to Mercury's commissioning of the Waipipi and Turitea Wind Farms in 2021, more wind, solar, and geothermal capacity will be available in the future (Table C.1).

Contact Energy announced that it would close its Te Rapa cogeneration natural gas plant, which has a capacity of 44 MW, at the end of June 2023. Contact Energy also announced that Taranaki Combined Cycle (TCC) natural gas plant, with a capacity of 380 MW, would close in September 2024. The TCC natural gas plant is typically used as a hydro-firming plant, which means that it generally only runs when demand is high and generation from hydroelectric plants is low.

Contact Energy retired its combined cycle plant at Ōtāhuhu in 2015, while Mercury also retired a combined cycle plant in Southdown in late 2015. After the decommissioning of TCC, Huntly Unit 5 will be the only combined cycle natural gas plant remaining in the country.

Table C.1 Consented renewable electricity plants

Plant name	Owner	Capacity (MW)	Expected commissioning
Turitea Stage 2 Wind Farm	Mercury	103	Mid-2023
Kaiwera Downs Stage 2 Wind Farm	Mercury	240	End of 2023
Tauhara Geothermal Plant	Contact Energy	168	End of 2023
Kaitaia Solar Farm	Lodestone Energy		End of 2023
Harapaki Wind Farm	Mercury	176	Mid-2024
Ruakākā Solar Farm	Meridian	75	End of 2024
Mt Cass Wind Farm	MainPower	95	2024-2025
Mahinerangi Stage 2 Wind Farm	Mercury	164	-
Puketoi Wind Farm	Mercury	230	-
Kaiwaikawe Wind Farm	Mercury	73	-
Ngāwhā OEC5 Geothermal Expansion	Top Energy	32	-
Te Huka Unit 3 Geothermal Plant	Contact Energy	51	-

2 For more information about the SAM and climate in 2022, see https://niwa.co.nz/climate/summaries/annual-climate-summary-2022

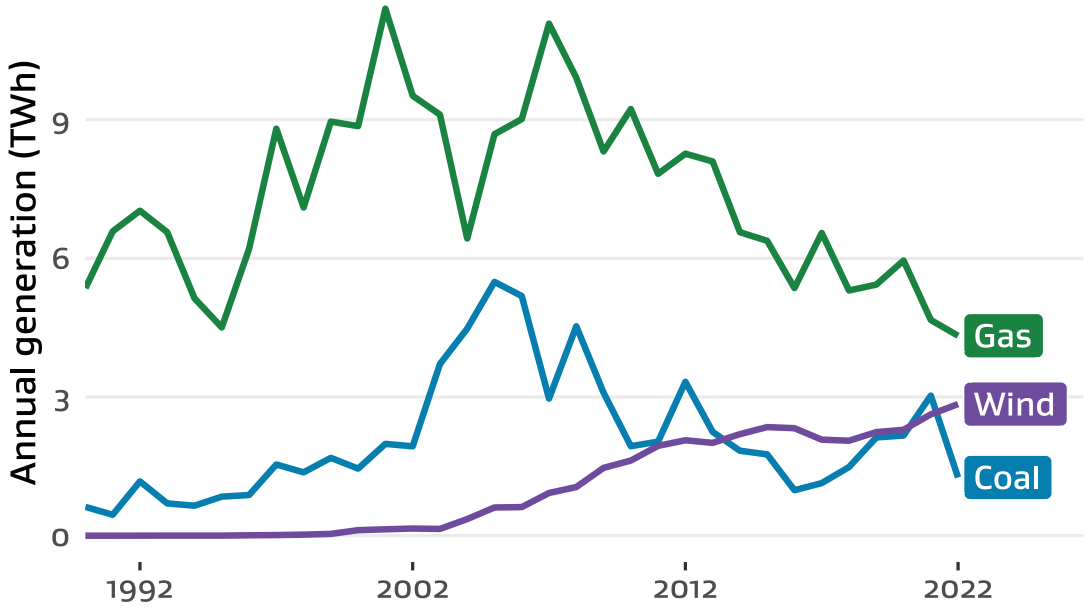
Favourable hydro conditions decreased our reliance on non-renewable sources for electricity generation

Warm weather accompanied by several storms throughout the year boosted hydro lake inflows. This decreased the country's reliance on coal for electricity generation.

Following early predictions that the 2022 winter would be dry, Genesis Energy increased the coal stockpile at their Huntly Power Station. The coal stockpile at the Huntly Power Station was 835 kilotonnes (kt) at the end of 2021. This was the highest level since 2014.

Electricity generated from coal fell to 2.9 per cent of total generation in 2022, a decrease from 7.0 per cent of total electricity generation in 2021. Figure C.2 shows a drop in the total share of coal generation in 2022. Electricity generated from natural gas also fell in 2022 to 9.9 per cent of total electricity generation, down by 0.8 percentage points compared to 2021.

Figure C.2 Share of total electricity generation by source, from 1990 to 2022



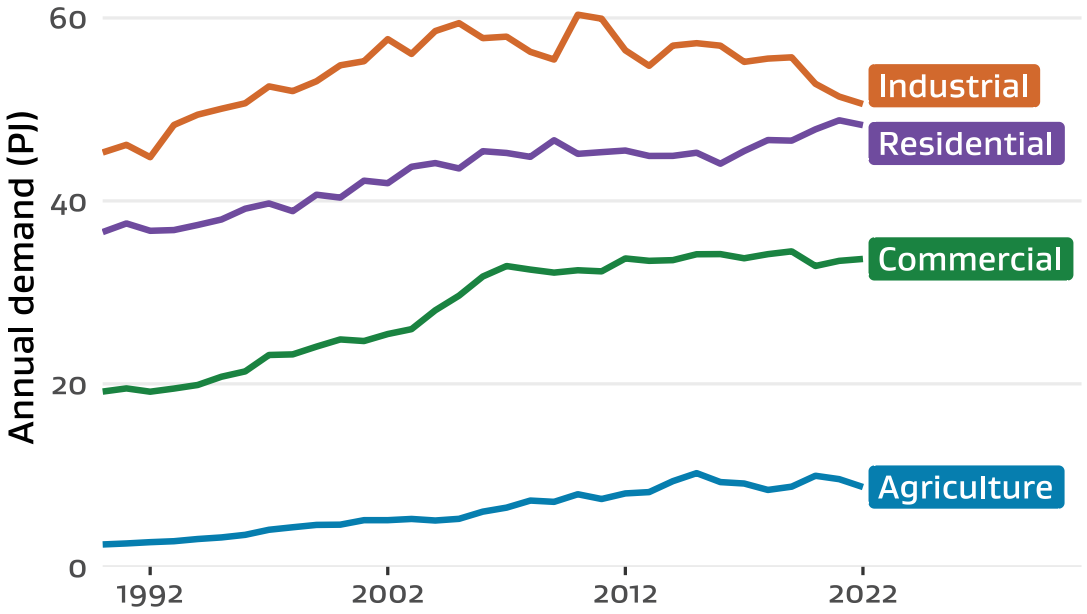
Electricity demand from residential and industrial sectors fell

Compared to 2021, electricity consumption slightly decreased by 1.3 per cent in 2022. This was driven by a decrease in demand from residential, industrial, and agriculture sectors. Demand from the food processing sector in 2022 increased by 5.7 per cent, however this increase was not enough to offset the decreases in demand from the chemicals and wood, pulp, and paper sectors.

Notable winter-like cold snaps carried on into spring, particularly during the early parts of both September and October. However, electricity demand from the residential sector decreased by 2.8 per cent in the third quarter of the year compared to the same period in 2021 (Figure C.3).

Compared to 2019, electricity demand dropped by 3.2 per cent in 2022.

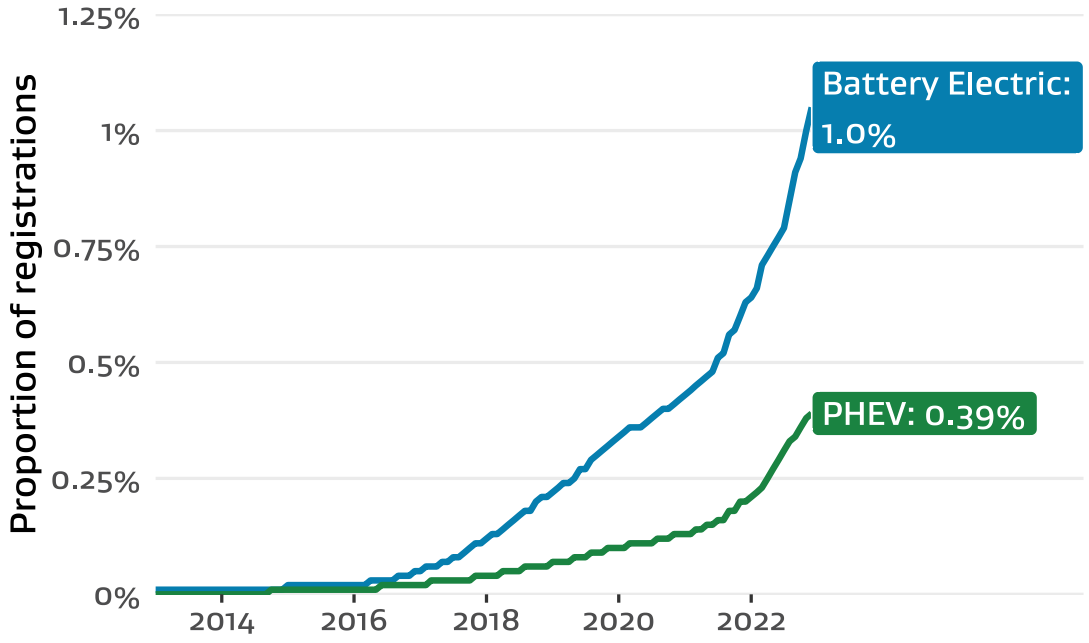
Figure C.3 Electricity consumption in New Zealand by sector, from 1990 to 2022



Charging electric vehicles will have an impact on the demand from the residential sector

Battery electric vehicles (BEVs) made up about 1.0 per cent of our total fleet at the end of 2022, doubling since mid-2021 (Figure C.4). In 2022, 20,896 BEVs were registered for the first time, twice as many as in 2021. The Government introduced the Clean Car Discount in 2021 to make low emission vehicles more affordable.

Figure C.4 Registrations of electric vehicles in New Zealand, from 2014 to 2022



A high rate of EV uptake will help increase the share of renewable transport energy consumption. EV owners typically charge their vehicles overnight when demand is low, making use of cheaper rates offered by many retailers for off-peak electricity consumption. EV charging can also be automated through technology like smart EV chargers. In addition, retailers can provide incentives that reward customers for allowing more flexibility over when EVs are charging. This enables increased charging when there is extra renewable generation, or reduces demand to avoid congestion of the local network.

The projected increase in demand of electricity for charging EVs will require more investment in New Zealand's electricity infrastructure for the generation, transmission, and distribution of electricity. However, the amount of investment in generation capacity and transmission could be moderated using smart EV chargers. Smart charging and overnight charging of EVs outside of peak times would not only reduce the cost for customers taking advantage of off-peak rates, but also decrease the burden on our electricity infrastructure.

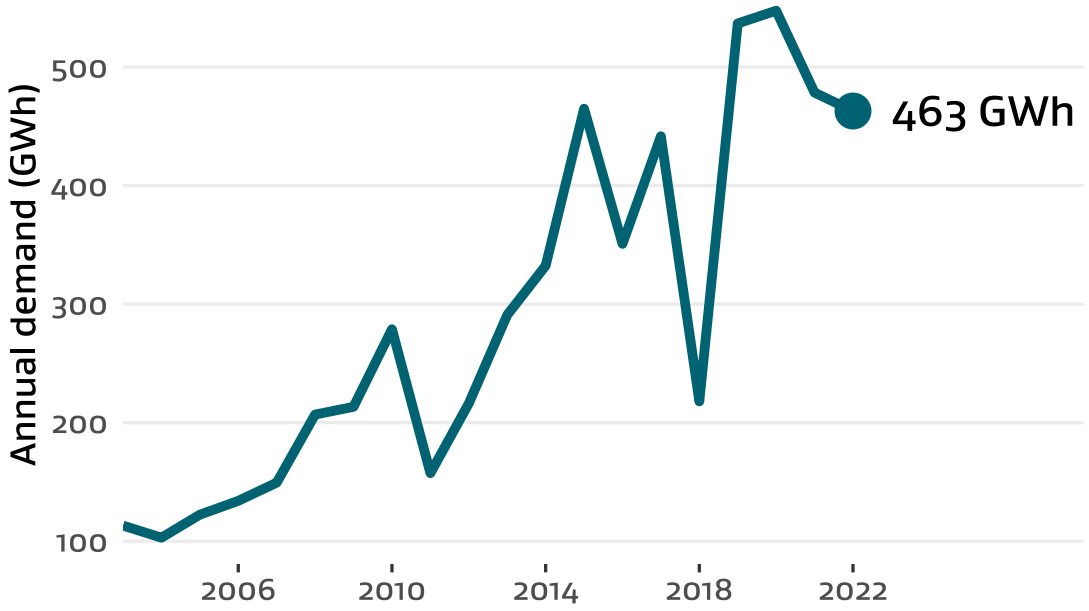
Electricity used for irrigation decreased because of higher soil moisture levels than average

Irrigation is a significant user of electricity, and the national irrigation load can make up 2–3 per cent of national demand during summer. As the weather warms between October and April each year in New Zealand, national household electricity demand decreases overall. However, in some agricultural regions the load increases during this time, as farmers compensate for lower rainfall with increased irrigation.

The La Niña phenomenon in 2022 brought higher soil moisture levels than usual across the country, particularly in key irrigation regions. This contributed to the decrease in electricity consumption from the agriculture, forestry and fishing sectors which fell by 6.8 per cent.

As a large portion of the country's irrigation load comes from the Canterbury region, Ashburton can be used as an indicator of the national irrigation load, see Figure C.5.

Figure C.5 Ashburton Grid Exit Point (GXP)[3] demand, from 2003 to 2022



The decreasing demand from the industrial sector was largely driven by wood and chemical processing

In 2022, the industrial sector's demand for electricity was 8.4 per cent lower than in 2019, and 1.3 per cent lower than in 2021. Electricity consumption fell by 29 per cent in the chemicals sectors and 12 per cent in the wood, pulp, and paper sector.

We can expect an increase in electricity demand from the commercial and industrial sectors in the future. The Energy Efficiency and Conservation Authority (EECA) announced its list of approved projects from round three of the Government Investment in Decarbonising Industry (GIDI) fund in April 2022. The GIDI fund is a multi-year programme to support businesses in the industrial and commercial sectors as they switch from fossil fuels to renewable energy sources. More information on the GIDI fund can be found in the Renewables chapter on page 31.

3 Grid Exit Points (GXP) are the points where electricity leaves the national grid operated by Transpower and enters the local distribution network

Box C.1

Electricity price regulations are being phased out

The Low Fixed Charge Tariff regulations are currently being phased out over a five-year period that began on 1 April 2022[A]. Under these regulations, the fixed charge for households was capped for low users. The fixed charge is on top of paying variable charges relating to the actual amount of electricity they use.

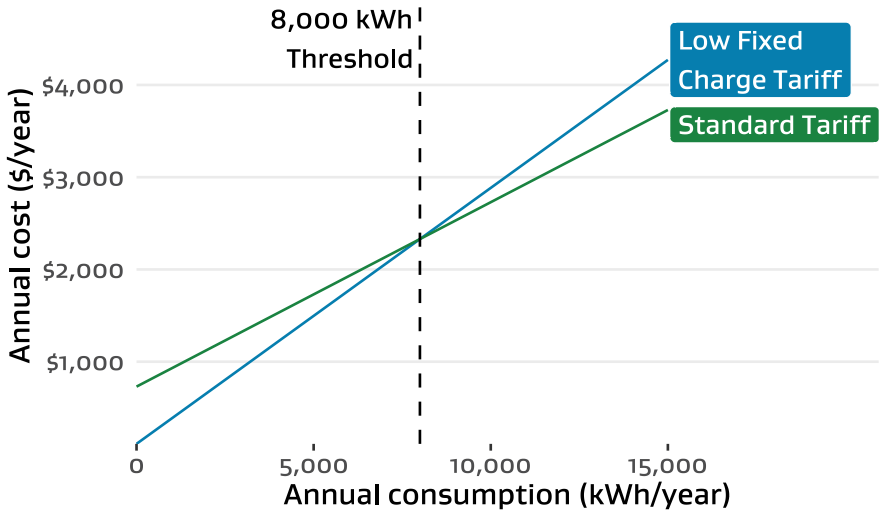
This cap is going to be gradually increased over five years before it is removed.

What were the regulations and why are they being removed?

These Low Fixed Charge Tariff regulations were introduced in 2004 to provide electricity plans with a discounted fixed charge aimed to reduce power bills for low-use, low-income households. However, as the regulations were poorly targeted, they have only helped some low-use households. The regulations have pushed others into greater energy hardship, including many low-income families with high electricity use, for example larger families.

Under the regulations, low users tended to pay more for each unit of electricity.

Figure C.6 The annual cost of electricity for Low Fixed Charge Tariff versus Standard Tariff. Costs are illustrative only



This higher rate could be up to 30 per cent more than high-use households paying the standard fixed charge. Low-income homes may choose to under-heat their homes to save on power bills, which can negatively affect their health and wellbeing.

The Low Fixed Charge Tariff regulations also created barriers for the industry to undertake distribution pricing reform. Removing the regulations will help electricity retailers introduce pricing plans, like Time of Use pricing, where households get cheaper rates if they can shift their power use away from peak periods. This has the potential to save households money while also reducing the need for expensive network upgrades that could see further costs passed onto households' bills.

A For more information about the phase-out of Low Fixed Charge Tariff regulations see https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-consultations-and-reviews/electricity-price/phasing-out-low-fixed-charge-tariff-regulations/

What are the expected impacts?

We are still uncertain over how power companies will choose to structure their pricing plans during the phase-out, and therefore what the impact on households will be. It may be that fixed charges rise and variable charges fall, meaning greater benefits for larger households that use more electricity.

Overall, we expect about 60 per cent of all households — about 970,000 households — will have lower power bills during the phase-out as the lower rate for electricity used will have a greater impact on their overall power bill. These households are likely to be those on standard-use plans and those on low-use plans using more than 6,500 kilowatt hours (kWh) a year.

Box C.1

The effects of Cyclones Dovi and Gabrielle on the electricity market

Cyclone Dovi and Cyclone Gabrielle brought a large amount of rain to the North Island in 2022 and 2023 respectively.

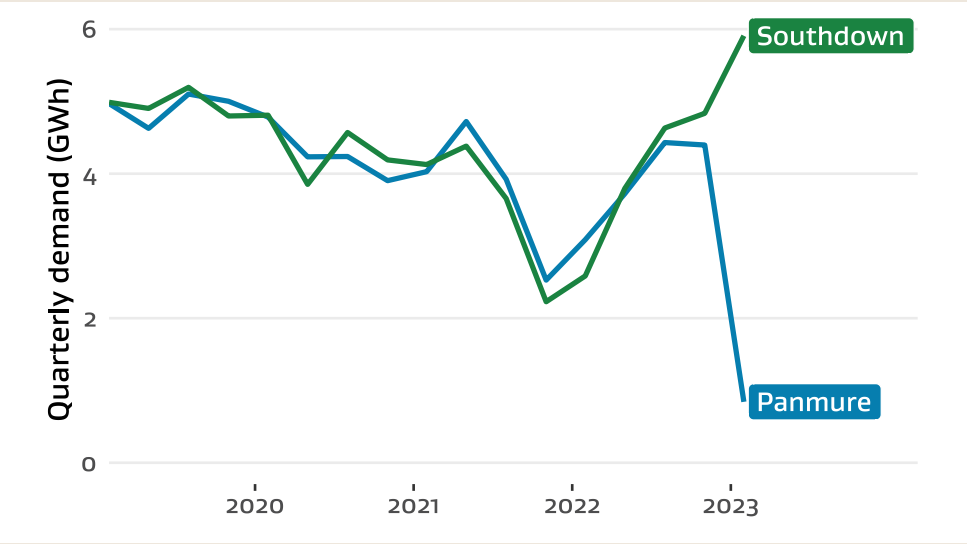
The week that Cyclone Dovi arrived in February 2022, hydro storage in the North Island increased by 29 per cent, bringing our national hydro storage to 93 per cent of full capacity. Lake Tekapo was operating above its maximum operating level, resulting in spill. Cyclone Dovi also brought strong winds to the country, which meant we required low levels of thermal and hydro generation.

Cyclone Gabrielle affected the country differently in February 2023. North Island hydro storage was not affected because the central North Island avoided the worst of the rain associated with the cyclone. National demand decreased by 4 per cent from the previous week, to 705 GWh. The reduction in demand was due to a significant number of power outages in the distribution networks because of the cyclone. Transpower issued a Grid Emergency Notice (GEN) when supply from the grid was cut to Hawke's Bay and Gisborne. Demand peaked at 5, MW at 17:30 on Monday evening, 13 February, before the Grid Emergency started.

Additionally, Cyclone Gabrielle brought significant challenges to energy security. The Redclyffe sub station in Napier was flooded, leaving households in the region disconnected from the national grid. The power cuts also led to the failure of communication infrastructure in the region.

The Auckland Panmure Grid Exit Point (GXP)[B] saw a decrease in electricity demand due to flooding, while Southdown GXP saw an increase. Both GXPs power Auckland's rail network, while Panmure GXP also powers the charging stations for Auckland EV buses. Pan Pac's Whirinaki plant was also flooded and shut down. At the time of writing, Pan Pac had yet to fully restore operations at the plant.

Figure C.7 Auckland metro GXP demand, from March 2019 to March 2023



B Grid Exit Points (GXP) are the points where electricity leaves the national grid operated by Transpower and enters the local distribution network

D. Renewables

The share of renewable energy in New Zealand's total energy consumption was at an all-time high in 2022. This was driven by strong renewable resources from hydro, geothermal, and wind energy production.

Around 30 per cent of New Zealand's total energy consumption comes from renewable sources. This is closer to 12 per cent for countries that belong to the Organisation for Economic Co-operation and Development (OECD). New Zealand's average share of renewable electricity production is over 80 per cent most years — much higher than the OECD average of around 30 per cent.

New Zealand's renewable energy consists of renewable energy for electricity generation and direct use. Renewable sources for electricity generation are geothermal, hydro, solar, and wind.

Renewable energy for direct use includes:

› geothermal energy used as heat for industrial applications

› woody biomass (such as black liquor)

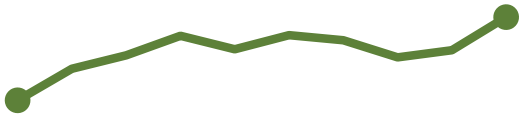
› liquid biofuels (such as sustainable aviation fuels)

› biogas (such as sludge gas and landfill gas).

Renewables

At a glance

Electricity generated from renewable sources



37.9 TWh

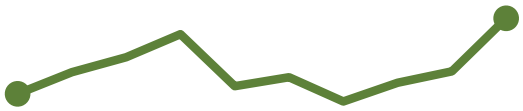
▲ 6.6% on 2021
▲ 4.5% on 2019

Total primary energy supply from renewable sources

363 PJ

▲ 1.7% on 2021
▲ 1.0% on 2019

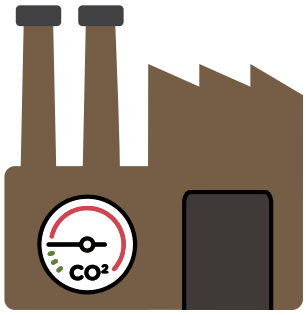
Share of total final energy consumption from renewable sources



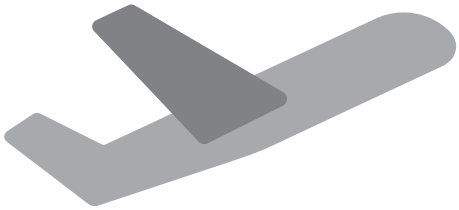
30%

▲ 1.8 pp on 2021
▲ 2.7 pp on 2019

The Government funded **13 projects** that could abate **900 kt of CO_2** in 2022



New Zealand has one of the **highest renewable electricity shares** in the world



NZ **imported its first sustainable jet fuel** in 2022, which is partially made of waste animal fat

New Zealand performs well for its production of renewable energy, but there is more work to do

New Zealand ranks well internationally for the proportion of energy produced by renewable sources. This is mainly driven by hydroelectric and geothermal resources. A little over 80 per cent of our electricity comes from renewable sources, and around 30 per cent of our total energy consumption is renewable.

The Government has committed to reaching net zero for long-lived gases by 2050. New Zealand also has a target that 50 per cent of total energy consumption will come from renewable sources by 2035, and an aspirational target of 100 per cent renewable electricity by 2030[4]. New Zealand will need to make changes to the way we produce and consume energy to meet these targets.

New Zealand has one of the highest shares of renewable electricity in the world

Electricity

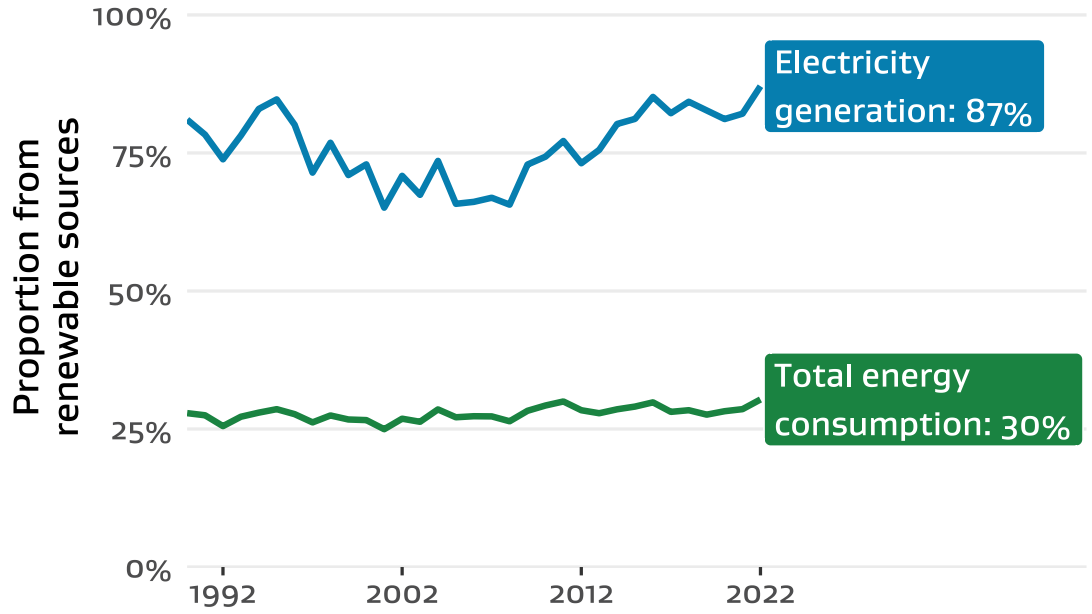
Over 80 per cent of Zealand's electricity supply is powered by renewable energy (Figure D.1). Our hydro and geothermal resources provide abundant electricity, but this means that our share of renewable electricity is heavily dependent on rainfall in any given year. New Zealand's hydro lakes are relatively shallow, so we are reliant on consistent inflows to support renewable electricity generation.

New Zealand's share of electricity generation from renewable sources is one of the highest in the world. Only a few countries such as Norway, Iceland, and Costa Rica have higher shares than New Zealand. In Australia it is below 40 per cent.

Direct renewable energy use

Only 30 per cent of New Zealand's total energy consumption comes from renewable sources (Figure D.1). Total energy consumption includes petrol and diesel used for transportation, and coal and natural gas used for industrial processes. The energy consumption of some of these sectors is hard to 'abate' or difficult to switch to renewable sources of energy. For example, high-heat industrial processes might require prohibitively costly heating to electrify[5]. Currently, several industrial and commercial processes make use of other renewable energy, particularly geothermal and woody biomass.

Figure D.1 Share of renewable electricity generation and total energy consumption in New Zealand, from 1990 to 2022[6]



4 For more information about the New Zealand Energy Strategy, see https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/new-zealand-energy-strategy/

5 Read more about the electrification of industry at https://www.iea.org/commentaries/frontier-electric-technologies-in-industry

6 Total final energy consumption (TFEC) is the energy consumed by end-users such as factories and households.

Box D.1

New Zealand's direct use of renewable energy

Geothermal energy

Geothermal energy is extracted from heat deep beneath the earth's surface. New Zealand is particularly rich in geothermal energy, especially in the Taupō and Kawerau regions. Geothermal energy has been used in New Zealand for hundreds of years — first by Māori and then by European settlers and tourists. Since the 1950s, geothermal energy has been used increasingly as direct energy for uses such as heating homes or generating electricity. Kawerau, where geothermal steam is a significant source of energy for pulp and paper mills, is among the world's largest user of direct geothermal heat concentrated in one location.

Geothermal energy is often used for electricity generation. However, it's estimated that around 7.30 petajoules (PJ) of geothermal steam was used for direct heat in 2022. These uses include drying paper or milk in industrial processes, or in residential or commercial heating, such as the heated pools in Rotorua. Just under 60 per cent of this was in industrial applications, 33 per cent in commercial and the remainder in residential and agricultural applications.

Other examples of the direct use of geothermal energy in New Zealand include:

- timber drying — Tenon's wood processing plant near Taupō uses geothermal energy to heat its timber-drying kilns
- aquaculture and tourism — the Huka Prawn Park near Taupō is the only geothermally heated prawn farm in the world. Heated discharge water from the nearby Wairakei geothermal power station helps heat the ponds
- horticulture — the use of geothermal energy to heat the glasshouses of Rotorua-based PlentyFlora and Taupō-based Gourmet Mōkai has reduced the production costs for flowers (PlentyFlora) and tomatoes/capsicums (Gourmet Mōkai)
- milk drying — the Māori-owned dairy company (Miraka) based near Taupō is the first milk drying facility in the world to use geothermal energy
- space heating — Rotorua Hospital uses geothermal energy via a heat exchanger for space heating and hot water heating. The system, commissioned in 1977, has proven to be a very reliable source of energy.

Woody biomass

Pulp and paper mills and wood processors use the majority of woody biomass (around 40 PJ) to provide heat energy and generate electricity (cogeneration). Households use a smaller quantity, estimated at 7.44 PJ, for space heating. Current estimates for the use of wood for residential space heating are based on census data for the proportion of households that use wood burners, and the Household Energy End-use Project (HEEP). HEEP surveyed household energy use from 1995 to 2005 . At the time of writing, an updated HEEP study is underway which will provide further insight into New Zealand's residential use of woody biomass energy[C].

C For more information about HEEP, see https://www.branz.co.nz/environment-zero-carbon-research/heep2/

Black liquor

Black liquor is a dark liquid generated during the paper-making process. Throughout the wood pulping process, chemicals are added to help separate the fibres from the lignin, which acts as a binder holding the fibres together. This resulting combination of chemicals, lignin, and wood fibres is a dark, viscous liquid known as black liquor.

Rather than being discarded, this black liquor is utilised as a valuable energy source at several industrial sites in New Zealand. The organic materials can be incinerated to generate heat and steam, reducing the mill's reliance on external energy sources.

Liquid biofuels

Liquid biofuels are renewable, low-emission fuels that can be blended with petrol and diesel to reduce greenhouse gas emissions from transport. They are also less dependent on new vehicles (for example, electric vehicles or hydrogen fuel cell vehicles) because they can be used in existing internal combustion engine (ICE) vehicles.

Currently, the use of biofuels in New Zealand is very low and domestic production is limited. New Zealand uses very little biofuels in transport and our use is not increasing. Biofuels currently cost more than fossil fuels.

Sustainable aviation fuels

Sustainable aviation fuel (SAF) is a type of jet fuel produced from renewable feedstocks, such as vegetable oil or animal fat. It is very similar to traditional fossil jet fuel in its chemical composition and is generally blended with traditional fuel to reduce the emissions of aviation transport. New Zealand does not currently produce SAF. Air New Zealand imported the first 1.2 million litres of SAF in September 2022.

Biogas

Originating from a variety of non-fossil sources, such as wastewater and sewage, biogas is primarily a mixture of methane and carbon dioxide which is combusted to produce heat and/or electricity.

Sludge Gas

Sludge gas is derived from the anaerobic fermentation of biomass and solid wastes from sewage. In New Zealand, Fonterra produces sludge gas at the Tīrau dairy processing facility in Waikato using cattle effluent. The sludge gas provides heat for the seasonal milk-processing facility, open from September through to December each year. Sludge gas is also produced at several municipal wastewater treatment plants around the country, where it is used to generate electricity.

Landfill gas

Landfill gas is derived from the anaerobic fermentation of biomass and other organic solid wastes in landfills. About a dozen sites around the country collect landfill gas and use internal combustion engines to produce electricity.

New Zealand is working to increase supply and use of renewable energy

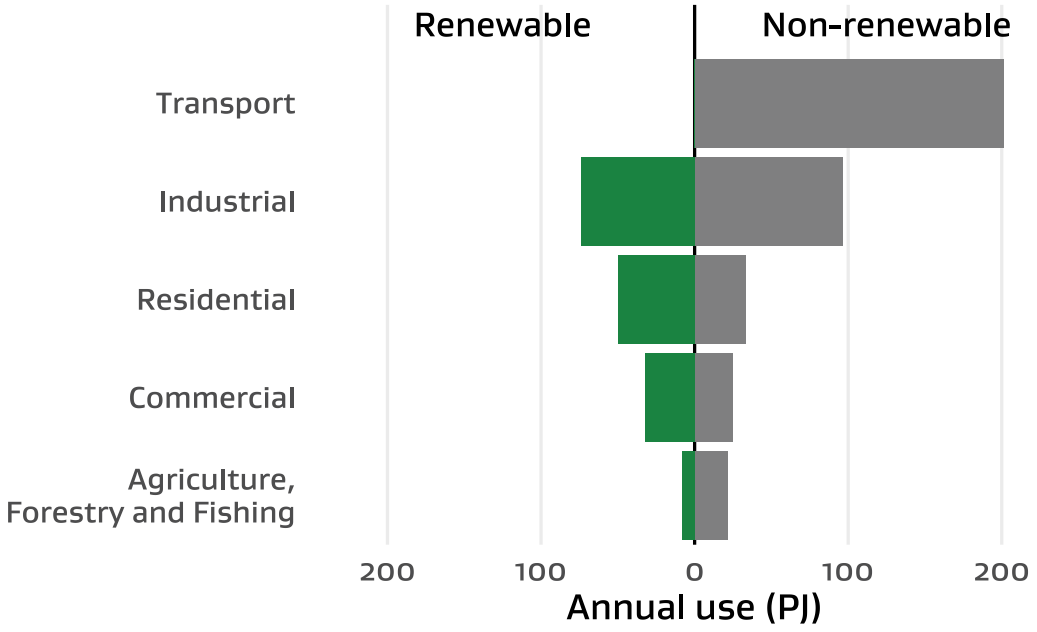
The Government's aspirational goal is for New Zealand to reach 100 per cent renewable electricity generation by 2030. This will require dealing with the 'dry year problem' — how we generate clean electricity when inflows for hydroelectric generation are insufficient. This may involve investing in solutions to better store electricity when it is plentiful and allow for more generation when lake levels are low.

Under the umbrella of the Energy Strategy, the Government will look at the roles of hydrogen, gas, and offshore wind in achieving our transition to the 100 per cent target. Further work will consider what, if any, additional support measures might be needed in the electricity market to help New Zealand achieve its targets for renewable energy and emissions reduction.

Different solutions are needed to increase our renewable energy consumption across sectors

New Zealand's energy consumption from non-renewable sources is currently 70 per cent. The transport and industrial sectors are most reliant on non-renewable energy sources (Figure D.2). To reach 50 per cent renewable energy consumption, we need to move some of this industrial or transport energy use towards renewable energy, such as biomass or liquid biofuels, or direct electrification. Most processes have very different needs, so the most cost-effective solution is likely to be different for each application.

Figure D.2 Energy consumption by sector in 2022



The Government has several programmes intended to assist with our renewable energy targets. The Government Investment in Decarbonising Industry (GIDI) fund supports industry to move from fossil fuels to cleaner renewable options, while the NZ Battery Project aims to identify a solution to New Zealand's dry year problem. More information about GIDI is included in Box D.2.

The industrial sector's use of energy

Industrial energy use often involves process heat, where businesses require high temperatures to run industrial processes, such as pulping wood into paper or creating milk powder. Many of these processes can be hard to decarbonise because not all fuels can reach the same levels of heat. For example, coal is considered to be a cost-effective way for the dairy industry to produce the necessary heat for their processes.

Box D.2

The Government Investment in Decarbonising Industry (GIDI) fund

The Energy Efficiency and Conservation Authority (EECA) announced its list of approved projects from round three of the GIDI fund in April 2022. The GIDI fund is a multi-year programme to support businesses as they carry out energy efficiency measures and switch from fossil fuels to renewable energy sources in industrial and commercial sectors[D]. The 2022 funding round was made up of 13 projects with the potential to abate over 900 kilotonnes of carbon dioxide. This is the equivalent of taking 14,000 cars off the road. Projects include high temperature heat pumps, replacing coal with biomass, and heat recovery systems.

This funding round built on the two rounds of funding announced in 2021, which included:

- a total of over $55 million dollars in Government co-investment projected to abate 6.5 million tonnes of lifetime emissions through energy efficiency initiatives
- the replacement of fossil fuel boilers with wood pellet boilers
- the installation of high temperature heat pumps for process heat purposes.

In May 2022, the New Zealand Government announced that this fund, originally $69 million dollars, would be expanded to $650 million over four years. The scope of the fund is also expanding to cover regionally targeted decarbonisation plans, network upgrades, and streamlined processes for smaller projects.

Further projects were announced in early 2023, including a major upgrade to electrify coal-heavy process for New Zealand Steel, saving 800 kilotonnes of emissions a year.

D For more information about GIDI, see https://www.eeca.govt.nz/co-funding/industry-decarbonisation/about-the-government-investment-in-decarbonising-industry-fund/

The transport sector's use of energy

Electric vehicle (EV) registrations are currently at an all-time high, and the rate of new registrations is increasing. More New Zealanders are buying EVs. BEVs made up about 6 per cent of all new car registrations during 2022. The total number of BEVs in the fleet doubled between mid-2021 and the end of 2022. The Electricity chapter (page 19) has more information about EVs.

Other renewable energy options for transport include liquid biofuels, such as sustainable aviation fuel, or hydrogen fuel cells.

In 2022, domestic aviation accounted for 5.4 per cent of all New Zealand's oil consumption, and the vast majority of this is non-renewable consumption. Aviation is a challenging industry to decarbonise — electric or hydrogen-based aviation fuel alternatives are not feasible for long-haul flights in the short to medium term.

Sustainable aviation fuel (SAF) is a type of jet fuel produced from renewable feedstocks, such as vegetable oil or animal fat. It is very similar to traditional fossil jet fuel in its chemical composition. SAFs emit up to 80 per cent less carbon than the fuels they replace, depending on the feedstocks used or production method. The current cost of SAF is prohibitive — around ten times that of traditional, fossil-based fuels. It's estimated that it would take the fat of 753 pigs to fuel a flight from Auckland to Christchurch[7].

7 Derived from Cerulogy's estimations for Transport & Environment. Cerulogy estimated that approximately 0.7 kg of category 1 and 2 fats and 6.8 kg of category 3 fats can be recuperated from one dead pig. The number of animals required per flight is then derived from the average HEFA conversion factor (0.76 kg of fuel per kg of fat, from Biograce) and the average fuel consumption of such flights (4.29 tonnes of fuel per flight between AKL and CHC, according to ICAO's emissions calculator)

E. Natural Gas

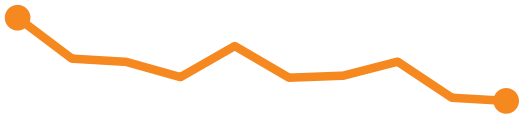
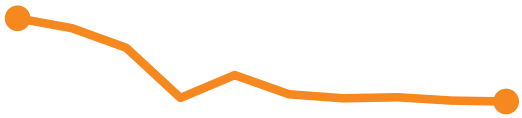
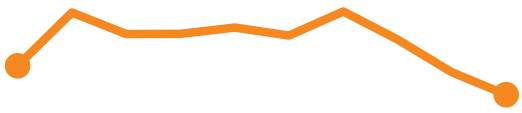
New Zealand's natural gas fields are concentrated around and off the coast of the Taranaki region. All natural gas produced in New Zealand is used in New Zealand.

The largest user of natural gas in New Zealand is Methanex, which uses natural gas to produce methanol. While some large users have direct connections to natural gas fields, most users draw natural gas from a network of pipes maintained by Firstgas. As this network does not extend to the South Island, natural gas is exclusively used in the North Island.

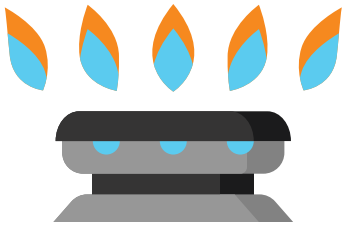
A subsidiary of Firstgas, Flex Gas, operates the New Zealand's only natural gas storage facility at Ahuroa.

Natural Gas

At a glance

Net indigenous production	
	**143 PJ** ▼ 9.1% on 2021 ▼ 22% on 2019
Natural gas used for electricity generation	
	**29.6 PJ** ▼ 3.0% on 2021 ▼ 20% on 2019
Natural gas used for cogeneration	
	**12.4 PJ** ▼ 0.39% on 2021 ▼ 1.4% on 2019
Non-energy use	
	**35.3 PJ** ▼ 6.8% on 2021 ▼ 31% on 2019
Consumption	
	**63.2 PJ** ▼ 8.2% on 2021 ▼ 25% on 2019

5%



Residential consumption makes up **5%** of natural gas use

Natural gas **production** is expected to **peak in 2024**

There has been a **17% decrease** in **Proven plus Probable reserves** (2P)

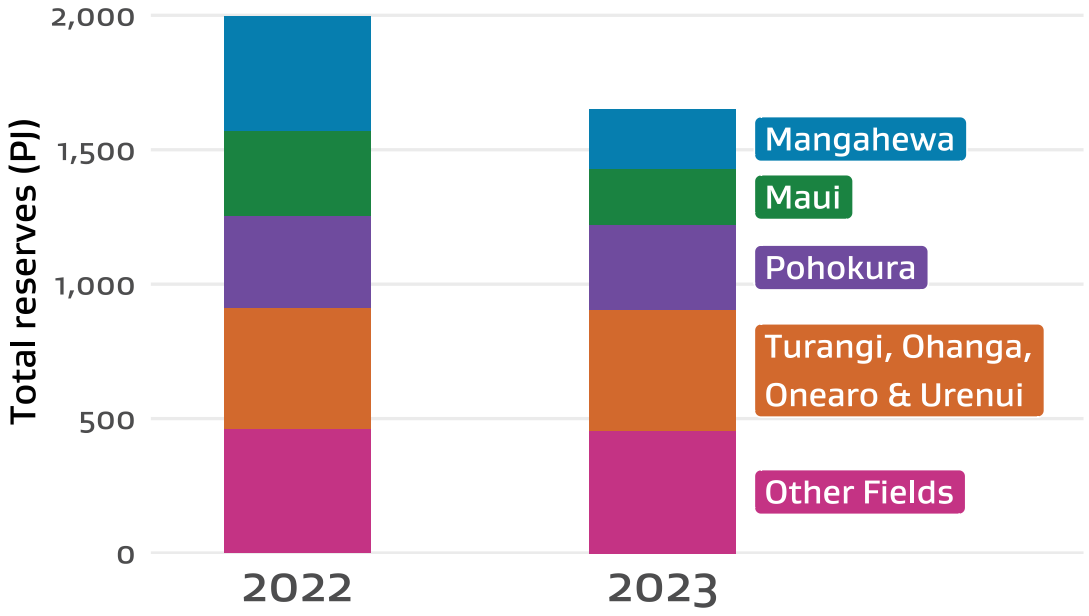
Less natural gas is available to produce than previously thought

Proven plus Probable (2P) reserves represent the amount of natural gas that field operators expect to extract from the ground based on current technological and economic conditions.

Total 2P Reserves were revised down by 332 petajoules (PJ) (17 per cent) between January 2022 and January 2023 (Figure E.1). Most of these revisions occurred at the Mangahewa field (down 205 PJ or 48 per cent) and the Maui field (down 106 PJ or 34 per cent).

There was 143 PJ of natural gas produced in 2022. This means that 43 per cent of the change in reserves was due to natural gas being extracted in 2022 and 57 per cent of the change was a result of fields revising how much natural gas there was in the field.

Figure E.1 2P Remaining Reserves by major field, 2022 versus 2023

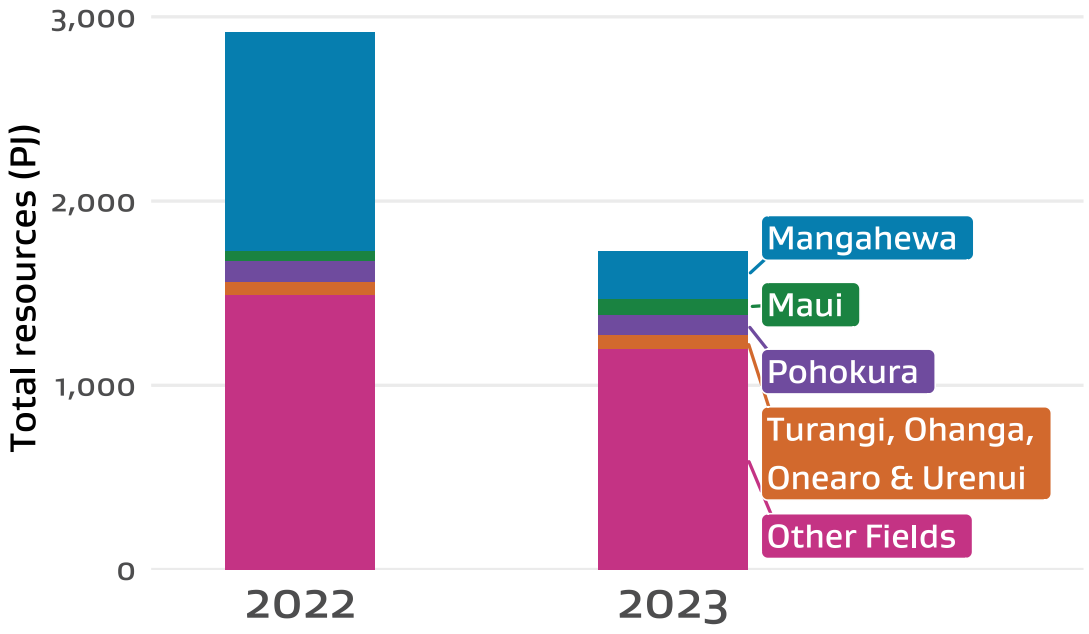


Contingent Resources (2C) provide estimates of quantities of natural gas in a field that may be extracted, but only under different economic or technological conditions to what we have today. It is likely that producers will extract some contingent resources in future, but not all.

2C Contingent Resources have decreased by 1,188 PJ (41 per cent) between January 2022 and January 2023 (Figure E.2). This drop came almost entirely from the Mangahewa field (down 930 PJ or 78 per cent) and Kapuni field (down 294 PJ or 36 per cent). The largest increase in 2C Contingent Resources came from the Maui field, which increased 35 PJ (up 70 per cent).

This shows that the drop in natural gas reserves is not only because producers are less sure that they can economically extract the natural gas in their fields, but also because they believe there is less natural gas available in those fields.

Figure E.2 2C Contingent Resources by major field, 2022 versus 2023



Our use of natural gas will need to decline in coming years

Natural gas use fell in 2022 due to the closure of the Marsden Point Oil Refinery in March 2022 and Methanex mothballing its Waitara Valley facility in 2021. Chemical use (including non-energy use) fell by 4.77 PJ (7.5 per cent) between 2021 and 2022 , and has fallen 26.6 PJ (31 per cent) since 2019.

In the past, the largest use of natural gas in New Zealand has been for chemical production such as producing methanol and urea, and refining oil (Table E.1). Other major users of natural gas in recent years are the food processing and electricity generation sectors.

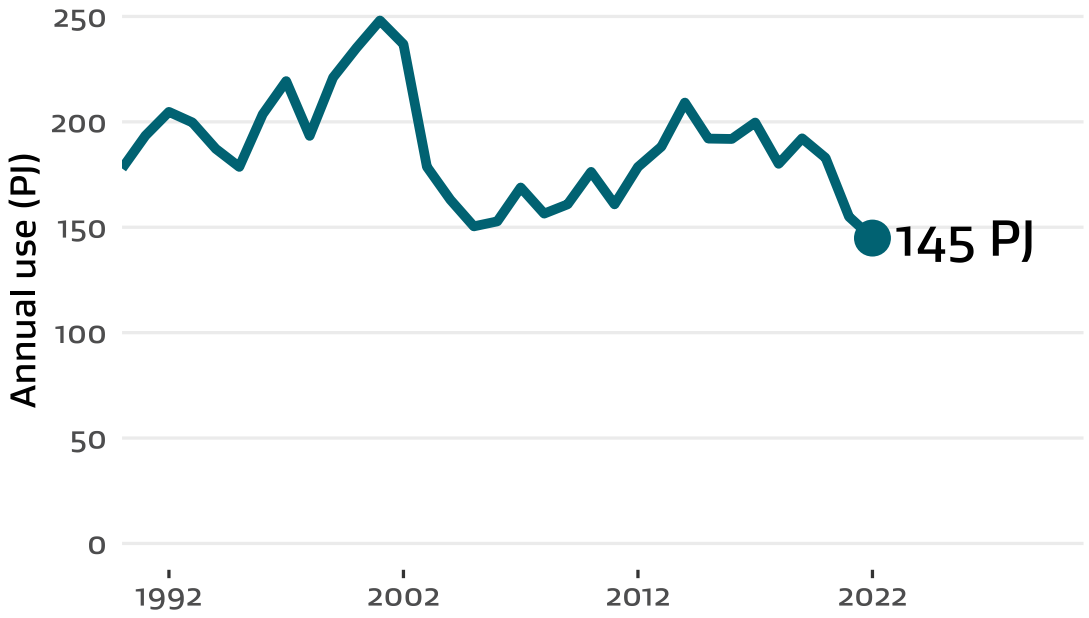
Table E.1 Natural gas use by sector, from 2018 to 2022 (petajoules a year (PJ/year))

Sector	2018	2019	2020	2021	2022
Chemical production (including non-energy use)	77.0	85.6	77.8	63.8	59.0
Electricity generation (including cogeneration)	49.2	49.6	53.7	42.9	41.9
Food processing	18.3	21.7	19.7	19.4	17.2
Other consumption	21.0	21.1	18.7	16.3	15.4
Residential	6.78	6.83	7.20	7.19	6.79

A common method used to understand the amount of natural gas left in New Zealand is to compare the total amount remaining to the amount used in a typical year. This gives us an estimate of how many years we could keep using natural gas at our present rate.

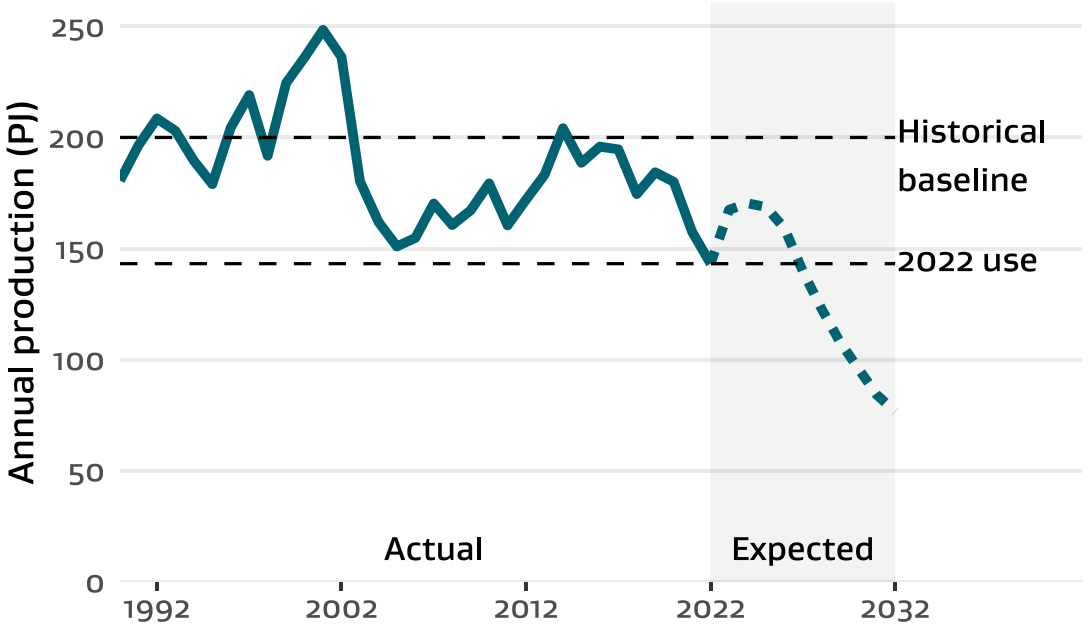
In the past, the baseline for a 'typical year' of usage has been 200 PJ a year. But this figure does not reflect current market conditions. The last year when total annual usage was more than 200 PJ was 2014 (Figure E.3).

Figure E.3 New Zealand's total annual usage of natural gas, from 2013 to 2022



Alternatively, we could look at the remaining natural gas is to compare current use with expected future production year-by-year (Figure E.4).

Figure E.4 Actual and expected natural gas production in New Zealand, from 1990 to 2032



Based on reporting by natural gas producers, New Zealand's annual production from 2P Reserves is expected to peak at 170 PJ in 2024. It is then expected to start a sustained decline, falling below our total use in 2022 of 145 PJ by 2027, and decreasing to 77 PJ by 2032. These production profiles do not include any additions that may come from 2C Contingent Resources that producers may decide to extract.

New Zealand will need to invest in natural gas producing reserves and upgrading existing resources at natural gas fields to sustain current levels of use. Alternatively natural gas use may be reduced by replacing natural gas with electricity or renewable alternatives.

The Government is working to develop a Gas Transition Plan to support the gas industry to reduce emissions in such a way that ensures energy remains accessible, reliable and affordable to New Zealanders[8].

8 For more information about the Gas Transition Plan, see https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/gas-transition-plan/

F. Oil

‘Oil’ is a term that covers a wide range of different products. These include:

› crude oil extracted from oil fields

› refined fuels like petrol and diesel

› more unusual products like bitumen which is used as a construction material rather than a fuel.

Up until March 2022, New Zealand’s supply of refined fuels (petrol, diesel and jet fuel) was made up of a mix of imported fuel and fuel produced at the Marsden Point Oil Refinery. Five companies import fuel for sale in New Zealand: Z Energy, BP, Mobil, Gull, and Tasman Fuels.

New Zealand’s crude oil fields are concentrated around Taranaki, either within Taranaki itself, or offshore.

The country’s only oil refinery at Marsden Point stopped refining operations on 31 March 2022, transitioning to operating as a dedicated fuel import terminal. It is important to note that the Marsden Point Oil Refinery was not suited to refining domestically produced crude oil, so both before and after this change nearly all crude oil produced in New Zealand has been exported.

Oil

At a glance

Net indigenous production

1,244 ML

▼ 8.9% on 2021
▼ 29% on 2019

Imports

8,354 ML

▲ 6.0% on 2021
▼ 12% on 2019

Exports

1,329 ML

▲ 30% on 2021
▼ 13% on 2019

International transport

735 ML

▲ 50% on 2021
▼ 61% on 2019

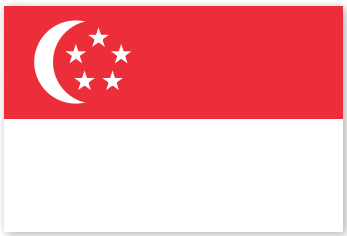
Consumption

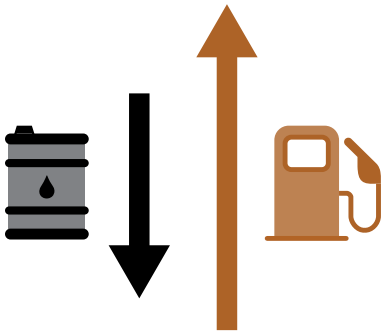
7,564 ML

▲ 1.3% on 2021
▼ 3.7% on 2019

The **Marsden Point Oil Refinery closed** on 31 March 2022

We now **import most** of our oil products from **Singapore**





Crude imports fell 100%, while **refined product imports increased** 159%

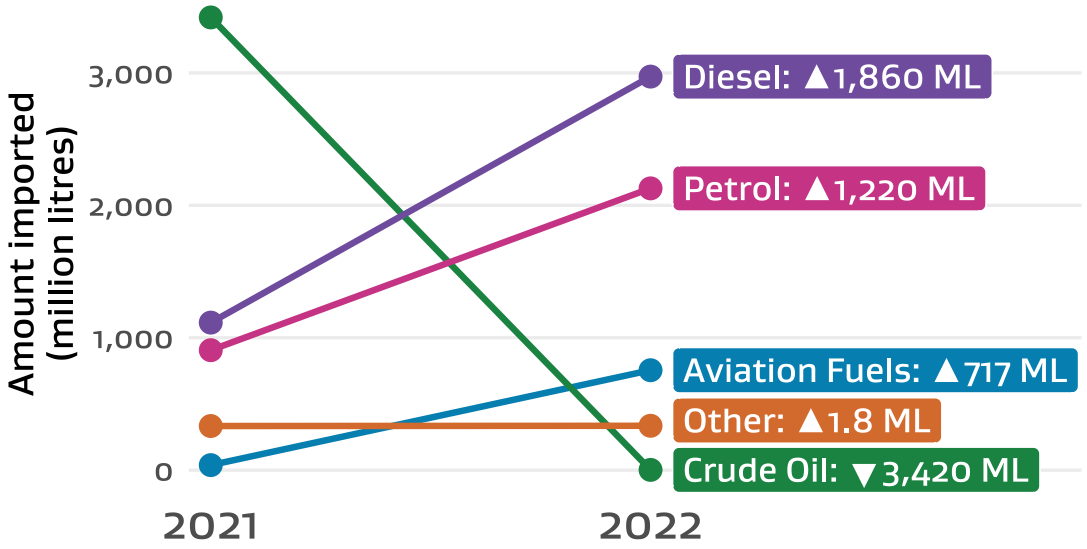
Under the proposed Fuel Industry Amendment Bill, fuel importers would **hold 24 days' use of jet fuel**

Closing the refinery changed has changed the mix of oil imports

On 31 March 2022, Channel Infrastructure (formerly Refining New Zealand) closed the Marsden Point Oil Refinery, New Zealand's only oil refinery. Since the start of April 2022, New Zealand has relied exclusively on imported oil products to meet its liquid fuel needs, apart from liquefied petroleum gas (LPG) which is condensed from locally produced natural gas.

To analyse the effects of closing the refinery on New Zealand's oil industry, we have compared the amount of oil products that were imported in the last 9 months of 2022 (referred to as "late 2022") to the amount imported in the last 9 months of 2021 (referred to as "late 2021") (Figure F.1). We have considered the timeframes between April and December 2022 (the part of 2022 after the refinery was closed), and between April and December 2021 (the same period in the previous year).

Figure F.1 Amount of oil imported during the final three quarters in 2021 versus the final three quarters in 2022, by product



'Crude Oil' includes blendstocks.
'Other' includes fuel oil, LPG, blendstocks, and other petroleum products.

While the amount of imported refined products increased by 3,798 million litres (ML) (159 per cent) in late 2022 compared to late 2021, the amount of imported crude oil and refinery blendstocks fell by 3,417 ML (100 per cent). In late 2022, New Zealand's total imported oil increased by 381 ML (6.6 per cent) and our total usage increased by 295 ML (4.8 per cent) compared to late 2021. This means that our total imported oil largely tracked our total usage, even though the refinery had closed.

Singapore is now our main source of oil products

The change in the type of oil products we need means that we have changed where we import them from. In late 2022, we imported most of our oil products from:

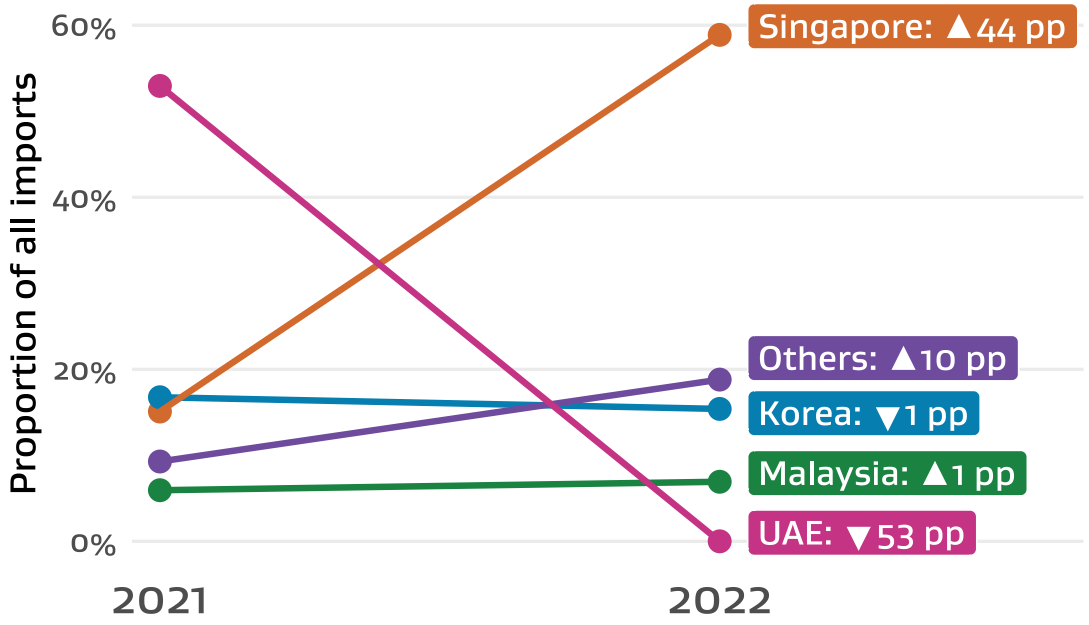
› Singapore (59 per cent)

› South Korea (15 per cent)

› Malaysia (7 per cent).

This is in comparison to late 2021 where the main sources were the United Arab Emirates (53 per cent), South Korea (17 per cent), and Singapore (15 per cent) (Figure F.2). Driving this change has been the stoppage of crude oil imports, of which the United Arab Emirates was a major source.

Figure F.2 New Zealand's imported oil during the final three quarters in 2021 versus the final three quarters in 2022, by country of origin



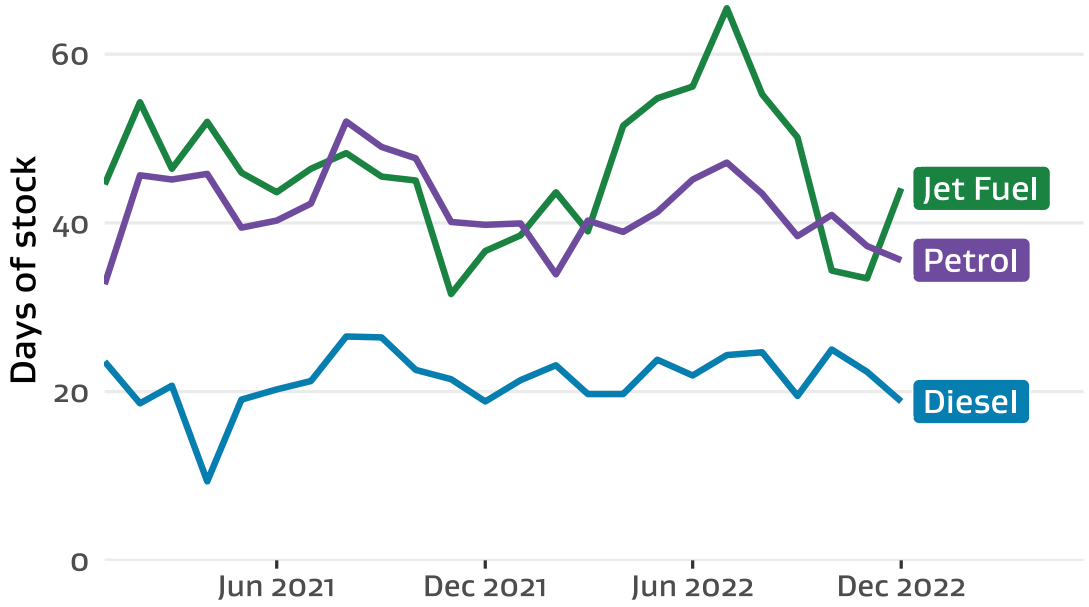
One difficulty with importing more refined products is that it is less clear where our oil originates. We can only see which country the product was imported from, not which countries they originally received the crude oil from.

Stockholding is more important than ever

Just as closing the refinery changed how we import oil products, it also has implications for how we hold oil stocks. In late 2021 we held 25 per cent of our in-country stock of oil as crude oil. By late 2022 that had fallen to 12 per cent, and it will likely fall further in future as we decommission the former refinery and remove any of the remaining crude oil.

As a member country of the International Energy Agency, New Zealand maintains oil stocks that are equivalent to at least 90 days of net imported oil. This stockholding enables New Zealand to play its part in collective oil security through the release of reserve oil stocks to moderate the impact of a global oil supply disruption. The formula to determine the days of net imported oil counts all oil and stocks of refined oil products, and includes stock held overseas under reserve stock contracts known as 'stock tickets'. The formula measures those stocks in terms of New Zealand's oil imports minus oil exports (from domestic crude production).

Figure F.3 Petrol, diesel, and jet fuel stock levels by month and fuel, from 2021 to 2022



Comparing domestic stocks with the average daily consumption provides an alternative stockholding indicator that is more reflective of domestic fuel supply security. Stocks of jet fuel and petrol rose after the refinery closed at the end of March 2022 (Figure F.3). Stocks of jet fuel peaked at 65 days, and diesel stocks peaked at the end of 25 days in July 2022. Stocks of both fuels declined over 2022 to levels similar to the start of 2022.

Box F.1

Fuel prices have been driven up by Russian invasion of Ukraine

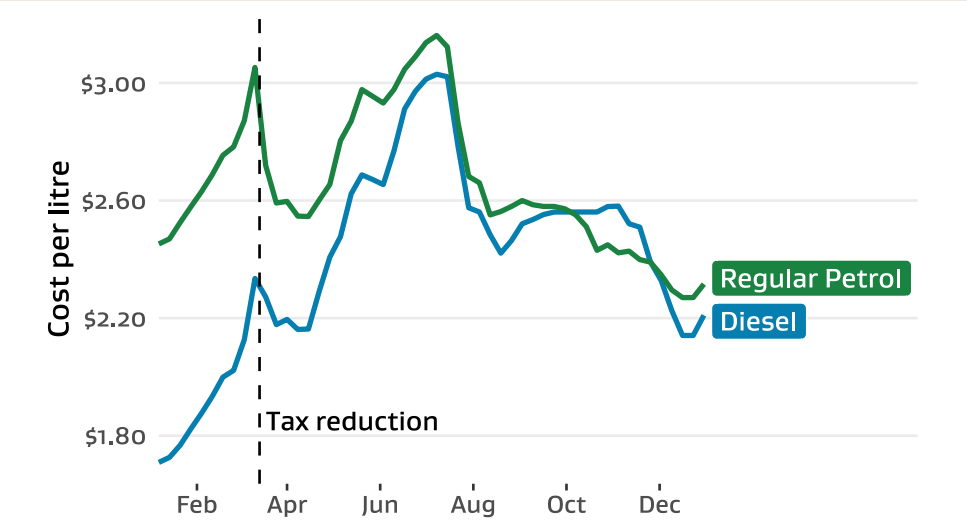
On 28 February 2022, Russia invaded Ukraine. To exert pressure on Russia to change its course of action, many countries around the world placed sanctions on major Russian exports, such as oil and diesel. Countries that previously relied on Russian oil products began looking for new sources, putting pressure on global supply.

At the same time, global refining capacity was under pressure. The years of slow economic growth and uncertainty caused by the coronavirus (COVID-19) pandemic meant that countries had reduced their investment in and maintenance of oil refining. The 'refining margin' — the difference in cost between crude oil and finished products, like diesel or petrol — was also increasing.

This was especially true for diesel. Russia once exported significant quantities of diesel to the European Union (EU). In 2022, the EU was looking for other sources, including products from as far east as Singapore or South Korea, directly competing with New Zealand importers.

While supply was tightening, there was also uncertainty in demand, as global economies started recovering from the impacts of COVID-19. This all contributed to driving up prices — average prices for Regular 91 leapt above $3 a litre. In response, the Government temporarily cut excise taxes on petrol by 25 cents a litre (plus GST) on 14 March, and temporarily reduced Road User Charges for diesel users. This had an immediate effect, but the impacts of the invasion and supply uncertainty lasted for most of the year. This was such an unusual year for the global market that diesel prices even overtook petrol in New Zealand.

Figure F.4 Fuel prices in 2022



Towards the end of 2022, demand for oil was falling due to slowing economic growth and COVID-19 lockdowns in China. At the same time, global supply chains were adjusting. Russian oil and oil products found new export countries, such as Brazil, Turkey, India, or China — albeit often at heavily discounted prices, under heavy sanctions and price caps. Prices began to fall towards levels last seen before the invasion. In New Zealand, the temporary tax reduction was reversed on 1 July 2023.

Box F.2

New Zealand's fuel supply resilience is being improved

In November 2022, the Government announced a fuel resilience policy package after considering the implications of the refinery's closure, the changing geopolitical environment, and the role of the energy sector in the transition to a low carbon economy.

The main components of the policy package include:

- introducing a minimum fuel stockholding obligation on fuel importers that have the right to draw fuel from bulk storage facilities
- investigating financial and contractual options for government procurement of services for holding at least 70 million litres of reserve diesel stock in New Zealand (roughly equivalent to seven days of New Zealand's diesel consumption).

The Fuel Industry (Improving Fuel Resilience) Amendment Bill, which will provide the statutory framework for the minimum fuel stockholding obligation[E], was introduced in June 2023.

The proposed minimum stockholding level that fuel importers will have to meet will be an average of:

- 28 days' use of petrol
- 24 days' use of jet fuel
- 21 days' use of diesel.

E For more information about the minimum stockholding obligation, see https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-generation-and-markets/liquid-fuel-market/fuel-security-in-new-zealand/minimum-stockholding-obligation/

G. Coal

New Zealand has extensive coal resources. Our estimated in-ground resources are over 15 billion tonnes, although 80 per cent 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.

New Zealand's coal industry can be divided into three distinct geological areas.

1. In the North Island, coal production is centred in the Waikato region where large coalfields like Maramarua and Rotowaro produce sub-bituminous coal. This coal is excellent for heating and electricity generation, although its quality is generally not high enough for it to be used in the production of iron and steel. The main consumers of this coal are Genesis' Huntly Power Station and the Glenbrook steel mill. Unlike most steel mills around the world, the Glenbrook mill can use sub-bituminous coal due to the unique processes used at the facility.

2. Coal extracted on the West Coast of the South Island is mostly bituminous coal, along with some sub-bituminous. The bituminous coal is generally exported for steelmaking.

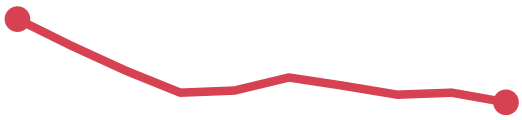
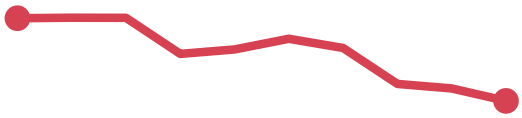
3. The rest of the South Island tends to produce either sub-bituminous coal, or the even lower-energy lignite.

Fourteen mines were operating in New Zealand at the end of 2022 compared to 18 at the end of 2020. Most of the imported coal is sub-bituminous coal, used for electricity generation and steel production[9].

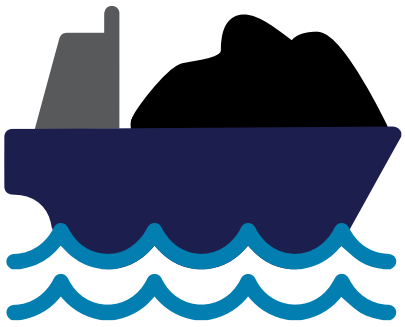
9 Additional background information on New Zealand's coal industry is available on the New Zealand Petroleum & Minerals website, https://www.nzpam.govt.nz/our-industry/nz-minerals/minerals-data/coal/

Coal

At a glance

Production	
	**2,637 kt** ▼ 8.0% on 2021 ▼ 13% on 2019
Consumption	
	**992 kt** ▼ 4.0% on 2021 ▼ 15% on 2019
Imports	
	**727 kt** ▼ 61% on 2021 ▼ 32% on 2019
Exports	
	**1,278 kt** ▲ 2.7% on 2021 ▼ 12% on 2019

Coal **use fell by over 30%** in 2022



New Zealand is a **net exporter of coal** again, after becoming an importer for the first time in 2021

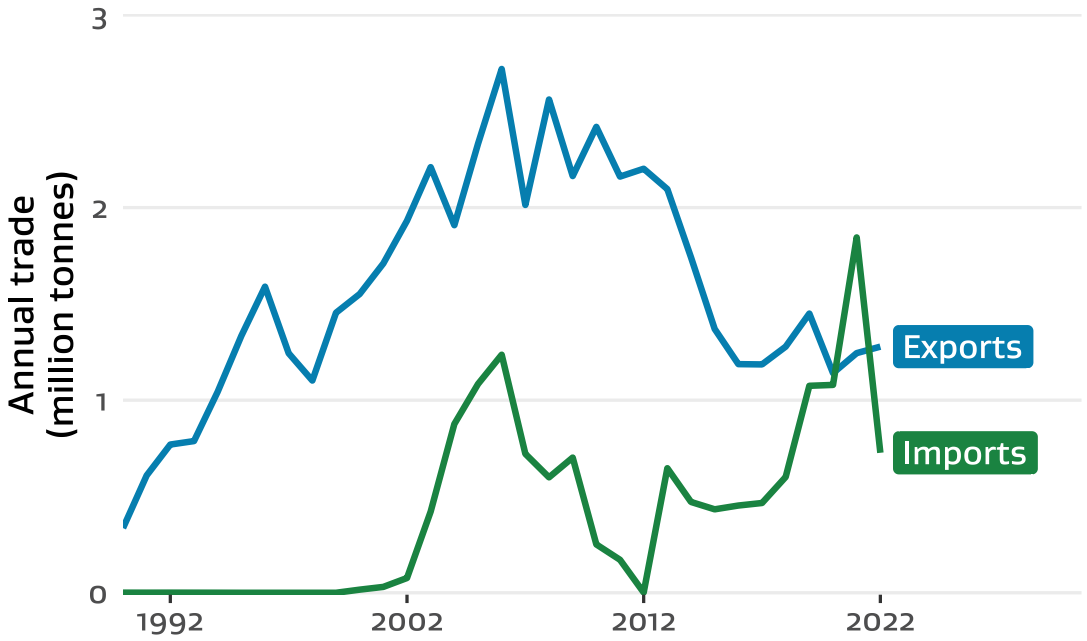
We **produced 2.6 million tonnes** of coal in 2022, the **lowest in 33 years**

The amount of imported coal has fallen back below export levels

The amount of imported coal more than halved in 2022 (Figure G.1). In 2021, the amount of imported thermal coal spiked by 71 per cent to the highest level on record and exceeding exports for the first time on record. This was driven by demand for electricity generation due to low hydro levels in the first part of the year. The decline in imported coal in 2022 was mostly driven by improved hydro generation, reducing the need for thermal back-up. Subsequently, coal stocks remained high throughout the year.

The amount of exported coal increased slightly in 2022, driven mostly by increased amounts of West Coast coking coal exported. New Zealand mostly exports coking coal, with smaller amounts of thermal and specialist coals. New Zealand coal is exported to countries such as Japan, India, China, South Korea, and Australia.

Figure G.1 New Zealand's export and import of coal, from 1990 to 2022



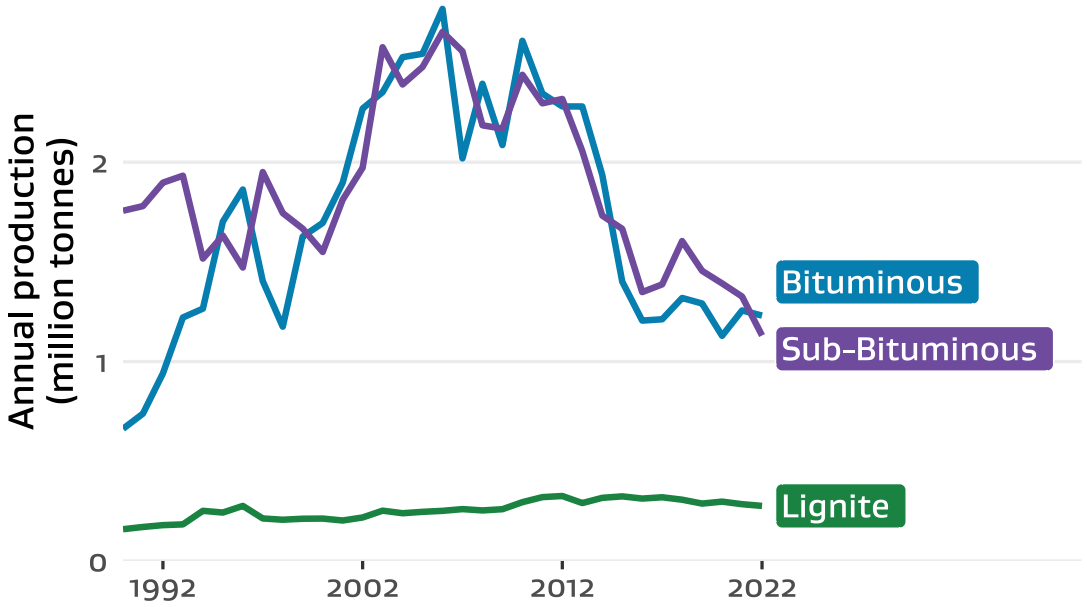
In 2022, coal production was the lowest in 33 years

New Zealand's total coal production in 2022 was 2.6 million tonnes (66.0 PJ), a decrease of 8.0 per cent from 2021. This was the lowest level of production in 33 years. Production fell across all ranks of coal (Figure G.2).

Over the last few years, several mines have stopped operating, including the Escarpment and New Creek mines on the West Coast, Ohai mine in Southland, and Malvern Hills mine in Canterbury.

Sub-bituminous coal production decreased by 15 per cent nationally. North Island mines decreased production by 17 per cent and South Island mines decreased production by 11 per cent. Bituminous coal production decreased by 2.1 per cent compared to 2021, while lignite production decreased by 3.0 per cent.

Figure G.2 New Zealand's coal production by rank of coal, from 1990 to 2022



Coal use has dropped because of lower levels of both consumption and transformation

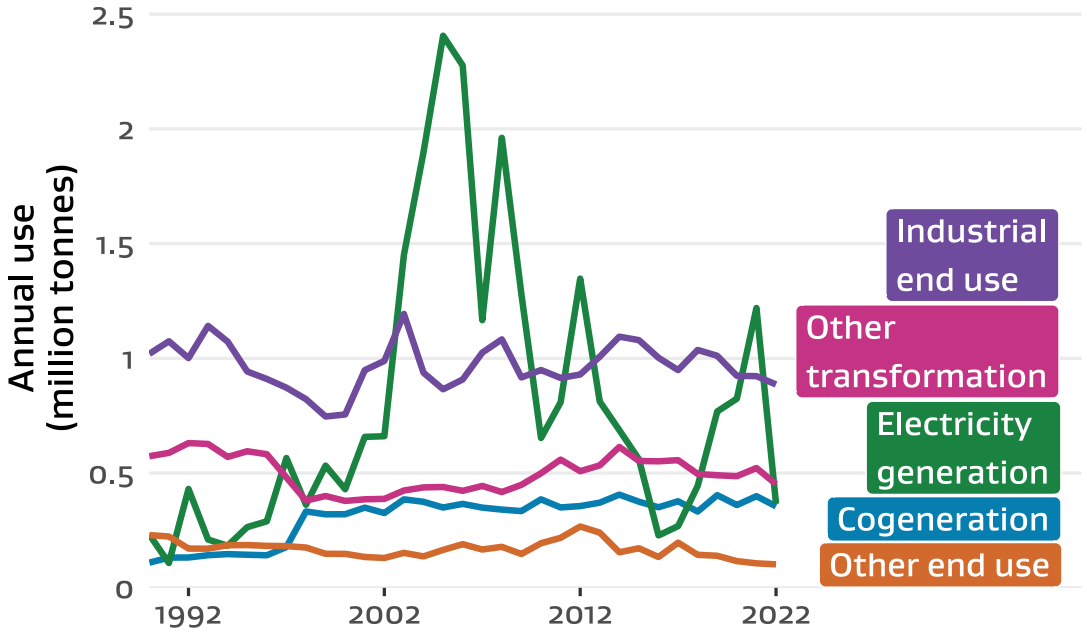
Total use of coal in New Zealand fell by over 30 per cent in 2022. This was because of drops in both consumption and transformation use.

New Zealand's total consumption (excluding transformation) of coal in 2022 decreased by 4 per cent compared to 2021. This was the fourth year in a row that demand reduced, resulting in the lowest level of consumption in 22 years. The decrease in consumption was led by the industrial sector — the dominant user of coal in New Zealand (Figure G.3).

Coal use for transformation also dropped in 2022. Coal use for primary electricity generation decreased 70 per cent from 2021, with cogeneration and other transformation processes (including iron and steel use) dropping 11 and 14 per cent respectively. The decrease in coal use for electricity generation was mainly due to improved hydrological conditions in 2022, compared with the dry hydrological year and decreased natural gas production in 2021. Refer to the Electricity chapter (page 17) for further information.

Changes in coal use in the North Island are heavily influenced by the Huntly Power Station. This is the only coal-fired power plant in New Zealand and is important for security of electricity supply. Electricity from the Huntly Power Station may be needed in dry years and periods of limited natural gas supply to meet our requirements for winter energy and peak demand.

Figure G.3 New Zealand's coal use (consumption and transformation) by sector, from 1990 to 2022



Government programmes are starting to impact coal use

Coal consumption is dominated by the industrial sector, which has been targeted by Government policies designed to reduce emissions.

Government Investment in Decarbonising Industry (GIDI) fund

Several projects initiated through the Government Investment in Decarbonising Industry (GIDI) fund are starting to impact the industrial use of coal. There is more detailed information about GIDI in the Renewables chapter (page 31).

Industrial conversion of coal to alternative fuels include the following examples.

- Fonterra's Te Awamutu site started using biomass instead of coal to operate in 2022.
- Fonterra's Stirling site started the conversion to biomass in 2022 and this was commissioned in April 2023.
- Fonterra's Hautapu and Waitoa sites are converting to biomass in 2023 with commissioning expected in 2024.
- Open Country Dairy commissioned an electric boiler at the Awarua site in 2021.
- Open Country Dairy is converting its Waharoa site to biomass.
- The Washdyke industrial centre converted to biomass in 2022.
- Affco and Silver Fern Farms have converted a number of meat works from coal to electricity.

State Sector Decarbonisation Fund

The State Sector Decarbonisation Fund (SSDF)[10] is also starting to impact coal use across the public sector. Progress and recent developments include the following examples.

- In May 2023, the Government announced investments through the SSDF to support the removal of all state-owned coal boilers from public hospitals and tertiary institutions by 2025.
- Most coal-fired boilers in schools have already been replaced with the remainder tracking to be removed by 2025.
- Christchurch Hospital switched from coal to new biomass boilers in February 2023.

10 For more information about the SSDF, see https://www.eeca.govt.nz/co-funding/public-sector-decarbonisation/state-sector-decarbonisation-fund/

H. Glossary

Glossary

Baseload generation: Baseload generation refers to power plants that do not change their electricity generation output quickly. These plants are less flexible with meeting electricity demand and take a long time to start up and shut down.

Biomass: Organic material from plants or animals which can be used as fuel for producing heat or electricity.

Black liquor: A recycled by-product made during the pulping of wood in the paper making industry. It is burned in a boiler to produce heat and electricity and is considered to be a solid biofuel.

Calorific value: The amount of energy that can be generated by burning a fuel. Usually expressed in megajoules per kilogram (MJ/kg). A calorific value may either be a gross calorific value (GCV) or a net calorific value (NCV) — see the relevant entries in this glossary.

Capacity factor: A measure of how often an electricity generation plant runs in a period of time. It is calculated as the amount of electricity generated by a plant divided by the maximum amount that could have been generated if it operated continuously at full power in that period of time.

Coal ranks: Used to refer to different types of coal. In New Zealand, we have three main types of coal: bituminous, sub-bituminous and lignite.

- Bituminous coal is the highest rank of coal in New Zealand. Bituminous coal is generally exported for steelmaking.
- Sub-bituminous coal is mainly used in heating and electricity generation. In New Zealand, steel can be made using sub-bituminous coal due to the unique processes used at the Glenbrook mill.
- Lignite coal, also known as brown coal, is the lowest grade coal with the least concentration of carbon.

Cogeneration: When electricity plants generate electricity and heat at the same time. Otherwise known as combined heat and power, or CHP.

Conversion efficiency: The amount of energy produced in a transformation process divided by the amount of energy that went into the process.

Conversion losses: The energy lost in transforming one type of energy to another. This is calculated as the difference between the amount of energy that has gone into a transformation process and the amount of energy that has been produced.

Direct use: The use of energy without it first going through a transformation process (such as electricity generation). For example, the use of geothermal energy to heat greenhouses.

Electric vehicles: Vehicles that run either partially or fully on electricity. These include:

- Battery electric vehicles (BEV) can only be powered by electricity.
- Plug-in hybrid electric vehicles (PHEV) have both an internal combustion engine that runs on petrol and a rechargeable battery for electricity.

Energy use: The use of fuel to provide energy (for example, burning coal to heat a boiler, or using electricity to power a motor). Sometimes also referred to as "energy end use".

Generation capacity: The maximum amount of electricity that can be produced by an electricity generation plant running at full power at a specific point in time.

Grid Exit Points (GXP): Grid Exit Points (GXP) are the points where electricity leaves the national grid operated by Transpower and enters the local distribution network.

Gross Calorific Value (GCV): The total amount of energy released when combusting a fuel. This value will be higher than a fuel's net calorific value.

Indigenous production: The production of primary energy sources within New Zealand. This includes extracting fossil fuels (such as coal and natural gas) and capturing energy from renewable sources (such as water and the wind).

Modern renewables: A classification for all renewable energy types excluding traditional use of solid biomass. 'Traditional use' refers to the use of solid biomass with basic technologies, such as a three-stone fire, often with no or poorly operating chimneys.

Net calorific value (NCV): The amount of energy that can be recovered when combusting a fuel. Some energy from combustion will always be lost due to heating water vapour and other factors, and the net calorific value takes this into account. This value will be lower than a fuel's gross calorific value.

Non-energy use: The use of energy for purposes other than combustion. This includes the use of bitumen in the construction of roads, and the use of natural gas in ammonia production.

Process heat: The energy used for warming spaces and industrial processes (such as drying milk powder). This is often in the form of steam, hot water, or hot gases.

Reserves (1P, 2P and 3P): The amount of crude oil, LPG, or natural gas that is believed to be available and commercially producible in an oil or natural gas field. These are reported at different levels of confidence or certainty.

- 1P reserves are Proven reserves (both developed and undeveloped). These reserves have a 90 per cent certainty of being produced.
- 2P reserves are the sum of Proven reserves and Probable reserves. These reserves have a 50 per cent certainty of being produced.
- 3P reserves are the sum of Proven reserves, Probable reserves, and Possible reserves. These reserves have a 10 per cent certainty of being produced.

Resources, Contingent (2C): 2C Contingent resources are resources estimated at a particular time to be potentially recoverable but are not yet commercially recoverable. This could be a result of technological barriers or economic factors. It is possible for remaining reserves to be reclassified as Contingent resources (or vice versa) because of changing economic conditions.

Self-sufficiency: A measure of a country's ability to meet its own energy supply requirements and is calculated as domestic production divided by total primary energy supply. A value of 100 per cent indicates that a country produces all the energy it needs, whereas values above or below 100 per cent indicates it is a net exporter or importer of energy, respectively.

Total final energy consumption (TFEC): Energy consumed by end-users such as factories and households.

Total primary energy supply (TPES): The total amount of energy available for use in New Zealand, accounting for domestic production and trade.

Transformation process: The conversion of one energy type to another. For example, the conversion of geothermal energy to electricity.

Utility-scale solar: Large solar photovoltaic (PV) projects that directly supply an electricity grid or network.

Waste heat: Heat that is generated from a by-product chemical reaction and used to generate electricity.

Conversion equivalents between units of energy

	TJ	PJ	GWh	TWh
Terajoule	1	0.001	0.2778	0.0002778
Petajoule	1000	1	277.778	0.2778
Gigawatt hour	3.6	0.0036	1	0.001
Terawatt hour	3600	3.6	1000	1

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government