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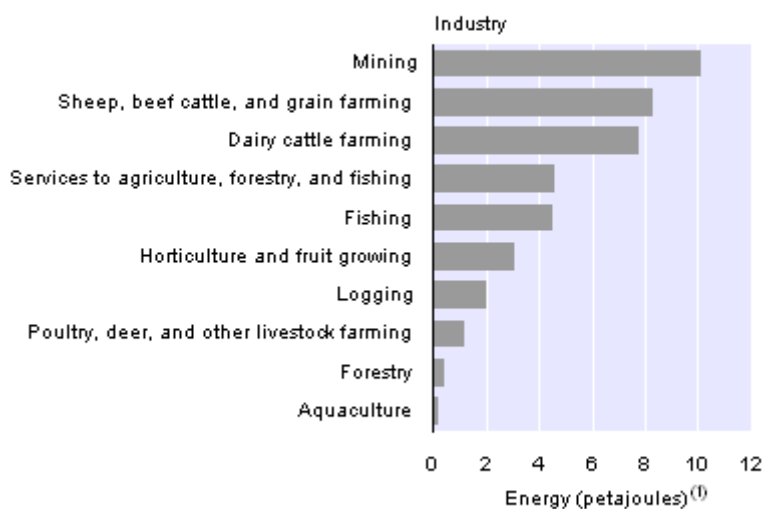
Energy Use Survey: Primary industries 2008

Highlights

- The total energy used by primary industries was 42,288 terajoules. The graph below shows how this energy was split between the various industries.

Total Energy Use by Industry

2008



(1) 1 petajoule is equivalent to 1,000 terajoules.

- The mining industry was the largest user of energy, using 24 percent of the total.
- Diesel was the energy type used in the greatest quantity, accounting for 50 percent of the primary industries' energy use. This proportion is an estimated 20 percent of New Zealand's total diesel use.
- 44 percent of businesses actively monitored their energy use and costs.

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Commentary

Overview

This release presents the results for the first year of the New Zealand Energy Use Survey (NZEUS) carried out in early 2009. This survey will be run annually to cover energy use across the entire New Zealand economy. In the first year, the survey interviewed businesses in the primary industries including those in agriculture, fishing, forestry, and mining. Other industries will be surveyed in the following two years, after which the cycle will repeat.

The survey collected information on the amount of energy used by businesses in each primary industry group. Energy commodities include electricity, petrol, diesel, and wood. The NZEUS also included questions on energy saving practices, the areas in which businesses could use less energy, and the use of biofuel.

Guide to interpreting the data

For this release, the main unit of measurement used is the terajoule (TJ). A terajoule of energy is roughly equivalent to filling a 40-litre petrol tank 700 times, or the total electricity used by 35 households in one year. The reference period for this survey is the last financial year for which the business had results available at March 2009. The majority of respondents indicated a 30 June balance date, but there was a significant number of respondents that indicated 31 March. A relatively small number of respondents stated either 31 December or other dates. No adjustment has been made to produce figures for a single consistent time period for all units.

Energy use in the primary industries

Each industry uses energy in different ways and in various quantities as the activities they undertake vary. The primary industries are no exception. Agriculture, forestry, fishing, and mining all have a different focus, each using different types of machinery, with businesses varying in size from the very small family holding to the very large corporate organisation.

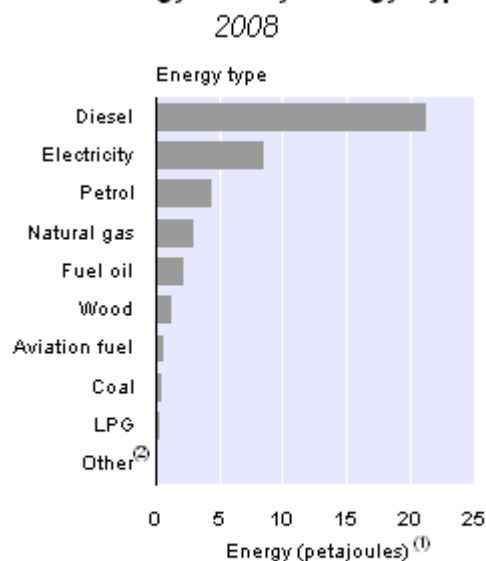
During the 2008 year, New Zealand's primary industries used 42,288TJ of energy. This represents around 9 percent of the estimated total consumer energy for New Zealand (Ministry of Economic Development, 2009). The table below shows energy use by each primary industry.

Energy Use by Primary Industry		
Industry	Energy use (TJ)	Percent of the total
Horticulture and fruit growing	3,070	7
Sheep, beef cattle, and grain farming	8,330	20
Dairy cattle farming	7,790	19
Poultry, deer, and other livestock farming	1,229	3
Forestry	405	1
Logging	1,998	5
Aquaculture	191	0
Fishing	4,504	11
Services to agriculture, forestry, and fishing	4,624	11
Mining	10,147	24
Total primary industries	42,288	100
Note: Data may not sum to stated totals due to rounding.		

Energy use by fuel type

The form of energy most used by primary industries was diesel. Diesel use totalled 21,288TJ, accounting for 50 percent of primary industry energy use and an estimated 19 percent of the total New Zealand diesel supply (Ministry of Economic Development, 2009). Electricity and petrol were also significant, with totals of 8,606TJ and 4,391TJ, respectively (or 20 percent and 10 percent, respectively, of the primary industries' total). Other forms of energy used include fuel oil, natural gas, wood; and minor quantities of liquefied petroleum gas (LPG), coal, and aviation fuel.

Total Energy Use by Energy Type



(1) 1 petajoule is equivalent to 1,000 terajoules.

(2) Includes other fuels not captured anywhere else, eg steam.

Electricity use

Due to the nature of agricultural industries, where farmers most often live at their workplace, the NZEUS enquired about all electricity use for household and business. Then, they were asked to estimate the proportion used for business purposes. The total electricity use reported was 10,213TJ. Of this, 8,606TJ were for business use, and the remaining 1,608TJ were reported as household use of electricity. Please note that the totals reported in the tables attached to this release (except table 2) report only on the business use of electricity.

Petroleum fuels end use

An important characteristic of this survey is that it identifies, in broad categories, the main end uses of petroleum fuels. These questions were included due to a need to track the use of energy as it becomes an increasingly important economic resource. The broad categories are as follows:

1. on-road use – the use of motor vehicles on public roads
2. mobile off-road used – includes the use of motor vehicles off public roads such as tractors, harvesters; effectively, machinery that needs to move to perform its work, but its main job is not transport on roads
3. stationary off-road use – applications that are fixed or portable but do not generate motive power to work; for example, pumps, chain saws, and power generators
4. marine – includes fuel required for boats and other water craft; for fuels used in off-shore platforms and oil production ships, the energy was allocated to stationary, as it is a stationary application.

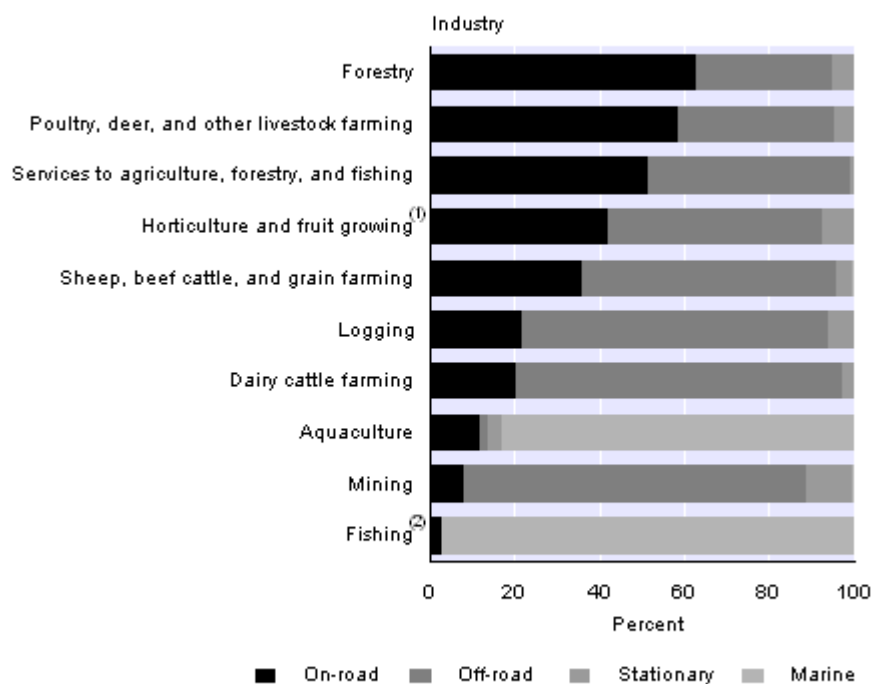
While all petroleum fuels have similarities and have a degree of substitutability, particular applications tended to use specific fuels (Smil, 2008). There are many reasons for this tendency, including economic, environmental, and fuel quality requirements. Knowing how energy is used is important as it allows the assessment of the impacts of energy related initiatives. Information on how energy is used also enables businesses to benchmark themselves, and make more informed choices on the fuels they use.

Diesel use

Diesel is mainly used in internal combustion engines (Eng, Bywater, & Hendtlass, 2008), yet these engines can have many applications. The main use of diesel was for mobile off-road purposes, such as excavators, tractors, and harvesters, accounting for 57 percent of total diesel use in the primary industries. On-road use accounted for 26 percent, marine use accounted for 12 percent, and stationary use at just under 5 percent.

In the primary industries, mining businesses were the largest users of diesel, using 23 percent of the total. The great majority of this diesel was used in mobile off-road applications. Forestry and aquaculture were the smallest users of diesel, both using less than 1 percent.

Diesel End Use by Industry 2008



(1) Stationary and marine use of diesel are combined for confidentiality reasons.

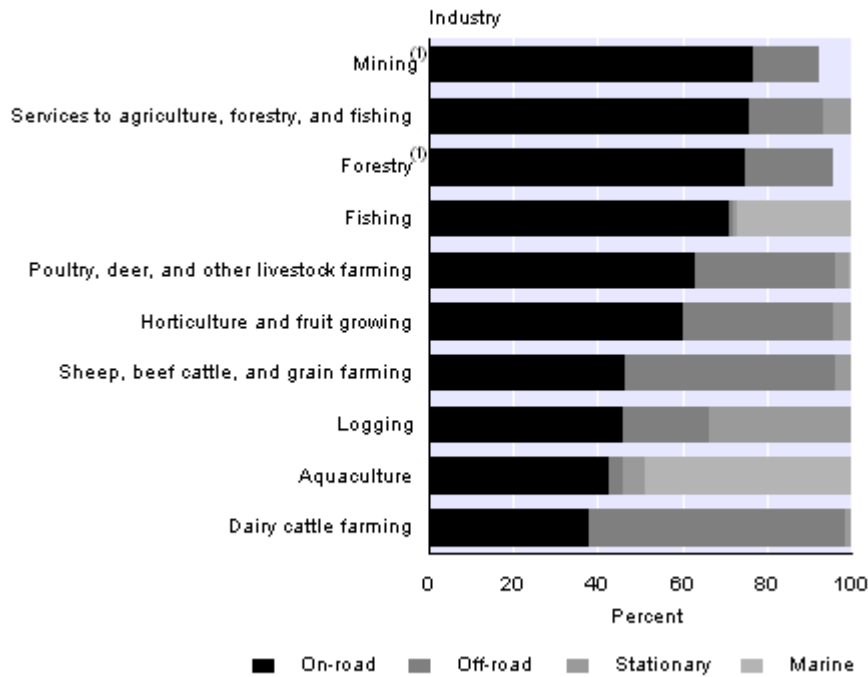
(2) Stationary and on-road use of diesel are combined for confidentiality reasons.

Petrol use

Similar to diesel, petrol is also mainly used in internal combustion engines. However, petrol is more specialised towards transport applications. For primary industries, petrol was mainly for on-road use, accounting for 50 percent of total petrol use. Mobile off-road accounted for 44 percent, stationary use for 5 percent, and marine for less than 1 percent.

The sheep, beef cattle, and grain farming industry was the largest user of petrol, accounting for 41 percent of the total primary sector use. Aquaculture, mining, forestry, and fishing all accounted for 1 percent or less.

Petrol End Use by Industry 2008



(1) Data does not add up to 100% because of confidentiality constraints.

Fuel oil use

Fuel oil is a heavier petroleum distillate than petrol and diesel and is mainly used for industrial boiler fuel and marine applications. The use of fuel oil in the primary industries was dominated by the fishing industry, accounting for 88 percent of total fuel oil usage in the primary industries. Over 92 percent of fuel oil was used for marine applications.

Liquefied petroleum gas use

For liquefied petroleum gas (LPG), the survey provided three end-use options: on-road, mobile off-road, and stationary off-road. Mining businesses were the largest primary industry users of LPG for the period, accounting for 38 percent of the total. This was followed by poultry, deer, and other livestock farming at 25 percent. LPG was mainly used for stationary purposes (81 percent), while the remainder was split between off-road (11 percent) and on-road purposes (8 percent).

Aviation fuel use

The majority (87 percent) of primary industry aviation fuel was used by businesses in the services to agriculture, forestry, and fishing industry. Possible uses are crop dusting and other services requiring airplanes and helicopters.

Natural gas use

The use of natural gas was heavily dominated by the mining industry, specifically in oil and gas production activities, accounting for 98 percent of the primary industry total. It is important to note that the majority of the gas used in the mining industry does not enter the national gas market as it is usually used directly from the extraction well for fuel production.

Coal use

Coal is a minor fuel for primary industries, with a reported use of 467TJ or 1 percent of the total energy used. Horticulture reported the largest use accounting for 44 percent of coal usage.

Wood use

Reported wood use was 1,343TJ. Wood use is mainly concentrated on farms, which accounted for 95 percent of total wood use in the primary industries. In particular, sheep and beef cattle farms, and dairy farms together accounted for 82 percent of total wood use. During data processing, respondent callbacks revealed that the majority of this use was for home-heating purposes.

Energy management

The survey included questions on energy management. This section asked respondents to indicate what energy saving initiatives they currently had in place and the areas of the business where they could reduce electricity or diesel usage.

Of the options provided, the most common way of managing energy was to monitor energy use and costs, with 44 percent of primary industry businesses doing so. Providing information to staff was the second most common energy management initiative with 19 percent of businesses.

Other results show that 9 percent of businesses in the primary industries have a formal or informal energy policy, while 7 percent have assigned a person the responsibility for energy management. Aside from these specific initiatives, 32 percent of businesses reported other initiatives for energy reduction, including setting targets for the reduction of energy use; signs or stickers to encourage staff to turn off lights or equipment when safe to do so; and the recognition of energy reduction initiatives and other initiatives.

Conversely, 46 percent of primary industry businesses do not have any energy saving initiatives in place. The forestry industry had the lowest incidence of energy management, with only 21 percent of businesses monitoring their energy use and cost, and 73 percent had no energy saving initiatives.

Dairy farming showed the highest uptake of energy management practices. Dairy businesses had a 55 percent uptake of energy use and cost monitoring, while 36 percent gave their staff information on how to reduce energy. Only 31 percent of dairy farms had no energy saving initiatives.

The most common ways businesses perceived they could use less electricity was through reductions in water heating and lighting. For less diesel usage, reductions in on-road and mobile off-road use were the most commonly reported. Responses showed that one-quarter of agricultural businesses (horticulture; sheep and beef cattle farming; dairy cattle farming; and other livestock farming) could use less electricity in both water heating and lighting, while one-eighth could use less in both electric motor power and refrigeration. On the other hand, 51 percent of all respondents reported that no further savings on electricity were possible for their business, while 64 percent said the same for diesel.

Electricity generation

Survey responses showed that the total amount of electricity generated by businesses in the primary sector was 8.7 gigawatt hours (GWh). Of the businesses surveyed, 3 percent indicated that they had generation capacity on-site, although most of these respondents generated comparatively small amounts of electricity. A small number of units generate the majority of this electricity, with approximately 75 percent being generated by 9 percent of respondents.

By far the most common form of energy used for self-generation was petrol or diesel (eg generators). Over 80 percent of the businesses in the primary sector that generate their own electricity used petrol or diesel to do so. The second and third most common generation types were solar/photovoltaic and hydro, with one-quarter and one-tenth of respondents using these, respectively. However, solar was often used with smaller generation amounts, while hydro was often used with larger amounts. Overall, more electricity was produced through hydro than solar generation.

During respondent callbacks it became apparent that the majority of those reporting low amounts of self-generated electricity did so using small portable generators. In terms of the solar photovoltaic use, some respondents indicated they used this for isolated sheds or facilities for which lines and metering costs were high compared with the low, sporadic use of energy.

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Next release ...

Energy Use Survey: 2009 will be released in October 2010.

Technical notes

Survey background

The New Zealand Energy Use Programme is a product of the Energy Domain Plan that was published in 2006. The Energy Domain Plan was produced by Statistics New Zealand in collaboration with the Energy Efficiency and Conservation Authority (EECA) and the Ministry of Economic Development (MED). The domain plan identifies energy use statistics as a key gap on energy information, and a suite of energy use surveys were given top priority.

The information delivered by the New Zealand Energy Use Survey (NZEUS) will help fill gaps in current energy statistics and provide a benchmark of energy use information for New Zealand's primary industries. It will also provide data to feed into current modelling systems that give current energy-use estimations and future demand forecasts (eg MED's Energy Data File). This new data will enable the update of modelling assumptions, and subsequent improvement in the accuracy of modelled information.

This need resulted in the development of a series of surveys, to be run annually to cover energy use across the entire New Zealand economy. The greatest need was for data on primary industries, which are covered in the 2008/09 collection period. Other industries will be surveyed in the following two years, after which the cycle will repeat.

Target population

For the 2008/09 collection covering primary industries, the target population included all economically significant businesses in the Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC06) categories A and B that were live at the time of selection. Industrial activities in these categories include agriculture, forestry, fishing, and mining.

Survey population

The selection unit for the programme is the kind-of-activity unit (KAU); the collection unit was also the KAU. Over 66,000 enterprises had KAUs that met the requirements above. The KAU was selected as an economy wide view of energy use that would require the uses of energy to be associated with an activity as closely as possible. In this manner, the KAU allows the differentiation of energy use by activity from larger multi-activity conglomerates. This approach is similar to the System of National Accounts methods for calculating economic indicators such as gross domestic product (GDP).

Sharemilkers were directly excluded from the sampling process as they operate in farms already included in the survey population. This exclusion addressed a significant risk for double-counting energy use in the dairy industry. Instead, the questionnaire directed farmers to include the energy use of sharemilkers operating in their farm.

After consideration of stakeholders' needs, industry characteristics, practical and compliance costs, the sample of the survey was designed to produce results for the following industry groups, based on the ANZSIC06 groups indicated (in brackets):

- Agriculture (A01)
Horticulture and fruit growing (A011, A012, A013)
Sheep, beef cattle, and grain farming (A014, A015)
Dairy cattle farming (A016)
Poultry, deer, and other livestock farming (A017, A018, A019)
- Forestry and logging (A03)
- Fishing (A04)
- Aquaculture (A02)
- Agriculture, forestry, and fishing support services (A05)
- Mining (B) – includes quarrying and petroleum explorations and production.

Sample design

The sample design was a one-stage stratified random sample. The stratification and design variables for agriculture and forestry were farm size and the estimated value of agricultural output (EVAO). The stratification and design variables for the support services, logging, fishing, and mining are GST sales and rolling mean employment (RME).

Data collection

The survey was posted out in March 2009 and collected data for the last accounting year. When full-year figures were not provided, the yearly quantity was estimated through extrapolation of the partial-year figures provided, taking into account seasonal variation where possible.

The survey collected information from New Zealand's primary industries on the following commodities:

- electricity – all electricity purchased from the national grid and energy sources used for input into electricity generation and cogeneration; did not include electricity generated on-site, to avoid double counting
- electricity generated in the business – electricity generated within the operations of the business but not necessarily owned by the business; this figure was not included in total energy used, to avoid double counting
- petroleum products – energy products derived from the refining process of crude oil. The following petroleum products were included:
 - > petrol – an aggregated figure of 96 and 91 octane petrol
 - > fuel oil – an aggregated figure of the major intermediate products, notably light fuel oil and heavy fuel oil
 - > diesel
 - > liquefied petroleum gas (LPG)
 - > aviation fuel
- coal – including all ranks
- wood and wood waste – used for any purposes.

The survey was sent to 3,823 businesses and the response rate achieved was 82 percent, just over the 80 percent target.

Units

Information on energy usage was collected in the applicable units in which each commodity is sold, for example, litres for petrol and kilowatt hour (kWh) for electricity. These were converted to a standard unit (joules) for reporting purposes. This conversion enables the direct comparison of the energy contained in different forms. The conversions were carried out by applying a calorific value (enthalpy value) to each energy type and form. The calorific values were sourced or derived from MED's Energy Data File 2008. See the table below for the calorific values used for each energy type.

Calorific Values for Energy Types		
Energy type	Technical notes	Calorific value
Electricity	Electricity's standard universal unit, the watt is defined as one joule per second.	3.60 megajoules per kilowatt hour
Coal	The conversion factor for coal is a weighted average of the values for lignite, sub-bituminous and bituminous coal, depending on their prevalence in the market place.	22,380 megajoules per tonne
Diesel	The value used is that of regular diesel.	38.31 megajoules per litre
Fuel oil	There are two major types of fuel oil: light fuel oil and heavy fuel oil. The conversion factor used in NZEUS was derived using a weighted average of the two according to their current prevalence in the market.	40.30 megajoules per litre
LPG	Liquefied petroleum gas.	26.54 megajoules per litre
Aviation fuel	There are two major forms: jet fuel and aviation gasoline. The conversion factor used is a weighted average of the estimated prevalence of these two forms in the market.	34.56 megajoules per litre
Natural gas	The majority of natural gas figures were provided in joules. However, in some cases the figure was provided in kilowatt hours.	3.60 megajoules per kilowatt hour
Petrol	There are two main forms of petrol in the market, regular and premium, and each has a slightly different conversion factor. The conversion factor used in NZEUS is a weighted average of the two values, according to their current prevalence in the market.	34.97 megajoules per litre
Steam	The calorific value of steam can vary, depending on the temperature and pressure of the steam resource.	2.70 megajoules per kilogram
Wood and wood waste	This fuel is an aggregation of a number of wood products that are used as fuel. The majority of this category is composed of residual products from the wood and paper manufacturing industry such as shavings, sawdust, bark, black liquor. The conversion factor used in NZEUS was based on available information on the use of wood products as a fuel.	11,597 megajoules per cubic metre

Measurement errors

The survey results are subject to measurement errors, including both non-sample and sample errors. These errors should be considered when analysing results.

Non-sample errors

Non-sample errors include mistakes by respondents when completing questionnaires, variation in the respondents' interpretation of the questions asked, and errors made during the processing of the data. In addition, the survey applied imputation methodologies to cope with non-respondents.

Statistics NZ has extensive procedures to minimise these types of error, but they may still occur and are not quantifiable.

Given the nature of the data collected, there are limitations on the level of accuracy that can be expected from the survey. Businesses' records may not be kept in the form required for the survey and some estimation by the respondent may be required.

Sampling error

Sampling error is a measure of the variability that occurs by chance because a sample, rather than the entire population, is surveyed. Given a certain sample size, the level of sampling error for any given estimate depends on the number of sampled individuals in the category of interest, and the variability of the estimate due to the random nature of the sample selection.

Sampling errors for this survey were calculated using the relative sample error (RSE) measure. RSEs are the sampling error as a percentage of the estimate. The sampling methodology for NZEUS was designed with the main objective of producing estimates of total energy use by industry with an RSE of less than or equal to 10 percent at industry group (two-digit ANZSIC06) and RSEs of less than or equal to 20 percent for further ANZSIC06 sub-aggregations. The overall RSE achieved by NZEUS was 7 percent. The following table portrays the RSE for each industry.

Relative Sample Error by Industry	
Industry	Relative sample error (percent)
Horticulture and fruit growing	18.2
Sheep, beef cattle, and grain farming	16.8
Dairy cattle farming	15.1
Poultry, deer, and other livestock farming	17.5
Forestry	48.4
Logging	8.4
Aquaculture	22
Fishing	20.2
Services to agriculture, fishing, and forestry	23
Mining	17.1
Total primary industries	7

Non-response and imputation

Unit non-response

Unit (or complete) non-response occurs when units in the sample do not return the questionnaire. The initial selection weight of the remaining units in the stratum was adjusted to account for the unit non-response (no item non-response imputation would occur for the units that did not return the questionnaire).

Item non-response

Item (or partial) non-response is when units return the questionnaire but some questions are not answered. No item non-response imputation was carried out for units that did not answer 60 percent or more of the questions they were required to answer (based on questionnaire routing rules). The respondents who did not meet this criterion were classified as unit non-responses and the weights were adjusted accordingly.

Imputation of numeric variables

The imputation method used was donor imputation. In this method, the figures of a randomly selected donor from within the same imputation cell as the non-respondent are imputed in the recipient unit. Donor imputation was used so that the distribution was maintained.

Imputation of categoric questions

For categoric imputation the method used was random donor imputation. The donor supplied responses for all categoric variables requiring imputation. If the donor unit did not respond to any of the variables requiring a response, then we chose the next best donor to supply this information. This was continued until all the variables had a response.

Definitions

ANZSIC06

Australian and New Zealand Standard Industrial Classification 2006.

Business Frame

A register of all economically significant businesses operating in New Zealand. The population of the NZEUS is drawn from the Business Frame.

Economically significant

An enterprise that meets at least one of the following criteria:

- has greater than \$30,000 annual GST expenses or sales
- has RMEs greater than three
- is in a GST-exempt industry (except residential property leasing and rental)
- is part of a group of enterprises
- is a new GST registration that is compulsory, special or forced
- is registered for GST and involved in agriculture or forestry.

Enterprise

A business or service entity operating in New Zealand. It can be a company, partnership, trust, estate, incorporated society, producer board, local or central government organisation, voluntary organisation, or self-employed individual.

Kind-of-activity unit (KAU)

A subdivision of an enterprise engaged in predominantly one activity and for which a single set of accounting records is available. This is the statistical unit used in the NZEUS.

Rolling mean employment (RME)

A 12-month moving average of the monthly employee count (EC) figure. The EC is obtained from taxation data.

References

Eng, G, Bywater, I, & Hendtlass, C (Eds). (2008). New Zealand energy information handbook. Christchurch: New Zealand Centre for Advanced Engineering.

Ministry of Economic Development (2009). New Zealand energy data file. Wellington: Author.

Smil, V (2008). Energy in nature and society: General energetics of complex systems. Cambridge, Massachusetts: Massachusetts Institute of Technology.

Tables

The following tables can be downloaded from the Statistics New Zealand website in Excel 97 format. If you do not have access to Excel 97 or higher, you may use the [*Excel file viewer*](#) to view, print and export the contents of the file.

List of tables

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