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ENERGY STATISTICS SOURCES AND METHODS

NOVEMBER 2021

Version 1.2

VERSION CONTROL

Document version	Date	Details
1.0	March 2020	Initial document created
1.1	August 2020	Incorporating new sources and methods introduced for the 2020 edition of Energy in New Zealand, covering: <ul style="list-style-type: none">• Electricity generation by solar PV panels• Electricity consumption• Direct use of renewables
1.2	November 2021	Incorporating new sources and methods introduced for the 2021 edition of Energy in New Zealand, covering changes to the estimation of solid biofuels direct use.

INTRODUCTION

This document gives an overview of the data sources and methods used by the Ministry to produce national energy statistics. These statistics reflect how energy supply and demand varies by fuel type and sector, and how this changes over time.

The Ministry also reports greenhouse gas emissions from the energy sector. The methodologies of this follow the United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines¹.

This document is organised mostly by energy type, which covers:

- [Electricity](#)
- [Renewables](#)
- [Oil](#)
- [Gas](#)
- [Coal](#)

This document also contains a summary of the methods used by the Ministry in reporting [greenhouse gases](#), and an overview of the [frequency of data releases](#).

Overview of supply and use statistics

The Ministry follows International Energy Agency (IEA) guidelines for the compilation of national energy statistics².

In general, statistics on supply and use are calculated separately. When these separate calculation methods are used there can be a discrepancy between calculated supply and use, which is referred to as a “statistical difference”.

Supply

Supply statistics are organised by energy type, and cover:

- Indigenous production³
- Imports and exports
- Stocks and stock change

Use

Use statistics cover energy transformation activities, non-energy use, and consumption by sector.

Energy transformation includes electricity generation, cogeneration, fuel production, other transformation activities, and losses and own use.

Sectors for consumption statistics are based on Australian and New Zealand Standard Industrial Classification (ANZSIC) codes⁴ with the following mappings used for industrial and commercial sectors:

¹ <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements>

² For more information, see the IEA Energy Statistics Manual: <https://www.iea.org/reports/energy-statistics-manual>

³ “Indigenous production” is defined by the IEA as ‘the extraction of primary fuels from fossil reserves and biofuel sources as well as the capture of renewable energy’.

⁴ More information on ANZSIC 2006 can be found in Stats NZ’s Ariā system: <http://aria.stats.govt.nz/aria/>

Sector	ANZSIC codes
Agriculture, Forestry, and Fishing	A
Mineral and Petroleum Extraction	B
Food Processing	C11, C12
Textiles and Leather	C13
Wood, Pulp, Paper and Printing	C14, C15, C16
Chemicals	C17, C18, C19
Non-metallic minerals	C20
Basic Metals	C21, C22
Mechanical/Electrical Equipment	C23, C24
Industry unallocated	C25, D26, D27, D28, D29
Building and Construction	E
Commercial	F-G, H, I, J, K-N, O, P, Q, R-S

ELECTRICITY

Electricity generation

The Ministry collects electricity generation data from companies at the plant level. Major generators are surveyed monthly and smaller generators are surveyed annually. These major companies account for approximately 95 per cent of national electricity generation. In these surveys, companies report plant-level gross generation, capacity, and consumption by fuel type.

As well data on electricity generation plants, these data collections cover cogeneration plants. Cogeneration (or combined heat and power, CHP) refers to the process where both electricity and heat are generated in the same process.

When data for a specific plant is not available, the dataset is complemented by using the Electricity Authority's estimates of generation by plant based on injections to the grid⁵. As these estimates are constructed using a methodology that differs from the data that is collected by the Ministry, its use is kept to a minimum.

Fuel consumption

When fuel consumption data is not provided, it has to be estimated. This is derived from the total generation by assuming a constant fuel efficiency and parasitic load factor⁶ for each type of plant.

The electricity generation data that is collected is classified as either primary production or autoproduction. An autoproducer produces electricity (and sometimes heat) onsite but this is not the main business activity of the company, whereas the main business activity of a primary producer is electricity generation. To avoid double-counting of the energy used for electricity generation of autoproducers under both energy transformation and sectoral energy consumption in the energy balance tables, energy consumption figures are calculated as sales reported to the sector less the reported electricity generation fuel use in the sector.

Solar photovoltaics (PV)

The Ministry estimates electricity generated by solar photovoltaic (PV) panels by applying an assumed capacity factor to data published by the Electricity Authority on installed capacity.

The Ministry assumes an annual average capacity of 14 per cent for solar PV. However as the capacity information is monthly, monthly capacity factors are required. Data from NIWA on monthly solar hours in the six main centres⁷ is used to scale the assumed capacity factor to account for variation in output from solar PV panels during the year.

This is done by:

- 1) Calculating the annual average sunshine hours for each year.
- 2) Dividing the average sunshine hours for each month in that year by the annual average, to give a scaling factor for each month.
- 3) The assumed capacity factor of 14 per cent is then multiplied by this scaling factor to produce a series of monthly capacity factors that account for seasonality.

⁵ https://www.emi.ea.govt.nz/Wholesale/Datasets/Generation/Generation_MD

⁶ The parasitic load factor accounts for the fact that all electricity generated at a plant does not get supplied to end-users. For example some electricity is used onsite by the generator for services such as lighting the facility.

⁷ These are Auckland, Christchurch, Dunedin, Hamilton, Tauranga, and Wellington.

- 4) Once the capacity factor has been scaled, this is multiplied by the total installed capacity in each month and the hours in each month to get the estimated monthly electricity generation by solar PV panels.

Electricity consumption

The Ministry's electricity consumption statistics are compiled from a range of sources:

- Volumes sold by electricity retailers, prepared with one of two methodologies (see below)
- An estimate of electricity used for transport
- An estimate of generation, and therefore consumption, of electricity generated with solar photovoltaic (PV) panels
- Calculated onsite consumption

To get final electricity consumption statistics, these series are aggregated.

Volumes sold

The primary source of this information is the Ministry's sales data collection, which was done on a March year basis until mid-2013. From the June quarter 2013 onwards, this became a quarterly collection called the Quarterly Retail Sales Survey (QRSS). The QRSS surveys major electricity retailers for data on sales classified by ANZSIC code.

The Ministry currently employs two separate methods to determine the volume of electricity sold by retailers to account for this change in data collection methods:

- An **estimated quarterly sales** method, going back to 1990, to ensure data continuity for analysis and modelling purposes
- An **actual quarterly sales** method, based on information collected under the new quarterly collections

The estimated sales method is based on March year end data, so the data has to be allocated to quarters to align with the Ministry's other supply and demand statistics. This is done using data from the Electricity Authority on grid exit point (GXP) demand⁸. GXPs are mapped to industries or sectors based on the primary users that are at these points of connection, and/or electricity usage at the GXP following what would be expected for a particular sector on a daily or seasonal basis. GXPs that are not mapped to any of these sectors (referred to as "scalar sectors") are classified as "General".

The process of allocating the March year data to quarters is as follows:

- 1) For March years where there is a full year's worth of data, the percentage shares of each quarter in the total March year GXP demand for a scalar sector are used to apportion the March year volume sold for the corresponding industry or sector
- 2) If a quarter is ahead of the most recent year ended March, the following formula is used to estimate demand:

$$\begin{aligned} \text{Quarter demand estimate} \\ = \text{Previous demand} \times (1 + \text{GXP scalar sector change}) \end{aligned}$$

where:

- 'Previous demand' is the demand for the same quarter in the previous year

⁸ https://www.emi.ea.govt.nz/Wholesale/Datasets/Metered_data/Grid_export

- 'GXP scalar sector change' is the relative change in the GXP scalar sector demand between the two quarters (e.g. June quarter 2020 on June quarter 2019).

The estimates calculated in step 2) above are then revised when data for the full March year is collected.

Sales data produced under the new method is an aggregation of data collected by the Ministry on a quarterly basis.

Electricity used for transport

Electricity consumption for transport falls under the commercial sector. However these volumes will include electricity used for more activities than transportation, such as lighting in an airport terminal.

For a more accurate breakdown, transport electricity use is estimated by compiling information on:

- Electricity supplied to GXPs that are connected to the Auckland urban rail network and the electrified section of the North Island Main Trunk
- Estimated electricity use by electric vehicles (EVs)
- Other electricity use for transport as collected by the Ministry

These estimates are mapped to either the commercial or residential sectors, and then deducted from sectoral consumption to ensure that there is no double-counting.

Solar photovoltaics (PV)

The same method of estimating electricity generation from solar PV panels is used as per the electricity generation statistics. The assumption is then made that for solar PV, consumption is equal to generation.

Onsite consumption

Onsite consumption at electricity generation plants is calculated as the difference between net electricity generation and electricity entering the grid system.

RENEWABLES

The Ministry's reporting on renewable energy covers hydro, wind, geothermal, solar, liquid biofuels, wood, and biogas.

As most renewable energy is currently used to generate electricity, the majority of this data is sourced from the electricity generation statistics.

This is supplemented by data on direct use⁹ that the Ministry collects or estimates on geothermal energy, solar thermal energy, biofuels, wood, and biogas. This data is compiled using various methods and assumptions. Due to data collection limitations, direct renewable energy use is assumed to be equal to supply.

The following sub-sections describe the data collections and methods used to produce statistics on direct use.

Geothermal

Direct geothermal energy use is modelled based off data collected from various sources. Major users directly provide data on their usage, and further use is modelled using data on the number of geothermal consents and their estimated capacity. Where we do not have any further data, it is assumed that all consents use the full amount of energy available. Consumption is allocated to sectors based on information supplied by the New Zealand Geothermal Association and GNS Science.

Solar

Solar thermal energy¹⁰ production is estimated from historical data that the Ministry holds on the number of solar thermal energy systems in New Zealand and their estimated capacity.

Data on solar thermal energy has not been updated since 2011 as it makes up a minimal proportion of national energy consumption.

Liquid biofuels

Production and imports of liquid biofuels (bioethanol and biodiesel) appears as renewable energy supply in the energy balance tables. Bioethanol and biodiesel are generally blended with petrol or diesel before being supplied to end-users. As a result of this, these blended fuels are reported as energy transformation in the balance tables.

Solid biofuels

Statistics on industrial and residential solid biofuel use (covering both woody biomass and charcoal) are estimated using multiple sources.

Industrial

Scion's Wood Processing Database forms the basis for estimates of solid biofuel use by the industrial sector. This database covers the majority of large-scale wood processors in the country and contains a range of information including annual estimates of energy demand at sites.

⁹ "Direct use" refers to the direct consumption by end-users of renewable energy sources, such as the use of geothermal heat for timber drying.

¹⁰ Solar thermal energy uses heat from the sun for energy purposes (e.g. hot water heating), as opposed to solar photovoltaic energy which uses the sun's radiation.

The Ministry for Primary Industries publishes data on the production of different wood processing products. This is used to extrapolate the estimates from the Wood Processing Database to construct a full time series.

Residential

The number of New Zealand households that use wood for energy is estimated using:

- Quarterly estimates of the number of occupied households
- Census information on the proportion of households that use firewood

These are both sourced from Stats NZ.

This is then multiplied by average household wood energy usage, derived from the 2005 edition of the BRANZ Household Energy End-Use Project¹¹. Because the Household Energy End-Use Project has not been re-run, this usage estimate has not been updated since.

Information on imports is used to estimate residential use of charcoal.

Biogas

Biogas use for electricity generation is reported to the Ministry by plant owners and operators. Direct use is estimated from research undertaken by the Ministry in the past, which involved collecting data directly from major users.

Data collection on biogas direct use has been discontinued because it makes up a minor proportion of total energy use. Currently, historical figures are carried forward by assuming usage has not changed.

¹¹ https://www.branz.co.nz/cms_show_download.php?id=b869c9c110a8b41d4a022b78f6898033994040b7

OIL

Oil supply

The Ministry surveys all oil field owners and operators monthly as part of the Monthly Oil Submissions (MOS) survey. This survey includes information on:

- Indigenous production
- Stock levels
- Exports of crude oil, condensate and naphtha
- Product density¹²

To calculate total national production and stocks, we add together the numbers reported by individual companies.

In addition to the export data from MOS, the Oil Statistics Return surveys major liquid fuel distribution companies monthly for data on their imports and exports. Data on the imports and exports of minor petroleum goods such as lubricants, waxes and solvents is supplied monthly by New Zealand Customs.

The Ministry directly receives monthly data from Refining NZ on oil processing activities at the Marsden Point Refinery, New Zealand's only refinery. Refining NZ reports on stocks, intake, and production of oil and oil products. In the balance tables, crude oil refining is reported under energy transformation, and the creation of refined products is reported as production of the relevant fuel type.

Oil consumption

Oil consumption is estimated using data from the Ministry's Delivery of Petroleum Fuels by Industry (DPFI) survey and Annual Liquid Fuels Survey (ALFS). The Ministry also receives data directly from companies that use oil for non-energy purposes¹³.

The DPFI surveys each major petrol company quarterly for data on sales broken down by sector and fuel type. For the ALFS, independent liquid fuel distributors are asked annually to report their fuel purchases and sales broken down by sector and fuel type:

- Data from the DPFI is used to calculate the quantity of petroleum fuels consumed by each sector for energy based on reported sales.
- The ALFS data is then used to supplement the DPFI data as some fuels are sold to independent distributors, which the DPFI cannot allocate to a sector.
- The data obtained directly from companies can be added to these calculations based on the companies' sector.

As part of the data collection for electricity generation, the Ministry also calculates the amount of oil used to produce electricity based on information provided by plant operators. This is reported under energy transformation in the energy balance table. Where autoproducers use oil for electricity generation, this is subtracted from industrial consumption figures and reported under energy transformation.

¹² The product's ratio of mass to volume (in tonnes per kilolitre)

¹³ Oil can be transformed into products that are not used for energy, such as bitumen used in road construction

Liquefied Petroleum Gas (LPG)

Data on Liquefied Petroleum Gas (LPG) production is also obtained under the MOS survey. LPG is made by refining raw natural gas or crude oil, which is typically done by field operators. Field operators that produce LPG therefore report production by source (oil or gas), sales, and exports as part of their MOS survey submission.

The LPG Association directly supplies data on imports, exports, and sales. LPG distribution figures by bottle size are collected monthly from major LPG distributing companies, through the Liquefied Petroleum Gas Supply survey. The Ministry does not collect data on LPG resales, so LPG end-use is estimated by assuming the uses of different bottle sizes.

GAS

Gas supply

The Monthly Oil Submissions (MOS) survey also gets returns from gas field operators, which are used to calculate New Zealand's natural gas extraction. For each field, gas supply is calculated as the total amount of gas produced minus:

- Gas flared¹⁴
- Gas reinjected¹⁵
- Gas extracted as LPG
- Losses
- Own use during gas production

As MOS surveys all gas production fields, total gas supply is calculated as the sum of the supply of individual fields.

Gas storage figures are based on gas held in transmission lines and the Ahuroa Gas Storage Facility. This data is directly supplied by First Gas, who owns New Zealand's gas transmission network and the storage facility. Gas held in transmission lines is calculated based on the volume of gas that passes through the network.

Gas consumption

Gas consumption is calculated from data collected under the Quarterly Retail Sales Survey (QRSS) and data collected directly from companies that use gas for non-energy purposes¹⁶. In the QRSS, gas retailers report their sales classified by ANZSIC code¹⁷.

As part of the data collection for electricity generation, the Ministry also calculates the amount of gas used to produce electricity based on information provided by plant operators. This is reported under energy transformation in the energy balance table. Where autoproducers use gas for electricity generation, this is subtracted from industrial consumption figures and reported under energy transformation.

¹⁴ This is the associated gas produced during oil and gas recovery that is combusted

¹⁵ Some extracted gas is reinjected into oil wells to increase the reservoir pressure, which stimulates gas extraction.

¹⁶ Non-energy use is gas used for purposes other than combustion, such as in the production of chemicals (e.g. urea and methanol)

¹⁷ Prior to the implementation of the QRSS in June 2013, the Ministry collected data on gas consumption through the Gas Sales Survey

COAL

Coal supply

MBIE surveys major New Zealand mine owners and operators on a quarterly basis to collect data on:

- Coal production by mine
- Purchases from others
- Losses
- Sales
- Exports
- Stock

This data is categorised by coal type: lignite, bituminous, or sub-bituminous.

Other companies that stockpile a large amount of coal are surveyed directly.

Coal imports are calculated from quarterly data published by Stats NZ. The data is reclassified to be consistent with the Ministry's reporting. This means that coke is disregarded, and sub-bituminous coal imports are estimated as total coal imports less bituminous and lignite imports.

Final coal production statistics are calculated by aggregating the data from the various companies.

Coal consumption

The sales reported by coal mine operators are classified by ANZSIC code, which enables the disaggregation of coal use by industry.

Coal mine owners and operators report on total coal resales. Coal resales is coal sold to other companies or parties, who then onsell it to end-users. MBIE does not collect data on coal resales, so consumption of coal that has been onsold has to be estimated. As the quantity of coal used is known from sales data, use of onsold coal by sector is estimated by allocating fixed proportions of this quantity to various sectors. This is done by assuming the end-uses of the different types of coal, and also accounting for sales between producers.

As part of the data collection for electricity generation, the Ministry also calculates the amount of coal used to produce electricity based on information provided by plant operators. This is reported under energy transformation in the energy balance table. Where autoproducers use coal for electricity generation, this is subtracted from industrial consumption figures and reported under energy transformation.

Greenhouse gas emissions

The Ministry calculates greenhouse gas emissions from the energy sector using a bottom-up sectoral approach, meaning that emissions are estimated from sectoral activity data. Most of the inputs for this approach come from MBIE's calculations of energy use, with some additional data being sourced directly from high-emitting companies or other government agencies.

Most of the methods involved in calculating greenhouse gas emissions from the energy sector follow protocols set by the Intergovernmental Panel on Climate Change (IPCC). The final output fuel combustion emissions are verified against the IPCC reference approach¹⁸.

Emission factors

Emissions are estimated by multiplying the activity data by an emission factor, which approximates the quantity of greenhouse gases emitted per gross unit of energy used or produced¹⁹.

The emission factors used are either sourced from the IPCC or country-specific research:

Fuel type	Emission type	Method	Source
Gas	Carbon dioxide	Annual weighted average for all of New Zealand's natural gas production fields	Ministry data collection
	Other ²⁰	IPCC 2006 default emission factor	IPCC
Liquid fuel	Carbon dioxide	Calculated from national data on carbon content and calorific values of fuels produced	Refining NZ data
	Other	IPCC 2006 default emission factor	IPCC
Liquid biofuel	Carbon dioxide	Calculated based on estimated carbon content	New Zealand Energy Information Handbook ²¹
	Other	IPCC 2006 default emission factor	IPCC
Solid (coal)	Carbon dioxide	Interpolation between estimates for 1990 and 2008, and 2008 calculated estimate carried forward since	1990: New Zealand Energy Information Handbook 2008: CRL Energy study

¹⁸ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

¹⁹ Gross values include the heat released from fuel during combustion including any carried away in the water produced during the combustion process.

²⁰ Includes carbon monoxide, methane, nitrate, nitrous oxide, non-methane volatile organic compounds, and sulphur dioxide

²¹ <https://ir.canterbury.ac.nz/bitstream/handle/10092/11527/EIH3.pdf?sequence=1>

Fuel type	Emission type	Method	Source
Biomass	Carbon dioxide	IPCC 2006 default emission factor	IPCC
	Other	IPCC 2006 default emission factor	IPCC

Fugitive emissions²² from coal mining, gas production and oil refining are estimated using emission factors and methods from IPCC guidelines¹⁷. Some fugitive emissions data is reported directly by companies.

²² Emissions that are not caught by a capture system, usually due to equipment leaks, evaporative processes or windblown disturbances

RELEASE OF DATA

The following table shows the frequency of data releases. Data that is released quarterly is included in the Ministry's New Zealand Energy Quarterly publications, while annual data is released in the Ministry's Energy in New Zealand publication.

Balance table category	Series	Coal	Oil	Gas	Renewables	Electricity
Supply	<i>Indigenous production</i>	Quarterly	Quarterly	Quarterly	Annual	N/A
	<i>Imports and exports</i>	Quarterly	Quarterly	Quarterly	Annual	N/A
	<i>Stock change</i>	Quarterly	Quarterly	Quarterly	N/A	N/A
	<i>International transport</i>	N/A	Quarterly	N/A	N/A	N/A
Energy transformation	<i>Electricity generation and cogeneration</i>	Quarterly	Quarterly	Quarterly	Quarterly (included in electricity generation statistics)	Quarterly
	<i>Fuel production</i>	N/A	Quarterly	N/A	Annual	N/A
	<i>Other transformation</i>	Quarterly	N/A	N/A	N/A	N/A
	<i>Losses and own use</i>	Quarterly	Quarterly	Quarterly	N/A	Quarterly
Non-energy use	<i>Non-energy use</i>	N/A	Quarterly	Quarterly	N/A	N/A
Demand	<i>Consumption by sector</i>	Quarterly	Quarterly	Quarterly	Annual	Quarterly

Any series coded as "N/A" are those which are not applicable, or not observed