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Regional Energy Survey 2003

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Executive Summary

This report presents the results of a Regional Energy Survey carried out for the Waikato Region based on the calendar year 2003. The purpose of the survey was to establish baseline energy consumption for the Region and for Hamilton from which to assess future trends in energy consumption.

A variety of sources were used to estimate energy consumption within the industrial, domestic and transportation sectors. These included:

- Annual kWh data from electricity line companies within the Region.
- Annual petrol and diesel use data derived from the Local Authority Petroleum Tax data collected by Territorial Local Authorities (TLAs) within the Region.
- Domestic fuel use data collected for selected urban areas using household surveys extrapolated for 2003, and the region based on census heating and population data.
- Industrial fuel use and energy consumption data collected directly from industry and from resource consent files and Environment Waikato staff.
- Data from Statistics New Zealand, the Ministry of Transport and the Ministry of Economic Development.
- Fuel use data from Tranzrail.

Across the Region, a total of around 109,000 TJ of energy was estimated to have been consumed during 2003. The majority of this was consumed by the industrial sector (73%), with 21% from transport and 6% from domestic heating. Oil products contributed 60% of the energy consumption with natural gas consumption dominating this source. Coal combustion was the second greatest source of energy at 24%.

In Hamilton around 8173 TJ were consumed, comprising approximately 8% of the Regional estimate. The majority of this was consumed by the transportation sector (56%) with domestic heating using 28% and industry 17%. Oil products contributed 56%, with petrol and diesel combustion dominating this source. Electricity consumption was responsible for 40% of energy use within Hamilton.

The total energy consumption per capita for the Region was 305 GJ/ person. This compares to 115 GJ/ person for Canterbury. The difference occurs as a result of the greater industrial energy consumption in the Waikato (222GJ/ capita compared to around 30 GJ/ capita for Canterbury).

Energy use within the Region was estimated to produce around 5991 kilo tonnes of CO_2 per year excluding emissions from wood consumption. Estimates relate only to energy use and do not include CO_2 emission estimates from geothermal power production or non-energy related sources.

1 Introduction

1.1 Purpose

This report presents the results of a Regional Energy Survey conducted by Environment Waikato and details information on energy use in the region. The purpose of this report is to establish a baseline from which to assess future trends in energy consumption.

1.2 Background

The Regional Policy Statement (RPS) identifies energy as a significant resource management issue. Issue number 3.12.2 of the RPS states *"inefficient energy production and use uses natural resources at a greater rate than is needed and results in unnecessary adverse effects on natural and physical resources."* The objective *"efficient use of energy within the Waikato Region"* is included in the RPS and a number of methods are identified to achieve this objective. These include:

- *Advocate, through community information and education, for the promotion of energy efficiency, conservation and the adoption of appropriate energy forms and technologies.*
- *Encourage the use of alternative and renewable energy sources through community education.*
- *Encourage inter-agency co-operation in undertaking research into the Region's available energy sources and appropriate energy technologies, through regional and annual plans and reviewing of research proposals (e.g. public good science funding input).*
- *Advocate energy efficiency in the design, location and operation of buildings and other structures, through community information, regional plans and resource consents.*
- *Encourage Central Government to prepare a National Energy Strategy.*
- *Encourage the efficient use of energy in the transport sector through the Regional Land Transport Strategy*

The inefficiency of New Zealand's energy generation, distribution and consumption is of concern. The impacts associated with improving energy efficiency include reduced pollution, both locally and globally. There are also significant resource and cost benefits of improving energy efficiency. In the Waikato Region, the main energy sources used are oil, coal, gas, geothermal resources and rivers (hydro-electricity). A Regional Energy Survey of these sources is required to monitor the effectiveness of the measures identified in the RPS for improving energy efficiency in the Region.

2 Methodology

2.1 Electricity

Electricity consumption data were obtained from the disclosure information provided by the line companies operating in the Waikato Region. The main network providers for the Region are WEL Networks (Hamilton and others), Waipa (South Waikato), Unison (Taupo area), The Lines Company (Te Kuiti and surrounds) and Powerco (Waikato East including the Coromandel). The area covered by each line company is shown in appendix one. Consumption was estimated as follows:

$$\text{Total electricity supplied (kWh)} - \frac{\text{loss ratio (\%)}}{\text{electricity supplied (kWh)}} = \text{consumption (kWh)}$$

Unison advised that the amount of electricity supplied to the Waikato Region was minimal and that it would not be possible to estimate an amount for this area. The consumption for the area covered by the Unison network was therefore estimated based on the number of domestic dwellings in the area and the average consumption per domestic dwelling for the region. Electricity consumption data includes loss from system, which accounts for between 4.9% and 6.8% of the electricity supplied by each line company during 2003.

A separate estimate for Hamilton was made based on information provided by WEL Networks, the sole line network provider for the Hamilton area. WEL indicated that Hamilton comprised 90% of the WEL network electricity consumption.

Data were collected based on the calendar year for the years 2000 to 2003. An estimate of the annual Powerco consumption for the "valley area' was provided directly by Powerco staff. The "valley area" was the company's Eastern Network minus consumption in the Tauranga and Mt Maunganui areas (pers comm., Sarah Brown, Powerco, 2003).

Some region specific data were available on the domestic and industrial components of electricity consumption. In particular, the WEL network advised that 40% of their consumption was industrial and commercial, and the remainder was domestic. For the rest of the region, the domestic versus industrial split in electricity consumption was based on national figures, as no further region specific data were provided.

2.2 Coal and wood use

Domestic coal and wood use were estimated based on a household survey carried out for the areas of Hamilton, Tokoroa, Te Kuiti during 2001 and a survey carried out for the areas of Huntly, Taupo, Matamata and Putaruru during 2000. From this the average amount of wood and coal burnt per day during winter was established for Hamilton and for the Region on average. Separate fuel use averages were used for Huntly owing to the predominance of coal. Daily fuel use for Hamilton and the Region were estimated based on 2001 census data on home heating methods. The estimates were extrapolated for 2003 based on a Statistics New Zealand estimated regional population increase of 2% from 2001 to 2003.

The annual average fuel use for domestic wood and coal was estimated for Hamilton and the Waikato Region based on seasonal variations in wood and coal use and the average number of burn days per week established for Auckland (Wilton, 2002).

Industrial coal and wood users were identified based on information from resource consent files held by Environment Waikato. While this captures all major industrial users within the region, combustion activities with a heat output of less than 5 MW that were established prior to the notification of the air plan (or 2 MW if established after the notification of the air plan) do not require a resource consent to discharge to air. In Christchurch, coal combustion from activities with a heat output of less than 5 MW contribute around 31% of the daily coal consumption during the winter if school boilers are included or 27% if they are excluded. However, use of these data would be inappropriate as the coal consumption for processes greater than 5 MW in the Waikato is significantly higher than for Christchurch because of differences in the types of activities.

The amount of fuel used was determined either from the resource consent files or by asking industries for recent fuel use statistics.

Other methods of estimating consumption from industrial coal combustion include surveys of industrial coal sales within the Region. However, discussions with Wayne

Hennessy at Coal Research Limited indicate that this is also not a reliable method of estimating annual fuel use (Hennessy pers comm., 2003).

Because of the greater quantity of coal consumed by larger industrial activities in the Waikato, compared to Christchurch, it is likely that processes greater than 5 MW will consume much more than 70% of the coal used by industry for the Region. No estimates of coal consumption by non-consented industrial processes within the region were therefore made.

Estimates of industrial wood use were based on the same approach. The Waikato Region contains a few large-scale industrial processes that burn wood to generate heat. Fuel use from any smaller industrial wood furnaces is likely to be minimal in comparison.

2.3 Oil products data

Industrial oil use data were obtained from resource consent files for discharges to air. In addition, Liquigas, Rockgas, OnGas and Shell were contacted for LPG use in the Waikato Region and in Hamilton. While data were provided by a few of these sources, necessary information was withheld on the grounds of commercial sensitivity.

Domestic oil, natural gas and LPG use data for the Waikato were estimated based on surveys of home heating methods and fuels carried out during 2000 and 2001 for a number of urban centres within the region. Annual fuel use for the region was extrapolated from these data using information on heating methods and fuels from the 2001 census and information on seasonal variations established for Auckland as described in section 2.2.

Fuel use data for motor vehicles were estimated based on the Regional Fuel Tax information collected by local councils. Fuel tax information was provided by the Hamilton City Council for the areas of Hamilton, South Waikato, Hauraki, Matamata-Piako, Thames Coromandel, Waikato and Waipa Districts. About 75% of the total number of dwellings in the Waikato Region are within these areas. These data were used to extrapolate fuel use for the remainder of the Region because of differences between TLA and Regional Council boundaries.

The amount of petrol tax collected by Hamilton City Council for the year December 02 until November 03 was used to estimate the amount of fuel used in these areas for the year 2003[1]. Table 2.1 summarises the amount of petrol tax collected for these areas by month of year. Estimates of fuel use in table 2.1 were derived from the petrol tax information based on the diesel component being one third of the dollar amount given and the tax rates of 0.66 cents per litre for petrol and 0.33 cents per litre for diesel (pers comm., Gwen Harrison, Hamilton City Council).

Because adequate LPG use data was not provided by all suppliers, use of the fuel for transportation within the Region was estimated based on national LPG use statistics apportioned for the Waikato based on Transit New Zealand territorial local authority VKT data for 2000/2001. Nationally LPG consumption for the year to March 2002 was 136,000 tonnes. Mulvena, (2002) indicates that around 20% of the national consumption is for motor vehicles, with the remainder split between domestic (40%), industrial (10%) and commercial (30%). Because industrial use is limited to a small number of large-scale industries in New Zealand and no consents have been issued in the Region for LPG use and because LPG is not usually competitive in the commercial market in the North Island (Mulvena, 2002) it is assumed that consumption by these sectors in the Waikato is negligible[2].

[1] The amount of fuel used in 2003 December was based on the December 2002 consumption figure provided.
[2] Although not quantifiable, data provided by LPG sources suggests that it is likely to be less than 400 tonnes per year (<20 TJ per year).

Table 2-1: Fuel tax data collected by Hamilton City Council from December 2002 until November 2003 and extrapolation for the rest of the Region.

	Fuel Tax	Diesel	Petrol	Diesel (litres)	Petrol (litres)	Fuel (litres)
Dec-02	$227,527	$75,842	$151,684	22,982,496	22,982,475	45,964,971
Jan-03	$215,467	$71,822	$143,645	21,764,362	21,764,343	43,528,705
Feb-03	$195,042	$65,014	$130,028	19,701,209	19,701,191	39,402,401
Mar-03	$213,799	$71,266	$142,533	21,595,871	21,595,851	43,191,722
Apr-03	$211,020	$70,340	$140,680	21,315,196	21,315,177	42,630,373
May-03	$206,440	$68,813	$137,626	20,852,514	20,852,495	41,705,009
Jun-03	$193,195	$64,398	$128,797	19,514,651	19,514,633	39,029,284
Jul-03	$204,029	$68,009	$136,019	20,608,938	20,608,920	41,217,858
Aug-03	$200,336	$66,779	$133,557	20,235,939	20,235,921	40,471,861
Sep-03	$206,797	$68,932	$137,864	20,888,553	20,888,535	41,777,088
Oct-03	$219,167	$73,056	$146,111	22,138,061	22,138,041	44,276,103
Nov-03	$218,513	$72,838	$145,675	22,072,038	22,072,018	44,144,057
Total				253,669,829	253,669,601	507,339,430
Region				337,330,134	337,329,831	674,659,965

Estimates of the Hamilton component were based on estimates of fuel use for Hamilton from road network modelling, carried out by Dave Hunter of Gabites Porter for the 2001 air emissions inventory and extrapolated to 2003 based on projected population growth. This indicated an estimated fuel use of around 131,563,513 litres for 2003. This is about 26% of the total of 507,339,430 litres for the area collected by Hamilton City Council. This is perhaps less than expected given that the Hamilton proportion of dwellings within the areas the petrol tax was collected is 39%. No fuel tax data were available for Hamilton alone.

Aviation fuel consumption was based on national data for Jet A1, FFII and AvGas 100 provided by Statistics New Zealand. The oil companies located at the Hamilton International Airport and the Taupo Airport had been approached for region specific fuel use but were unable to provide these data owing to commercial sensitivities. The proportion of national aviation fuel consumed in the Waikato Region was estimated based on aviation CO_2 emissions data from the National Transport Emission Inventory (NIWA, 1996). This attributes 2% of the national aviation fuel use to the Waikato Region.

Marine transport oil consumption for the Region was estimated to be minimal owing to the reliance on Ports outside of the Waikato. Discussions with staff at Coastal Tankers (04 472 8531) indicated that it was not possible to determine the quantity of oil coming into the area as this went from trucks via Auckland and Mt Maunganui and also included other areas such as the Bay of Plenty. They advised that the Local Authority Petrol Tax data would cover the majority of the oil use within the Region.

Estimates of energy use associated with diesel consumption from rail transport were based on data contained within the MOT report “Impacts of Rail Transport on Local Air Quality” (Ministry of Transport, 1999), data from the New Zealand Transport emission inventory (NIWA, 1996) and fuel use information supplied by Tranzrail (pers comm., Edward Kitt, 2004). The amount used within Hamilton was based on the MOT study (Ministry of Transport, 1999), which estimated emissions of CO, HC, PM, and NOx from rail transport for the main urban areas of New Zealand.

2.4 Conversion factors

The conversion factors used to estimate energy consumption from fuel use data are shown in Table 2.2. These are primarily from the MED energy data files and are based on net calorific values (Ministry of Economic Development, 2003).

Table 2-2: Net calorific values for fuels (primarily from MED, 2003)

	MJ/litre	MJ/kg	TJ/L	TJ/kg	TJ/tonne
Petrol	32.715	43.9	0.0000327	0.0000439	0.04390
Diesel	35.99	42.8	3.599E-05	0.0000428	0.04280
AvGas	31.06	44.5	3.106E-05	0.0000445	0.04450
Jetfuel	34.64	43.33	3.464E-05	4.333E-05	0.04333
LPG	24.38	45.65	2.438E-05	4.565E-05	0.04565
LFO	38.1	41.32	0.0000381	4.132E-05	0.04132
Coal		28.53		2.853E-05	0.02853
Wood - fuel wood 38-41% moisture wet basis		10.3		0.0000103	0.01030
Wood - oven dried		19.2		0.0000192	0.01920
Bark	60-70% wet basis	7		0.000007	0.00700
	kcal/m3	MJ/m3	TJ/m3		
Natural gas		36	0.0000355		
Biogas[1]	5000	20.929	0.000021		
	MJ/litre	MJ/kg	TJ/L	TJ/kg	TJ/tonne
Waste oil[1]		44.01		4.401E-05	0.04401

[1] **CV data from resource consent file**

3 Domestic energy consumption

3.1 Electricity (energy consumption only)

Table 3.1 provides an estimate of domestic electricity consumption for the Waikato Region and for Hamilton for the years 2000 to 2003. Estimates do not include annual variations in electricity consumption from the Powerco Eastern network, as data from previous years were unavailable for the Eastern component of the network. It was assumed that consumption during previous years was similar to 2003 levels. In reality it is probable that trends observed across the other networks i.e., an increase in electricity consumption also occurred across the Powerco network.

The kWh average consumption per connection was similar across each year from 2000 to 2003 suggesting that increases in electricity consumption have occurred as a result of an increase in the number of connections, for example as a result of population growth. These connections data are not specific to domestic connections and will include industrial, commercial and agricultural connections. The differences in average consumption per connection in Hamilton versus the rest of the region may relate to differences in city versus country lifestyles or may occur as a result of assumptions regarding the industrial and domestic components of electricity use for the Region (see Section 2.1).

The total amount of energy consumed by domestic households using electricity for 2003 was estimated to be 1860 TJ in Hamilton and 3419 TJ for the Waikato Region (Table 3.2).

Table 3-1: Electricity consumption for Hamilton and the Waikato Region from 2000 to 2003

	2003 MWh	2002 MWh	2001 MWh	2000 MWh
Total Region	1006760	985690	979366	981378
Hamilton	543360	519691	521545	526959
Regional average/ connection	12.8	12.5	12.5	12.7
Hamilton average/ connection	8.2	7.9	8.1	8.3

Table 3-2: Energy consumption from domestic electricity use for Hamilton and the Waikato Region from 2000 to 2003

	2003 TJ/ year	2002 TJ/ year	2001 TJ/ year	2000 TJ/ year
Total Region	3624	3548	3525	3533
Hamilton	1956	1871	1877	1897

3.2 Wood, coal, oil and gas consumption

The amount of domestic wood, coal, oil and gas estimated to be consumed in the Waikato Region and in Hamilton for the year 2003 is shown in Tables 3.2 and 3.3. The estimated energy consumption associated with the use of these fuels is shown in Tables 3.4 and 3.5.

Table 3-3: Estimated regional domestic wood, coal, and oil products consumption for 2003

	Wood tonnes/ year	Coal tonnes/ year	Oil tonnes/ year
Winter	105406	11107	1890
Spring	14921	1572	267
Summer	1688	178	30
Autumn	17795	1875	319
Total	139809	14732	2506

Table 3-4: Estimated Hamilton domestic wood, coal, and oil products consumption for 2003

	Wood tonnes/year	Coal tonnes/year	Oil products tonnes/year
Winter	14540	2174	687
Spring	2058	308	97
Summer	233	35	11
Autumn	2455	367	116

Total	19285	2883	912

Table 3-5: Estimated regional domestic wood, coal, oil and gas consumption for 2003

	Wood TJ/year	Coal TJ/year	Oil products TJ/year
Winter	2024	317	66
Spring	286	45	9
Summer	32	5	1
Autumn	342	53	11
Total	2684	420	88
% of total	84%	13%	3%

Table 3-6: Estimated Hamilton domestic wood, coal, oil and gas consumption for 2003

	Wood TJ/year	Coal TJ/year	Oil TJ/year
Winter	150	62	18
Spring	21	3	3
Summer	2	0	0
Autumn	25	7	3
Total	199	72	24
% Total	67%	25%	8%

3.3 Summary Domestic Energy Consumption

The estimated domestic energy consumption for the Waikato Region and Hamilton for 2003 is shown in Tables 3.6 and 3.7. The majority of the energy consumption for the domestic sector is electricity, at around 53%, compared to 40% for wood across the Region and 87% and 9% for electricity and wood respectively in Hamilton (Figure 3.1).

Table 3-7: Regional Domestic Energy Consumption for 2003

2003	Electricity	Wood	Coal	Oil products
TJ/ year	3624	2684	420	88
% Total	53 %	40%	6%	1%

Table 3-8: Hamilton Domestic Energy Consumption for 2003

2003	Electricity	Wood	Coal	Oil products
TJ/ year	1956	199	72	24
% Total	87%	9%	3%	1%

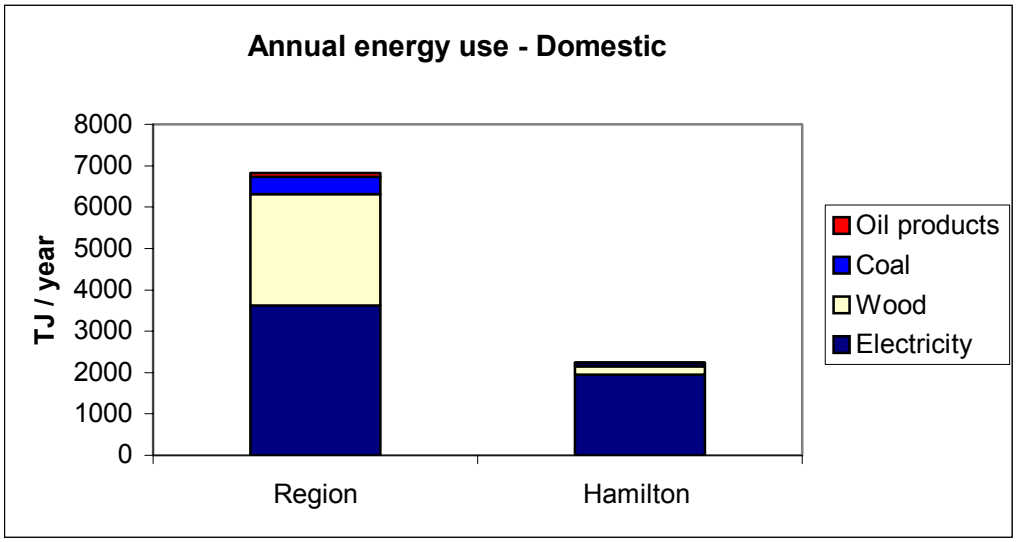

Figure 3-1: Annual domestic energy use by source

4 Transport energy consumption

4.1 Vehicle transport

4.1.1 Fuel use

For the year 2003, around 678 million litres of fuel was consumed by motor vehicles in the Waikato Region. Of this around half was estimated to be diesel and half petrol (Figure 4.1). LPG consumption for the region was estimated at just over 4 million litres.

Estimates of the proportion of vehicle transport fuel consumed in Hamilton are uncertain because disaggregated fuel tax data were not available. Road network modelling for Hamilton indicates that around 132,000,000 litres of fuel are consumed within Hamilton. This equates to about 17% of the petrol and diesel use for the Waikato, which seems low given that 28% of the Waikato population reside in Hamilton. It is uncertain whether the lower use relative to the population represents a real difference in fuel consumption, or differences associated with the methodology used to estimate fuel consumption.

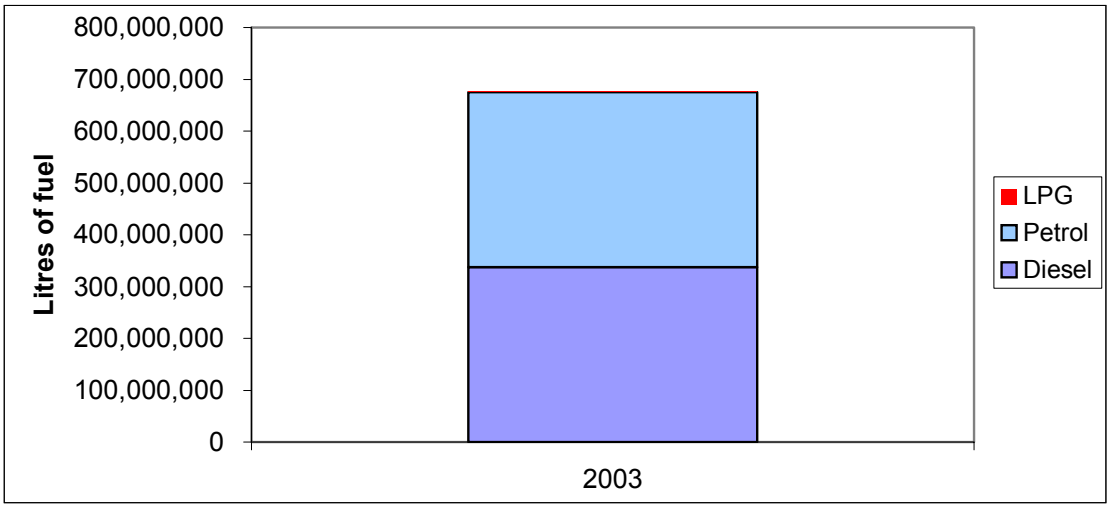

Figure 4-1: Petrol, diesel and LPG consumption for the Waikato Region for 2003

Seasonal variations in energy consumption for motor vehicles, shown in figure 4.2, suggest small monthly variations in energy consumption from this sector.

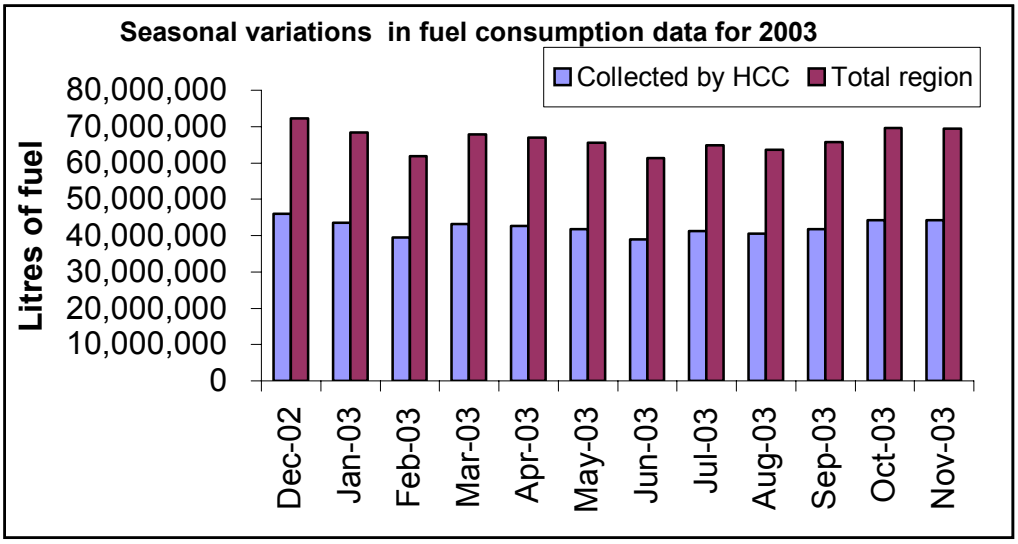

Figure 4-2: Monthly fuel sales for petrol and diesel based on regional fuel tax data collected by Hamilton City Council

4.1.2 Energy consumption

The energy consumption associated with this fuel use is estimated to be around 23,000 TJ for 2003 (Table 4.1). About 48% of the energy use comes from petrol vehicles with around 52% occurring as a result of diesel combustion. Around 0.6% is estimated for LPG consumption by motor vehicles. Petrol and diesel splits for Hamilton were based on the average for the Region as determined by the fuel tax data.

Table 4-1: Energy consumption from road transport in Hamilton and the Waikato for 2003

2003		Diesel	Petrol	LPG	Total
Region	TJ/ year	12,141	11,036	135	23,311
	% Total	52%	48%	<1%	
Hamilton	TJ/ year	2,367	2,152	26	4,546
	% Total	52%	48%	<1%	

4.2 Air transport

An estimate of the amount of fuel used and energy consumed by the aviation industry for 2003 is shown in Table 4.2. Around 22,102 tonnes of fuel is estimated to be supplied to aircraft at the Hamilton and Taupo airports. No aviation energy consumption is attributed to the Hamilton area as the airport is located outside of the city territorial limit.

Table 4-2: Fuel use and energy consumption from aviation in Waikato for 2003

	Avgas	Jet fuel	Total
Fuel use tonnes/ year	302	21800	22102
TJ per year	13	945	958

4.3 Marine transport

No estimates were made of commercial marine transport energy consumption because of the absence of a regional Port. Energy consumption by pleasure craft is assumed to be incorporated in the vehicle transport estimates as fuel sales and consequently fuel taxes do not distinguish between motor vehicle and pleasure craft use.

4.4 Rail transport (energy consumption only)

An estimate of the amount of fuel used and energy consumed by rail transport within the Waikato Region is shown in Table 4.3. This is based on a national figure of around 62.68 million litres of diesel consumed during 2003. From emissions data provided by MOT (1999) it is estimated that around 14% of the fuel use occurs within urban centres and that around 7% of the urban consumption occurs within Hamilton.

Table 4-3: Fuel use and energy consumption from rail transport in Waikato for 2003

	NZ Rail Network	Waikato Region	Hamilton*
Diesel - million litres/ year	62.68	9.5	0.6
TJ per year	2,468	374	25

*estimated based on NIWA, (1996)

4.5 Summary transportation energy consumption

The majority of the transportation energy consumption within the Region (95%) is associated with motor vehicle use (Table 4.4). The aviation sector consumes around 4% with rail consuming the remaining 1%. Estimates do not include marine use because of the absence of a Regional Port. In Hamilton City, motor vehicles are responsible for over 99% of the transportation energy use (Table 4.5).

Figures 4.4 and 4.5 show annual energy use by transport type and motor vehicle energy use by fuel type for both the Region and for Hamilton.

Table 4-4: Regional Transportation Energy Consumption for 2003

2003	Motor Vehicle	Aviation (AvGas & Jetfuel)	Rail (Diesel)	Total Transport
Fuel use (litres/year)	674,659,965	27,716,937	9,503,514	711,880,416
TJ/ year	23215	958	374	24547
% Total	94.6%	3.9%	1.5%	

Table 4-5: Hamilton Transportation Energy Consumption for 2003

2003	Motor Vehicle	Aviation (AvGas & Jetfuel)	Rail (Diesel)	Total Transport
Fuel use (litres/year)	131,792,941	-	638,073	132431014

TJ/ year	4527	0	25	4552
% Total	99.4%	0%	0.6%	

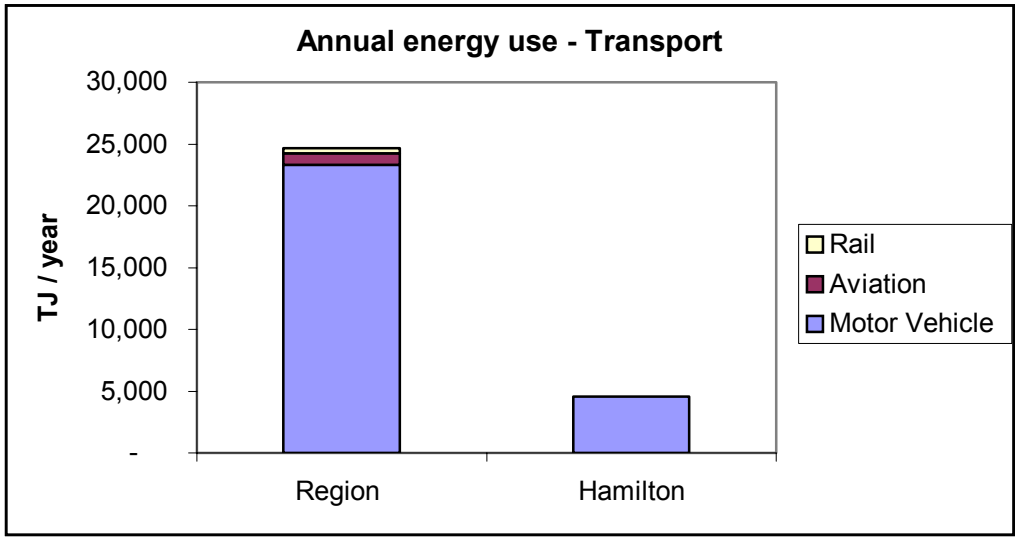

Figure 4-3: Annual energy use by transport type

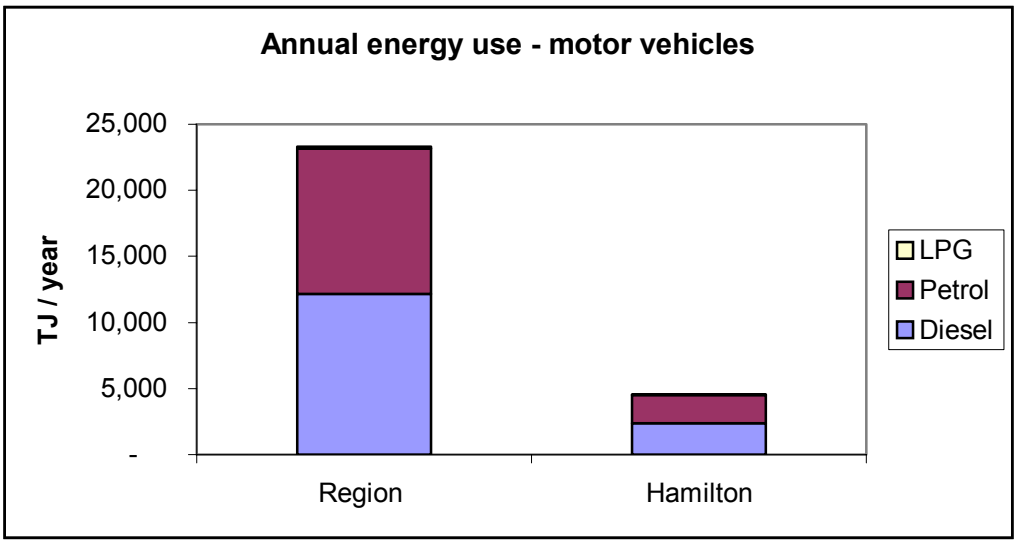

Figure 4-4: Annual motor vehicle energy use by fuel

5 Industrial energy consumption

5.1 Electricity (energy consumption only)

Industrial, commercial and agricultural electricity consumption for the Waikato Region and for Hamilton for the years 2000 to 2003 is shown in Table 5.1. These estimates do not include annual variations in electricity consumption from the Powerco Eastern network, as data from previous years were unavailable for the Eastern component of the network. It was assumed that consumption during previous years was similar to 2003 levels.

Table 5.2 shows electrical energy consumption for industrial, commercial and agricultural activities during 2003. Around 6171 TJ per year was estimated from this

sector for the whole Region, with only 1304 TJ/ year of this being consumed by activities in Hamilton.

Table 5-1: Electricity consumption from industrial, commercial and agricultural activities in Hamilton and the Waikato Region

	2003 MWh	2002 MWh	2001 MWh	2000 MWh
Total Region	1714213	1678337	1667569	1670995
Hamilton	362240	346460	347697	351306

Table 5-2: Energy consumption from industrial, commercial and agricultural electricity use in Hamilton and the Waikato Region

	2003 TJ/ year	2002 TJ/ year	2001 TJ/ year	2000 TJ/ year
Total Region	6171	6042	6003	6015
Hamilton	1304	1247	1252	1265

5.2 Coal, wood, gas and oil consumption

Tables 5.3 and 5.4 show regional coal, wood, gas and oil use and the associated energy consumption for the Region and for Hamilton. The fuel and energy use data are dominated by a small number of industrial activities and include assessments from all processes consented for combustion activities. Some non-consented activities have been included, e.g., the Waikato hospital boiler. However, in general smaller scale combustion processes are not included as regional energy consumption from smaller scale combustion processes is likely to be minimal.

In Hamilton, however, there are not many resource consents issued for discharges to air from combustion processes. The relative contribution from small-scale industrial processes in this area may therefore be more significant.

Table 5-3: Coal, wood, gas and oil consumption from industrial activities in Hamilton and the Waikato Region for 2003

	Coal Tonnes/year	Wood Tonnes/year	Gas m3/ year	Oil Litres/ year	Other Tonnes/year
Total Region	909,580	411,165	1,193,332,192	2,104	57,019
Hamilton	1575	0	59,595	0	0

Table 5.4: Energy consumption from coal, wood, gas and oil consumption by industrial activities in Hamilton and the Waikato Region for 2003

	Coal TJ/year	Wood TJ/year	Gas TJ/ year	Oil TJ/ year	Other TJ/ year
Total Region	25,950	4,233	42,317	93	599
Hamilton	45	0	2.1	0	0

5.3 Summary industrial energy consumption

Table 5.5 shows that around 79,363 TJ of energy was consumed by the industrial/ commercial sector within the Waikato Region. Gas is the main source of energy with coal contributing about one third. In Hamilton, electricity is the main source of energy

consumption within the industrial/ commercial sector. Energy consumption by this sector in the Hamilton area is minimal compared with the Region as a whole (Figure 5.1.

Table 5-4: Industrial energy consumption by source

	Coal TJ/year	Wood TJ/year	Gas TJ/ year	Oil TJ/ year	Other TJ/ year	Electricity TJ/ year	Total TJ/ year
Total Region	25,950	4,233	42,317	93	599	6,171	79,363
	33%	5%	53%	<1%	<1%	8%	
Hamilton	45	0	2.1	0.0	0.0	1304	1,351
	3%	0%	<1%	0%	0%	97%	

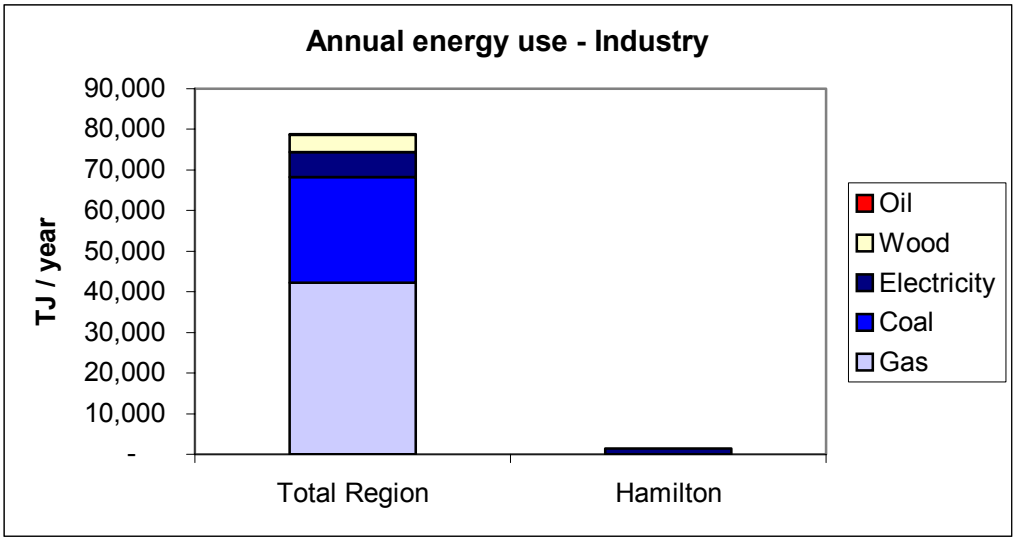

Figure 5-1: Industrial energy consumption by source

6 Energy consumption across all sectors

Across the Waikato, 109,043 TJ of energy was estimated to have been consumed during 2003. The majority (73%) was used by the industrial sector, with land transport consuming around 21% (Table 6.1 & Figure 6.1).

The total energy consumption per capita for the Region was 305GJ/ person compared to 115 GJ/ person for Canterbury (Pringle, 2003). The difference occurs as a result of the greater industrial energy consumption in the Waikato (212J/ capita compared to around 30 GJ/ capita for Canterbury).

The land transport energy consumption per capita for the year 2003 was 64 GJ/ capita. This is also higher than the 2000 estimate for Canterbury of 46 GJ/ capita.

Table 6-1: Summary of energy consumption by sector in the Waikato and in Hamilton

2003	Transport	Domestic	Industry/ commercial	Total
Region TJ/ year	22863	6817	79363	109043
Energy consumption per capita (GJ/ capita)	64	19	222	305

Region % total energy consumption	21%	6.2%	72.8%	
Hamilton TJ/ year	4573	2251	1351	8175
Energy consumption per capita (GJ/ capita)	13	6	4	23
Hamilton % total energy consumption	56.0%	27.5%	16.57%	

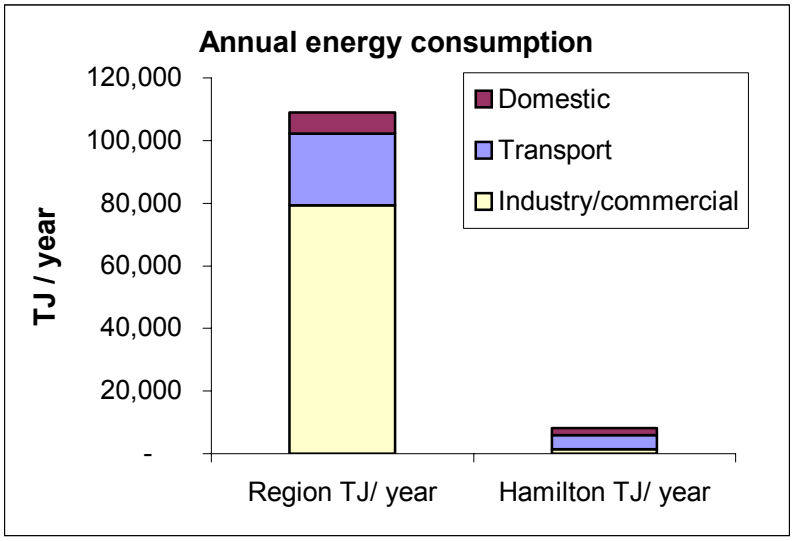

Figure 6-1: Annual energy consumption by sector

Table 6.2 and Figure 6.2 show the energy consumption for the Region and for Hamilton by fuel type. This indicates oil products as the main energy source for the region (60%) and for Hamilton (56%), with coal contributing 24% across the Region. In Hamilton, electricity was the second most dominant source, accounting for 40% of the energy consumption.

Table 6-2: Summary of energy consumption by source in the Waikato and in Hamilton

	Electricity	Wood	Coal	Oil products	Other	Total
Region (TJ/ year)	9796	6918	26371	65360	599	109,043
Hamilton (TJ/ year)	3260	199	117	4599		8,175
Region	9.0%	6.3%	24.1%	60.0%	0.6%	
Hamilton	40.0%	2.4%	1.4%	56.2%		

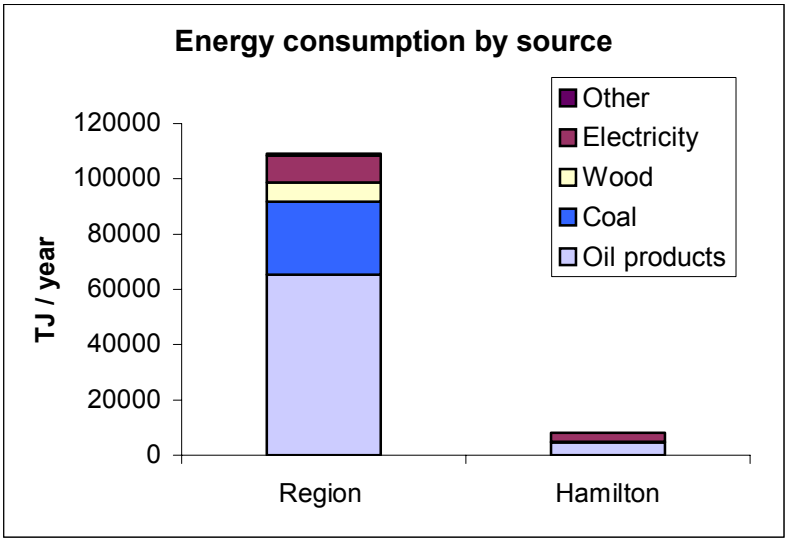

Figure 6-2: Annual energy consumption by source

7 CO_2 emissions from energy use

Estimates of carbon dioxide from energy use within the Region were derived based on the calorific value data shown in Table 2.1 and the following carbon contents (from Pringle, 2003):

- Petrol 86%
- Jet A1 87%
- AvGas 85%
- Diesel 86%
- LFO 88%
- HFO 88%
- LPG 82%
- Coal 63%

Estimates were based on the assumption that all carbon is oxidised to CO_2. This represents an upper limit of CO_2 emissions, as complete combustion is unlikely in reality. The amount of carbon that is not fully oxidised could vary from around 3% for internal combustion engines to 10% for solid fuels (Pringle, 2003).

The CO_2 estimates relate to energy consumption in the region and do not consider other sources of emissions. Industrial estimates therefore do not include CO_2 emissions that occur as a result of geothermal power production. Estimates do not include CO_2 emissions from the generation of electricity used within the Region but generated from outside of the Region. Table 7.1 shows the estimates of CO_2 from industry, domestic heating and transport for the Waikato Region.

The common practice in assessing CO_2 emissions is to assume that wood has zero overall emissions. This is because it is assumed that the CO_2 released during combustion is equivalent to that absorbed from the atmosphere during the life of the tree. For this reason, estimates of CO_2 from wood combustion are not included in the tables. However, the amount of CO_2 released from wood burning in the Region is around 888 kT for industry and 161 kT per year for domestic heating. Table 7.2 includes summary CO_2 data for the region including CO_2 emissions from wood combustion.

Table 7-1: Energy use estimates of CO2 emissions for the Waikato

	Industry	Domestic Heating	Transport	Total	Total

	CO_2 kT	CO_2 kT	CO_2 kT	CO_2 kT	%
Gas	2234	0.0		2234	37%
Coal	1931	31.3		1962	33%
Oil	8	4		12	<1%
Other	140			140	2%
AvGas			1	1	<1%
Jet fuel			69	69	1%
Petrol			730	730	12%
Diesel			834	834	14%
LPG			9	9	<1%
Total	4312	35	1643	5991	
%	72%	1%	27%		

Table 7-2: Summary CO2 emissions including wood use

Region	Industry CO_2 kT	Domestic CO_2 kT	Transport CO_2 kT	Total CO_2 kT	Total CO_2 %
Wood	888	161		1048	15%
Coal	1931	31		1962	28%
Oil products	2234	4	1643	3882	55%
Other	140			140	2%
Total	5053	196	1643	7032	
Total %	72%	3%	23%		

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Appendix I: Areas covered by different network suppliers

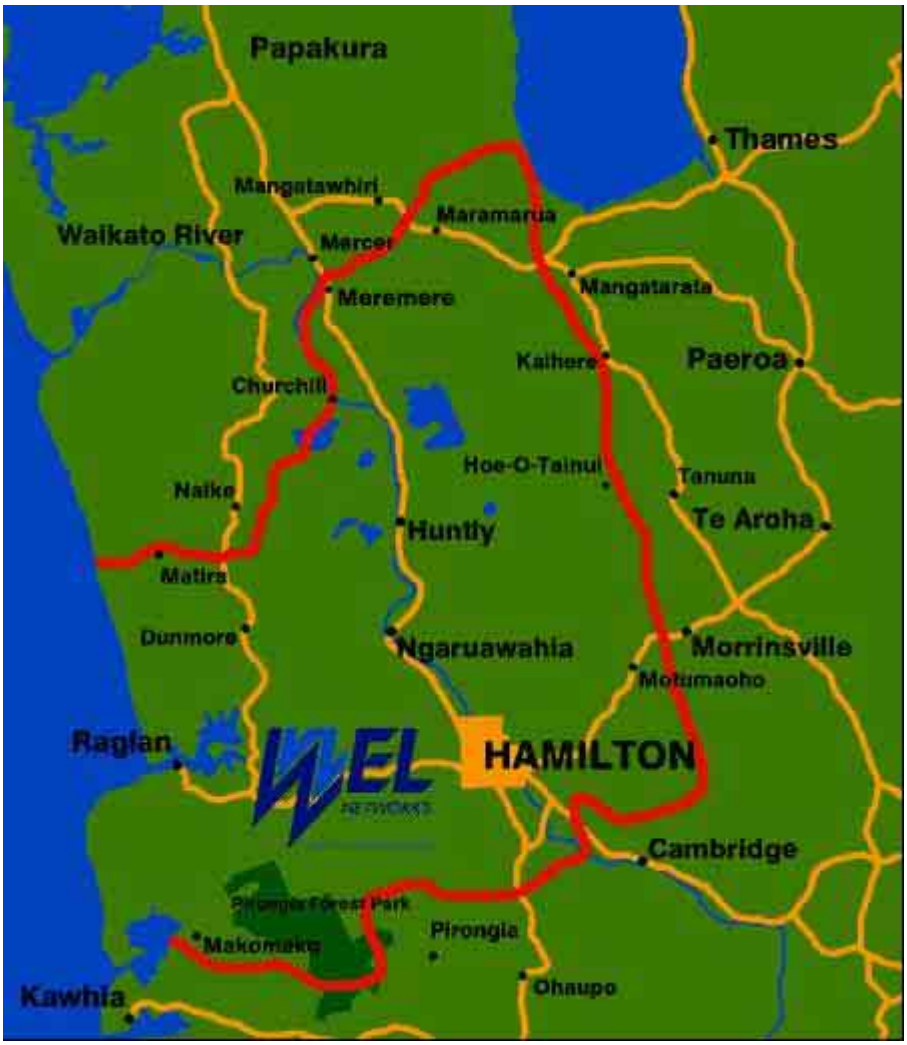

Figure A.1: WEL network coverage area (red line boundary)

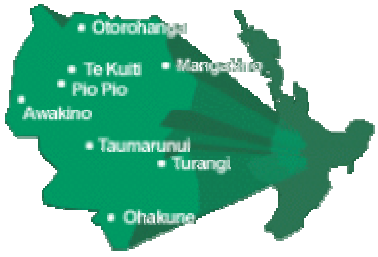

Figure A2: The Lines Company network coverage area

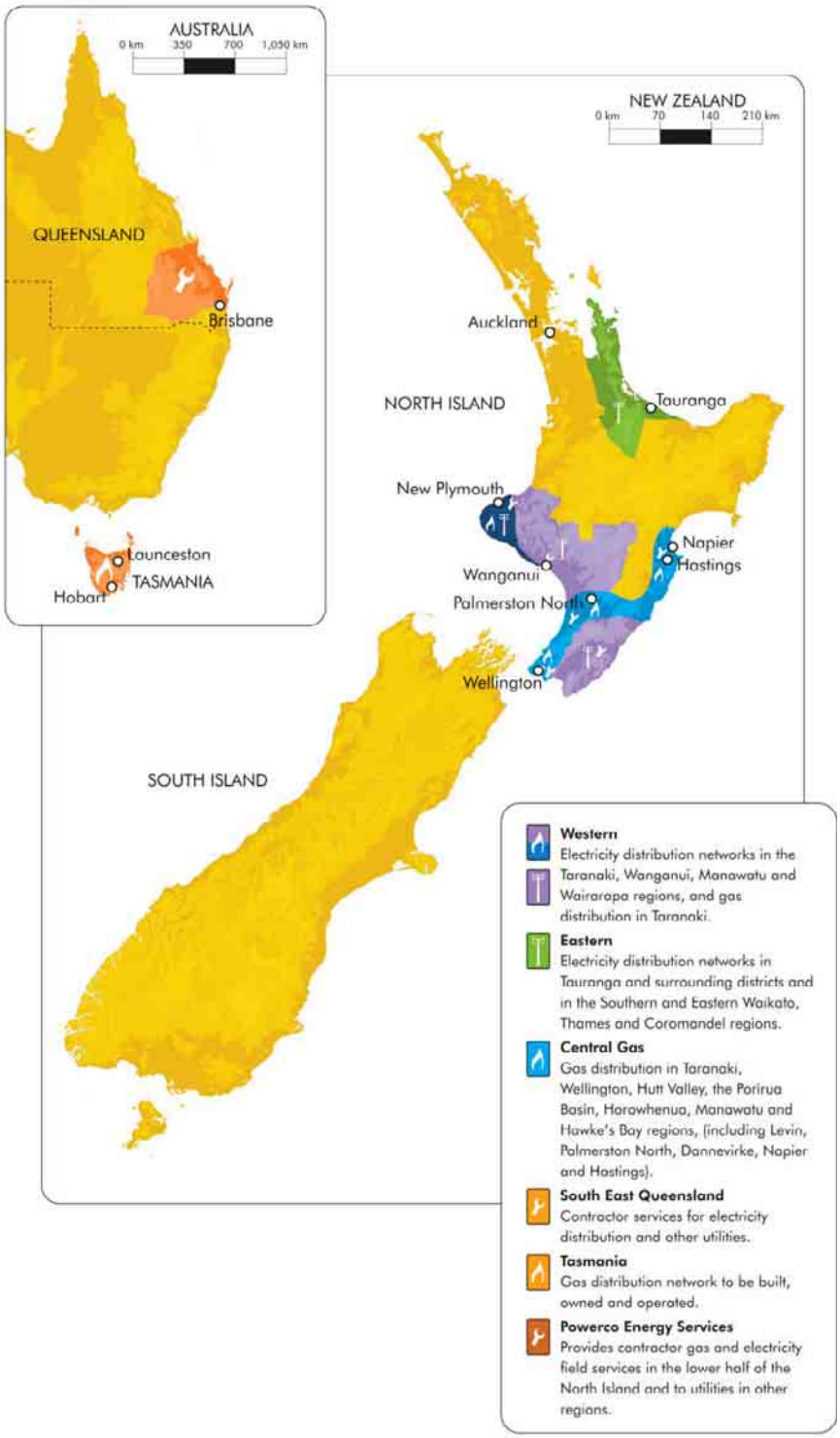

Figure A3: Powerco network coverage area

Figure A4: Unison network coverage area

Figure A5: Waipa network coverage area