workingpaper

Evaluating the Energy Dataset

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About the Resource Project Team

The Resource Project Team comprises of Jessica Prendergast, Nicola Bradshaw, Chris Aitken, Lisa Bazalo, Jean-Charles Perquin, and Steph Versteeg. Each team member has placed a significant amount of time and effort into each Working Paper and the corresponding datasets.

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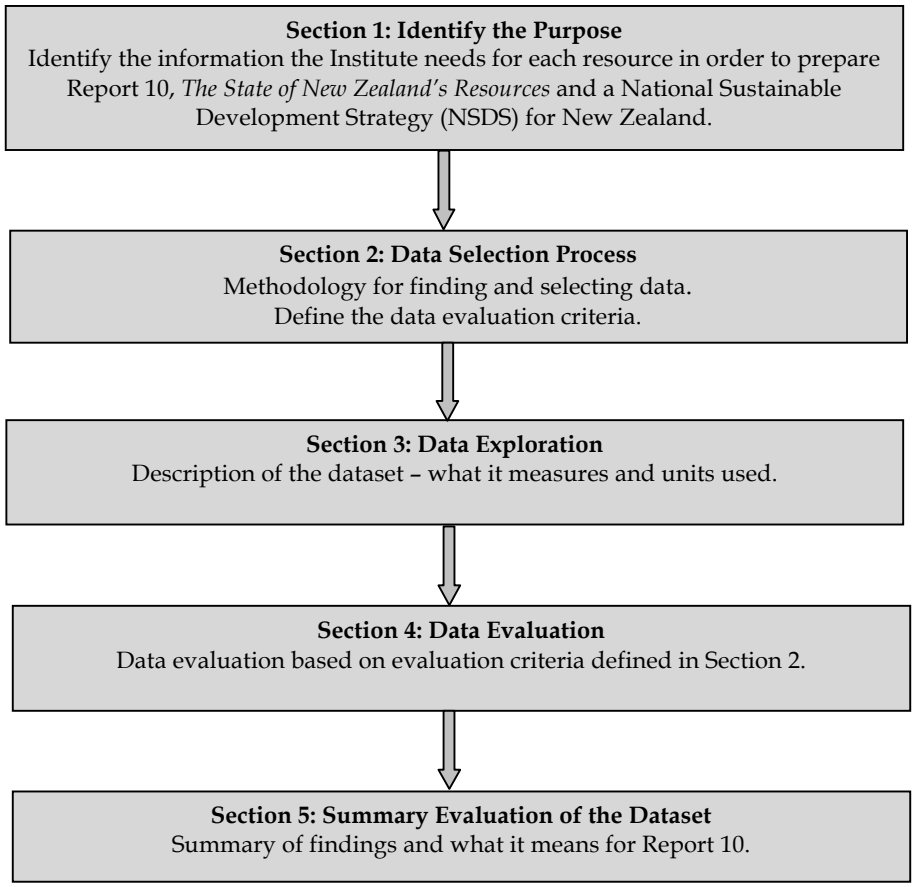
1. Purpose

This Working Paper is one of a series of 11 papers prepared as background to the Sustainable Future Institute's Report 10, *The State of New Zealand's Resources* (SFI, in press). Report 10 aims to provide an overview of available data and information covering a range of resources, and to discuss the use, availability and appropriateness of the data in the preparation of a National Sustainable Development Strategy (NSDS).

The purpose of this Working Paper is to describe the process by which the Institute collected, collated and presented a selection of data on energy consumption and production in New Zealand. The datasets are summarised and evaluated for completeness, accuracy, relevance, appropriateness of sources and public availability. This paper also discusses the purpose for which the data was collected by its custodians, and why the Institute has selected this data for it's reporting. The content of the dataset is not interpreted or analysed; rather, our purpose is to evaluate the usefulness of the dataset for the purposes of Report 10.

Following this evaluation any gaps and resulting limitations in using the selected data are assessed, as well as the data's relevance and reliability in relation to the Institute's purpose of using the comprehensive series of datasets to inform the development of an NSDS for New Zealand. A short glossary is included at the end of the Working Paper.

Figure 1 The Five-step Process for Evaluating the Institute's Datasets



1.1 The Sustainable Future Institute

The Institute is an independently funded think tank based in Wellington, New Zealand. Earlier work by the Institute has indicated that New Zealand is well behind other developed countries on its international obligations to develop and implement a National Sustainable Development Strategy (NSDS) (SFI, 2007). It is hoped that *Project 2058* will help inform ministers, policy analysts and members of the public about key events and trends in New Zealand's past, and alternative strategies for the future. With this in mind, this Working Paper is a step towards the Institute's goal of preparing an NSDS for New Zealand in 2011.

1.2 Project 2058

The strategic aim of *Project 2058* is to promote integrated long-term thinking, leadership and capacity building so that Aotearoa/New Zealand can effectively seek and create opportunities, and explore and manage risks, over the next 50 years. In order to achieve this aim, the *Project 2058* team is working to:

1. Develop a detailed understanding of the current national planning landscape, and in particular the government's ability to deliver long-term strategic sustainability thinking;
2. Develop a good working relationship with all parties that are working for and thinking about the 'long-term view';
3. Recognise the goals of iwi and hap□, and acknowledge te Tiriti o Waitangi;
4. Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future, such as government-funded science, natural and human-generated resources, the state sector and infrastructure;
5. Develop a set of four scenarios to explore and map possible futures for New Zealand;
6. Identify and analyse both New Zealand's future strengths and weaknesses, and potential international opportunities and threats;
7. Develop and describe a desirable sustainable future in detail, and
8. Prepare a *Project 2058* National Sustainable Development Strategy. (SFI, 2009: 3)

The culmination of *Project 2058*, the creation of a National Sustainable Development Strategy, depends on having an accurate assessment of key aspects of New Zealand society. Earlier reports have dealt in particular with points 1, 3, 5 and 6 above,[1] and this Working Paper is designed to help progress the fourth point: 'Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future …'

[1] For a detailed list of published and upcoming reports, see *Project 2058 Methodology: Version 3* (SFI, 2009: 7).

1.3 Energy Resources within an NSDS

Below we ask six strategic questions that drive this research. These are then expanded upon to discuss the use, availability and appropriateness of the data in the preparation of an NSDS. Without accurate, comprehensive, relevant and accessible data to answer the following questions, it will be difficult to develop and execute an informed NSDS for New Zealand.

- **What** are the issues facing energy and energy use in New Zealand? Are New Zealanders clear on exactly what these issues are? Does New Zealand have quality data and information to enable us to understand these issues as fully as possible? Are New Zealanders able to establish an informed understanding of the priorities?

- **Why** does New Zealand need to confront issues affecting energy? Are there improvements that can be achieved; or practices that need to change? Are current indicators relevant and meaningful to benchmark changes over-time? What is the purpose and the benefit in taking action?

- **When** should New Zealand start to address issues which impact on energy in New Zealand? Is now the right time? Are current economic, social and environmental conditions conducive? Would it be beneficial to wait and monitor events as they evolve? Are current measures and indicators appropriate to monitor developments? Is there a risk of rushing into short-term action when a long-term approach is needed?

- **Where** do New Zealanders most need to concentrate their efforts to address New Zealand's energy? Which aspects of the issue should be focused on first? Where should New Zealanders begin to ensure the most beneficial and sustainable outcome? Does New Zealand have sufficient knowledge, based on accurate and appropriate data, to assess outcomes?

- **Who** must be engaged to effectively address issues facing energy in New Zealand? Who needs to be involved if New Zealand is going to successfully tackle these issues? Is data on energy in New Zealand accessible and transparent to allow those interested to be accurately informed? Are data ownership issues affecting public involvement?

- **How** should New Zealand ensure we have effective energy management? What is the best approach? What skills or techniques are needed? Does New Zealand have comprehensive and accurate information to enable effective management? How can New Zealand learn from international experiences to assist in maximising effective and sustainable energy use?

This working paper does not attempt to answer the above overarching questions. These overarching questions do however inform our purpose for Report 10 and in progressing an NSDS. Data collected for inclusion within this dataset has enabled us to understand the level of accuracy, relevance, comprehensiveness and issues of ownership that exist surrounding publicly available data in New Zealand. The above questions function as a bridge between the dataset, this Working Paper and Report 10; specific questions pertaining to how the selected Institute's dataset will inform the development of an NSDS are outlined in Table 1.

2. Data Selection Process

2.1 Methodology

Report 10a, *Designing a Framework to Monitor New Zealand's Resources* (SFI, 2010a) outlined the process through which the Institute developed the framework for collecting and presenting the data. With this framework in place, the steps towards the completion of Report 10 are: (i) building the datasets for the 11 resource types studied; (ii) evaluating the selected datasets, and (iii) reporting on the findings in relation to the Institute's aim of defining an NSDS for New Zealand. The datasets developed in Step (i) are available on our website.[2] This Working Paper is one of 11 that form Step (ii), the data evaluation. Step (iii) will be published in Report 10.

The source data for the Institute's Energy Dataset was selected from a variety of static tables, extracted from the Ministry of Economic Development's (MED) *Energy Data File* and the *BP Statistical Review of World Energy*. The tables used are listed on the Institute's website under Project 2058 Publications and State of New Zealand's Resources. The static table format of the MED publication is such that the data is not readily accessible for analysis, however MED has produced a series of Microsoft Excel files, which include the figures used in the *Energy Data File*, to accompany the publication. The Institute has taken the original data and reformatted it in Excel spreadsheets to facilitate use and analysis. The original data values have been preserved.

2.2 Sources of Data

The Institute supports the free availability of data relating to environmental statistics. With this in mind, we deliberately used only openly accessible data so that we were able to report on its availability and identify potential gaps. This enables us to report on the implications of using only freely available data, and to evaluate the information that can be extracted from these data sources.

We acknowledge that many sources of information exist on New Zealand's energy that may or may not be publicly available or easily discoverable. Crown Research Institutes (CRIs), universities, national and local government, and other private and public organisations also hold data on energy.

For various reasons including privacy, commercial sensitivity, cost of dissemination or commercial sale price of the data, there are many datasets on New Zealand's resources that are inaccessible to the public. Without extensive research, funding or expertise to assist in the interpretation of the data, many others remain unavailable. The Institute has focused on open data; therefore no efforts have been made to retrieve the other datasets. This is a limitation of this project as gaps identified by the Institute could potentially be filled by these other data sources.

[2] www.sustainablefuture.info

For example, BP produces an annual statistical review of world energy usage presenting data on national consumption of coal, oil, natural gas, nuclear energy and hydroelectricity. While informative, there is less detail in the BP data than what was compiled by the New Zealand Ministry of Economic Development; there is no data on consumption by sector or additional data such as regional production or consumption figures.

Potential holders of more data include individual producers who may withhold commercially sensitive data; the Petroleum Exploration and Production Association of New Zealand, which may collect its own data; and Treasury, which may be able to gather information via taxes levied on petroleum products from both producers and end users.

The Institute searched for and compiled its dataset in 2009. What we have selected and discuss within this report reflects data fitting our purpose within the environmental data landscape at the time of research.

As data availability increases rapidly on an ongoing basis, it would not be practical to include within this Working Paper all datasets relevant to energy in New Zealand. Report 10 investigates the past, present and future of the environmental data landscape in New Zealand. It also provides a list of alternative sources of information pertaining to New Zealand's resources. When appropriate, we have mentioned complimentary data sources in this Working Paper.

Data on New Zealand's resources is often produced and targeted to industry experts. This makes a thorough analysis and evaluation of datasets a complex task for the uninitiated. We have referred to the original source documents to support our evaluation of the datasets.

2.3 Energy Dataset Evaluation Criteria

The Institute has developed a series of criteria to support the effective evaluation of its datasets and to consider the data in the context of our wider work programme. Each criterion is supplemented with questions to direct attention to relevant areas for consideration. The aim is to structure the analysis of each dataset in a way that is consistent and replicable across the 11 datasets. In this Working Paper, these criteria are applied to the Energy Dataset as a whole and to the different indicators and sources that comprise the dataset.

The criteria and guiding questions are outlined in Table 1.

Table 1 Criteria for Evaluating the Institute's Datasets

Criteria for evaluation	Guiding questions
Comprehensive time series	For how long has the data been collected? Are there gaps in the records? Are data/indicators consistent and comparable over time?
Quality data	What is the scope and range of indicators; are there any gaps? Is data comprehensive and detailed?

	How is data classified/categorised? Is the data local/regional/national? Is the data internationally comparable and valid? Is the data accurate – is there any sampling bias? Are error bars calculated? Is the data relevant and able to be interpreted with meaning?
Appropriate sources	How many sources are drawn on, and what are they? Who owns the data? Why, how and where is data collected/measured? Is the data original data, self-reported/obtained by survey? Is the data collection and analysis informed by sound assumptions? Is data reliable, independent, verifiable and/or of international standard? Is the data subject to (external) review?
Publicly available	Is the data easy to access? Is the data located online, in publicly available reports or databases, or within an institution? Is the data freely available?

2.4 Selected Sources

In order to find possible sources of data to establish a baseline portrait of the energy industry in New Zealand, the websites of agencies and organisations with relevant links to New Zealand's energy industry were reviewed for all publications which provided information and data on energy production and consumption in this country. A search was undertaken to find online datasets and statistics, documentation on the data collection and its uses, and specific publications on energy production and consumption as well as relevant publications such as annual reports. The New Zealand organisations whose websites were searched included, but were not limited to, Solid Energy, Meridian, the Electricity Commission, the Ministry of Economic Development (MED), and the Petroleum Exploration and Production Association of New Zealand. International organisations websites included those of British Petroleum (BP) and the International Energy Agency.

Most of the data for energy production and consumption was obtained from the MED publication *Energy Data File*, a document produced annually (MED, 2008; 2009).[3] This publication fits the criterion of public availability and provides the most complete dataset on energy production and consumption in New Zealand. The MED data is also used by The International Energy Agency who produces the annual publication *Key World Energy Statistics*.

[3] Earlier years are also available online at www.med.govt.nz.

2.5 Purpose for which the Data was Initially Collected

Statistics on energy production and consumption are collected by energy producers and suppliers for their own purposes and to fulfil statutory requirements. MED collates these statistics for policy and energy planning purposes, and to produce the *Energy Data File* which provides annual data and information on New Zealand's energy sector. It is part of the collection of publications produced by the Energy Information and Modelling Group of the Ministry of Economic Development (MED, 2009).

2.6 Additional Sources

The Institute's 11 working papers, prepared as background papers to Report 10, *The State of New Zealand's Resources,* are selective in their use of specific information and data from within a broader pool of information. The boundaries set for these working papers were tightly focused on openly accessible online data available as at February 2009, the original time of data collection for the Institute's accompanying datasets. There is likely to be further reading and comparisons which fall outside of our collection strategies or are developed and become available after publication of this working paper and its accompanying dataset.

3. Data Exploration

The Institute's Energy Dataset provides comprehensive coverage of all major and most minor renewable and non-renewable energy sources in New Zealand. The completeness of available data on energy needs to be considerable, as the omission of major sources of energy would hinder effective planning for the future and analysis of trends.

Table 2 Energy Dataset Summary Table

Dataset Category	Data Custodian	Data Presented	Dates	Measures	Data Reporting Frequency
Non-renewable	Ministry of Economic Development	Non-renewable energy production Non-renewable energy consumption	1974–2008	Petajoules (PJ) Kilotonnes (kt)	Annual
Renewable	Ministry of Economic Development	Wind Biogas Woody biomass and animal products	1980–2008 but 1994 at the earliest for renewable energy consumption	Petajoules (PJ)	Annual
Electricity	Ministry of Economic Development	Electricity generation non-renewable Electricity generation renewable Electricity consumption per sector	1974–2008	Petajoules (PJ) Gigawatt hours (GWh) Thousands of New Zealand dollars (k$NZ)	Annual

Non-renewable energy

The non-renewable energy dataset provides information on the production and consumption of fossil fuels within New Zealand. Production is classified according to the source from which energy is obtained. Consumption is similarly classified according to energy source, and is further divided according to the sector responsible for consumption. The range of dates for which the data is available is between 1974 and 2008. The units of measurement are petajoules (PJ) and kilotonnes (kt). An excerpt from the non-renewable energy production dataset is provided in Figure 2. Note that entries from 1977 to 2005 have been omitted for representation purposes.

Figure 2 Excerpt from the Non-renewable Energy Production Dataset
Source: SFI, 2010b

Indicator	Attribute		1974	1975	1976	2006	2007	2008	Data source table #
3a.1 Non-renewable energy production[1]	crude oil, condensate and naphtha	PJ[2]	7.87	8.13	21.57	37.93	87.69	127.56	3a.a
		kt[3]	168.47	174.09	461.54	818.07	1,874.54	2,710.04	
	LPG	PJ	0.11	0.15	0.40	8.28	5.83	4.25	3a.b
		kt	2.18	2.95	8.02	167.55	118.07	86.10	
	gas	PJ	14.06	15.36	40.22	164.31	180.88	173.75	3a.c
		kt	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	coal	PJ	62.80	59.10	60.90	152.99	124.84	127.47	3a.d
		kt	2,564.32	2,412.39	2,486.90	5,767.91	4,835.41	4,909.42	
	Total crude oil LPG gas and coal	PJ	**84.84**	**82.74**	**123.09**	**363.51**	**399.23**	**433.03**	
	Petrol	PJ	58.95	57.20	66.07	69.62	66.84	69.78	3a.e
		kt	1,248.27	1,211.19	1,399.51	1,482.09	1,422.91	1,485.49	
	Diesel	PJ	27.63	25.50	31.01	76.27	72.68	74.95	
		kt	601.32	555.01	674.95	1,658.87	1,580.64	1,630.05	
	Fuel oil	PJ	63.13	43.81	51.31	23.93	24.32	28.48	
		kt	1,422.37	989.87	1,157.56	541.73	550.52	644.70	
	Aviation fuels	PJ	0.00	0.00	0.00	42.23	38.94	40.59	
		kt	0.00	0.00	0.00	910.80	839.78	875.40	
	other petroleum products	PJ	5.27	3.51	4.69	5.81	5.89	5.16	
		kt	123.46	82.38	109.98	159.51	162.68	150.68	
	Total petroleum products	PJ	**154.98**	**130.02**	**153.09**	**217.87**	**208.67**	**218.97**	
		kt	**3,395.42**	**2,838.45**	**3,342.00**	**4,752.99**	**4,556.53**	**4,786.33**	

Renewable energy

The renewable energy dataset provides data on consumption and production of energy from renewable resources. Data on renewable total primary energy supply extends back to 1980; however, consumption data has been recorded by sector since 1994 at the earliest. Data is measured in PJ. An excerpt from the renewable energy dataset is provided in Figure 3. Note that entries from 1991 to 2005 have been omitted for representation purposes.

Figure 3 Excerpt from the Renewable Energy Supply Dataset
Source: SFI, 2010b

Indicator	Attribute		1980	1985	1990	2006	2007	2008	Data source table #
3b.1 Renewable total primary energy supply	hydropower	PJ[4]	69.02	70.94	83.46	84.86	85.10	80.32	3b.a
	geothermal		57.15	78.93	92.65	92.70	96.87	113.21	
	solar		0.00	..	..	0.27	0.30	0.32	
	wind		0.00	..	..	2.24	3.35	3.81	
	biogas		0.74	1.30	1.73	3.02	2.95	2.87	
	woody biomass & animal products		27.98	28.36	32.11	38.87	39.81	40.42	
	Total primary energy supply		**154.88**	**179.53**	**209.94**	**221.95**	**228.38**	**240.95**	

Electricity

This dataset presents information on electricity generation in New Zealand. Production data is divided primarily into renewable and non-renewable, and secondarily by the energy source, such as geothermal and hydro power. Electricity consumption is divided into residential, commercial and industrial sectors. Data is measured in PJ and GWh. An excerpt from the electricity dataset is provided below in Figure 4. Note that entries from 1977 to 2005 have been omitted for representation purposes.

Figure 4 Excerpt from the Electricity Generation Dataset
Source: SFI, 2010b

Indicator	Attribute		1974	1975	1976	2006	2007	2008	Data source table #
3c.1 Electricity generation non-renewable	oil	PJ[1]	6.99	2.83	4.61	0.08	0.00	0.44	3c.a
		GWh[2]	1,943.00	787.00	1,280.00	21.60	0.52	123.06	3c.b
	coal	PJ	4.69	3.79	3.97	18.40	10.43	16.01	3c.a
		GWh	1,302.57	1,051.57	1,102.57	5,110.48	2,896.33	4,446.05	3c.b
	gas	PJ	0.75	0.18	6.48	33.38	40.06	36.04	3c.a
		GWh	208.65	50.65	1,800.65	9,272.18	11,127.24	10,010.13	3c.b
	waste	PJ	0.07	0.15	0.18	0.24	0.19	0.17	3c.a
		GWh	18.43	42.13	50.03	67.78	52.92	47.01	3c.b
	Total	**PJ**	**12.50**	**6.95**	**15.24**	**52.10**	**50.68**	**52.65**	3c.a

4. Data Evaluation

In this section we evaluate the data presented in the Energy Dataset based on the criteria set in Table 1.

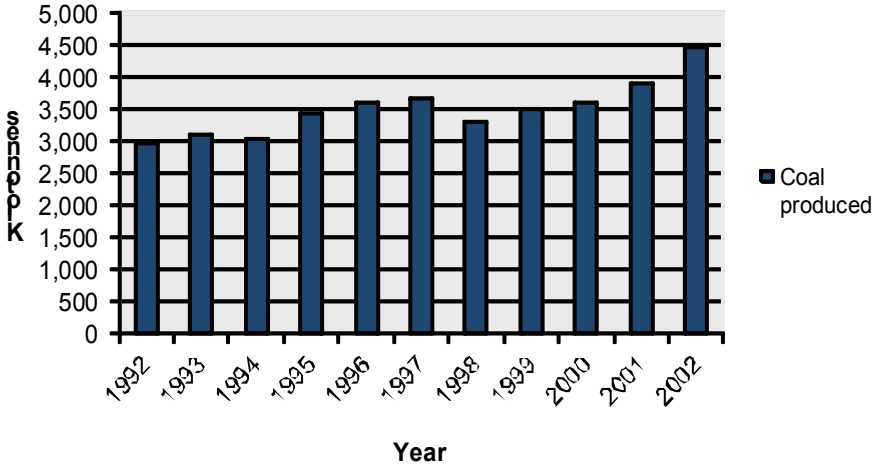
4.1 Comprehensive Time Series

Data available since 1974: useful for recent history time series analysis
Much of the data on energy in New Zealand, in particular production data, was available at the time of research over the time period 1974–2008. This period should be sufficient to capture any trends, and covers many of the significant changes that have occurred in energy production and consumption in New Zealand in recent history. An example of this is the opening of the Maui gas field in 1979 which significantly changed the profile of New Zealand's energy production (Contact Energy, 2010).

Consistent data collection over time once data recording begins
Data does not start at the same point in time in all categories; however, once data is provided for a given variable there are no temporal gaps until 2008. The temporal completeness of the Energy Dataset aids comprehensive analysis.

Changing methods of data collection on coal in 1997 may impact upon effectiveness of comparison with data supplied after 1997
Prior to December 1997, coal production data was reported in six-monthly reports by producers. After this date the method of collection was changed and it was instead based upon levies collected (Statistics New Zealand et al., 2006: 26). There has been no indication in the source material accompanying the MED data that these changes have resulted in inaccuracies in reporting, however the Institute notes that a drop in reported coal production occurs at this point in time, as shown in Figure 7.

Figure 5 Coal Production in New Zealand
Adapted from: SFI, 2010b



4.2 Quality Data

Absence of energy end use data

A major concern is the lack of reliable data for energy end use. The need for improvement in this area has been identified as a priority (Statistics New Zealand et al., 2006: 5). This problem typically arises because end users have no knowledge of, or system of recording their usage (as is the case for residential users), or because there is no incentive to measure their usage. This is also the case for most direct users of geothermal energy (NZGA, 2009: 8). Statistics New Zealand have established the *New Zealand Energy Use Survey* (NZEUS), piloted in 2006 with the manufacturing sector, and it has since been operating for a growing number of sectors. The NZEUS "surveys a sample of all businesses in NZ. This is done over three years, with about a third of New Zealand's full economy sampled and surveyed in each year of a three year cycle" (Statistics New Zealand, n.d.). This survey has begun to remedy the lack of energy end use data.

Comprehensive coverage of energy sources

The dataset has a comprehensive coverage of the different types of energy sources in New Zealand. It even includes newer sources such as wind, biogas and solar despite the lack of information available for these sources. It is to be expected from MED that data collection methods will be adapted over time to account for newer sources and for populating the data tables.

Detailed breakdown of consumption data

Energy consumption data is divided into sub-categories by fuel type and then consumer type (i.e. by sectors). This level of detail allows for a greater depth of analysis than a single indicator would.

Lack of comparable energy consumption data between datasets

In most instances data is missing for renewable energy consumption because of a lack of available reliable data (Statistics New Zealand et al., 2006: 12). Renewable energy

consumption data can only be provided where there is direct use, such as geothermal heat for industry, or private electrical generation, such as solar panels on homes.

In addition, the fungible nature of electricity means that it is not possible to determine its source for any given sector or use. Hydroelectricity, the largest source of renewable energy in New Zealand, is used entirely for electricity generation and is distributed through the national grid. As a result the renewable energy dataset has relatively sparse data on end use by sector which prevents analysis and comparison with non-renewable energy use by sector. Figures 6 and 7 illustrate the difference in the amount of consumption data available for renewable and non-renewable energy consumption.

Figure 6 Renewable Energy Consumption – Biogas
Source: SFI, 2010b

Attribute			2000	2001	2002	2003	2004	2005	2006
biogas	agriculture	PJ	..	..	..	..	..	..	..
	industrial		..	..	..	..	..	..	..
	commercial		0.15	0.18	0.19	0.18	0.11	0.22	0.26
	residential		..	..	..	..	..	..	..
	national transport		..	..	..	..	..	..	..
	Total		**0.15**	**0.18**	**0.19**	**0.18**	**0.11**	**0.22**	**0.26**

Figure 7 Non-renewable Energy Consumption – Coal
Source: SFI, 2010b

Attribute			2000	2001	2002	2003	2004	2005	2006
coal	agriculture	PJ	0.58	0.59	0.63	0.55	0.53	1.22	1.98
		kt	24.77	24.27	25.73	23.46	22.95	54.31	84.54
	residential	PJ	1.08	0.72	0.60	0.82	0.87	0.88	0.69
		kt	64.84	39.41	34.19	45.51	45.48	46.43	38.23
	commercial	PJ	3.30	5.12	4.92	4.16	6.59	3.36	3.82
		kt	146.50	225.35	218.31	181.27	291.88	152.88	175.34
	industrial[S]	PJ	14.65	18.07	17.56	23.26	14.53	13.20	16.44
		kt	671.75	798.73	790.14	1,029.93	686.12	630.24	772.29
	national transport	PJ	0.08	0.08	0.08	0.08	0.08	0.08	0.08
		kt	3.08	3.08	3.08	3.08	3.08	3.08	3.08
	Total	PJ	**19.70**	**24.58**	**23.79**	**28.87**	**22.60**	**18.75**	**23.01**
		kt	**910.94**	**1,090.84**	**1,071.44**	**1,283.24**	**1,049.51**	**886.93**	**1,073.49**

Data accuracy information and data collection methodologies not available on the MED website

MED does not provide information about how its statistics are collated, or the possible error margins in the data presented. These may or may not be sizeable however it is not possible for a party making use of the publicly available data to determine its accuracy.

Self-reporting in surveys used for *Energy Data File* data collection

Although all data is collected according to prescribed guidelines and using standardised surveys, data is ultimately self-reported by producers and distributors. The absence of independent data collection and verification decreases the reliability of data due to the increased potential for variation and inconsistencies in the measurement and reporting from the survey respondents.

Energy source importation and exportation data not represented
Some resources, in particular coal and crude oil, are produced within New Zealand and exported, yet significant quantities of both these resources are also imported to meet local demand. The reason for this is that the fossil fuels extracted within New Zealand are not suited to refinement and use within this country. The Institute's dataset does not include data on energy source importation and exportation. We accept this as a limitation.

Biofuel data not available
Although biofuel is currently only a small proportion of the market (MED, 2009: 42) it is worth noting that it was not included at the time of research within any of the current publicly available datasets on energy. However, information on biofuels is expected to be collected and included in future editions of the *Energy Data File*.

Total Primary Energy Supply (TPES) for renewable energy calculations do not take into account energy loss through energy transmission
Total primary energy supply (TPES) is the amount of energy available for use in New Zealand for energy transformation and end use (MED, 2009: 166). It includes energy as it is first obtained from natural sources (ibid.). The calculation of TPES for renewable sources is subject to several assumptions that must be noted.

The total amount of energy (in PJ) used for electricity generation from hydropower and geothermal sources is calculated based upon the amount of electricity generated multiplied by a factor to reflect the efficiency of the particular generation method. For hydropower this conversion efficiency is assumed to be 100%, although the efficiency for modern hydropower is reportedly closer to 90% (US Department of the Interior, 2005: 2). The result of this is that the estimated hydropower TPES will be lower than the actual TPES by approximately 10%. For geothermal electricity production the conversion efficiency is estimated at 10% prior to the year 2000, and 15% for 2000 onwards. While this figure is reasonable (Barbier, 2002: 41), it is an estimate, and the apparent drop in TPES from geothermal energy from 2000 onwards is in part an artefact of changes in this estimate. We note that the majority of the geothermal TPES is used directly as heat and not for electricity generation, thus the increase in the efficiency estimate only affects the portion used for electricity generation.

Inconsistent categories for non-renewable energy sources
Some of the sector categories used by MED to classify energy consumption are not consistent across different fuel types. For example, what is included within the industrial category differs between coal, gas and LPG. Industrial, as used for measuring coal consumption, excludes co-generation from 1997 onwards; when used for gas consumption it includes transport and co-generation; when used for LPG consumption neither transport nor electricity generation are included. This makes direct comparison between fuel types impossible. Where categories have varying definitions it is noted in the dataset.

4.3 Appropriate Sources

Data from MED: an authoritative source of energy data in New Zealand

The data in the Institute's Energy Dataset is from New Zealand's Ministry of Economic Development, the authoritative source of data on energy and resources. MED compiles data on New Zealand's energy sector from across the country, collected by energy producers and distributors.

Variation in data collection methods

The methods by which data is collected for MED's *Energy Data File* vary according to the resource being measured. Renewable and non-renewable energy production data is provided by New Zealand producers and suppliers of energy at regular intervals, either monthly or quarterly. The only exception is coal data prior to 1998, which was collected at six monthly intervals. Electricity production data is collected monthly from those who generate electricity on a commercial basis. Generators, wholesalers, transmitters, distributors and retailers of electricity provide data on consumption of electricity on an annual basis (Statistics New Zealand, et al, 2006: 22–27).

4.4 Public Availability

All data publicly available and well documented

It is the aim of this project to assess publicly available data, i.e. data that is able to be accessed by parties independent of those who collect or present it. MED's *Energy Data File* fit this criterion; the reports are freely available to the public via the agency's website, however, it is unfortunate that data collection methodologies were not provided online.

5. Summary Evaluation of the Dataset

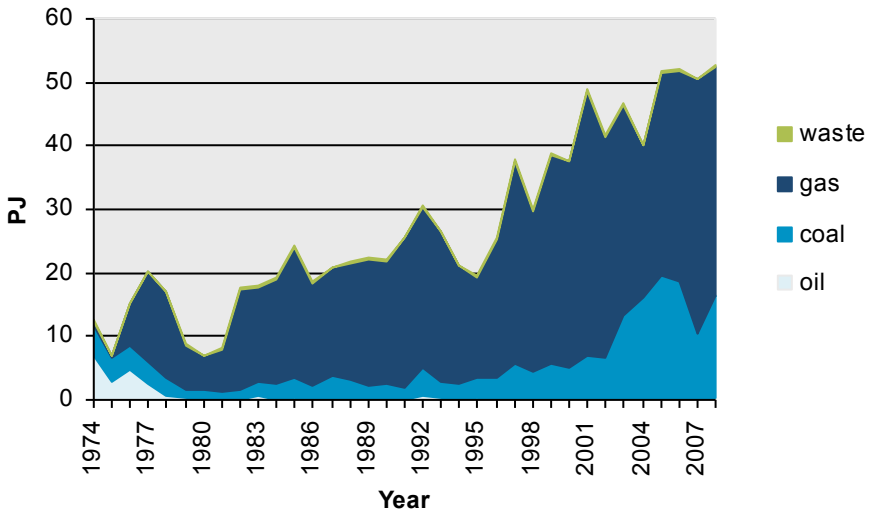
The Institute chose the MED dataset as the primary source of data to inform its upcoming Report 10 and an NSDS as it was deemed to be comprehensive and reliable. However the *Energy Data File* has certain limitations, especially since it does not provide information on how the data has been collected. Table 3 below summarises the Institute's evaluation of the dataset.

Table 3 Summary of Energy Data Evaluation

	Strengths	Weaknesses
Comprehensive time series	▪ Data available since 1974 for most of the datasets: useful for recent history time series analysis ▪ Consistent data collection over time once data recording begins	▪ No historical data prior to 1974 ▪ Changing methods of data collection on coal in 1997 may impact on the effectiveness of comparison with data supplied after 1997
Quality Data	▪ Comprehensive coverage of energy sources ▪ Detailed breakdown of consumption data	▪ Absence of energy end use data ▪ Lack of comparable energy consumption data between datasets ▪ Data accuracy information and data collection methodologies not available on the MED website ▪ Self reporting in surveys used for *Energy Data File* data collection ▪ Biofuel data not available ▪ Total Primary Energy Supply (TPES) for renewable energy calculations do not take into account energy loss through energy transmission ▪ Inconsistent categories for non-renewable energy sources
Appropriate Sources	▪ Data from MED: an authoritative source of energy data in New Zealand	▪ Data collection methods in the *Energy Data File* vary in function across the resources being measured
Publicly available	▪ MED statistics available online	▪ Data collection methodologies not available online

The Institute acknowledges that other sources may need to be consulted in order to gain a complete and comprehensive overview of energy in New Zealand. The Institute's dataset does not answer the questions outlined in Section 1.3, but can provide background statistics to support reporting, analysis and argumentation. An example of how the data may be used is presented in Figure 8 below.

Figure 8 Electricity Production from Non-renewable Resources
Adapted from: SFI, 2010b



Glossary

Glossary	
biogas	Fuel source produced from the anaerobic digestion of sewage and industrial waste. It includes landfill gas and sewage (MED, 2009: 162).
crude oil	A mineral oil consisting of a mixture of hydrocarbons of natural origins, yellow to black in colour, of variable density and viscosity (MED, 2009: 163).
end user	A company or individual that purchases energy for their own consumption and not for resale (i.e. an ultimate consumer) (EIA, 2009).
fossil fuels	Coal, natural gas, LPG, crude oil and fuels derived from crude oil (including petrol and diesel). They are called fossil fuels because they have been formed over long periods of time from ancient organic matter (MED, 2009: 163).
geothermal direct use	Direct use of thermal properties of geothermally-sourced heat. Electricity generation is excluded as are bathing, chemical and biotic uses (NZGA, 2009: 7–8).
gigawatt hour (GWh)	One billion watts of power over an hour. It is the standard unit for measuring electricity production on a national scale (MED, 2005).
non-renewable energy	Energy that cannot be replaced once it is used, or energy that is not being replaced as fast as it is being used (WWF, n.d). Within New Zealand, where nuclear fuel sources are not used, this means fossil fuels only.
petajoule (PJ)	The unit, equal to 10^{15} (one quadrillion) joules, most often used to measure energy generation and use on a national scale. One petajoule is roughly equivalent to: all the electricity used in Nelson in a year; a coastal tanker load of 25,000,000 litres of oil, or over 10 days output from the Huntly power station at full capacity (MED, 2005).
renewable energy	Energy obtained from sources that are essentially inexhaustible, unlike the fossil fuels, of which there is a finite supply. Renewable sources of energy include wind, biomass, geothermal and solar energy (Queensland Government, 2010).
woody biomass	Wood supplied as fuel, wood waste and residues (arisings, hog fuel, bark and black liquor) (MED, 2008: 171).

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