Domestic and commercial energy services and energy demand in the Ballarat Municipality

This report is a product of the distance learning course "Bioenergy Technology and Bioenergy Business", supervised by Professor Björn Zethræus at the Linnæus University in Sweden, and auspiced by CHAF, 2011

Summary
The domestic, commercial and retail sectors of the municipality of The City of Ballarat have a growing demand for energy services. These energy services include water and space heating, space cooling, refrigeration of foodstuffs, cooking, and power for electric motors and lighting. This group of sectors also requires transport energy services for movement of goods, people and services and this is covered by a separate report.

The energy required by the non-transport needs of the combined residential and commercial/retail sectors – and delivered by electricity, natural gas and bottled or bulk LPG - is about 50% of the overall energy provided by electricity and natural gas and LPG to the municipality. Use of these main energy carriers is presently growing at 6-9% annually.

Overview of the Ballarat study area

The study area:
The area administered by the Ballarat Council (commonly termed 'The City of Ballarat') includes Ballarat and surrounding areas, including former municipal areas of the city of Ballaarat and Shire of Ballarat, the Borough of Sebastopol, parts of the Shire of Bungaree, Buninyong, Grenville and Ripon.

However, when requesting information from utilities or the ABS, we referred to our study area as the "Municipality of Ballarat" or "The municipal area administered by the City of Ballarat" hence the figures they provided were for the whole municipal area.

For the purposes of this study we will refer to the study area as the City of Ballarat, or CoB. The CoB study area covers around 740 sq km, (74,000 ha).

Current and future population:
The Australian Bureau of Statistics, (ABS), 2006 census state that in 2006, the population was 88,451, and estimated to be 94,088 in 2009, growing at an average rate of 1.4% / annum. However, the anticipated population increase (used in the City of Ballarat Economic Strategy 2010-2014) is 2.1% from 2010 on, (SGS, 2010). Hence, the population in 2011 can be estimated to be around 98,000.

Energy overview
The CoB is a significant user of energy – natural gas, LPG, electricity, petrol and diesel. Overall the annual consumption of electricity is about 638 GWh/year or 75 MW (Powercor). Natural gas use for provision of energy services including heating, cooking is about 144 MW (1257 GWh), (SP Ausnet). Estimated annual volume of petrol is 94 million litres, of diesel 72

million litres. The daily passenger and freight trains arriving and departing from Ballarat are all diesel powered. Ballarat city is on the natural gas grid but the outlying towns and all farms are reliant on either electricity and/or bottled LPG for space and water heating and cooking.

No. of households:

The ABS, (2006) state that the number of occupied households in the CoB in 2006 was 33,163 and that the growth in the number of households is closely correlated with the population increase trend. Hence, it can be assumed that the total no. of households in 2011 is around 36,790.

Average household size:

According to the 2006 census, the average household size was 2.5 persons / household. However, if the assumed figures stated above for population and number of household, then the average household size can be assumed to be 98,000 / 36,790 = 2.7 persons / household in 2011.

Total energy consumption for the Ballarat CoB

In 2010, SP Ausnet's figure for total natural gas consumption for the CoB was 1257 GWh or 143.5 MW.

While one set of electricity consumptions figures give a total of 638 GWh or 74 MW, other figures for electricity supply to the City of Ballarat extrapolated for 2011 show a consumption of 91.4 MW (Note – this situation of contradictory figures from apparently equally reputable sources forces us to choose the figure that appears most plausible, so in this case we will use the 74MW figure).

The following figures show a monthly summary of data for electricity supplied by Powercor to the City of Ballarat in MWh usage (this is for overall electricity supply - see notes in appendix):

Figure 1: Historical Electricity Usage for Ballarat Jan 2006 – May 2011 (MWh/month) *(Powercor)* with trendline

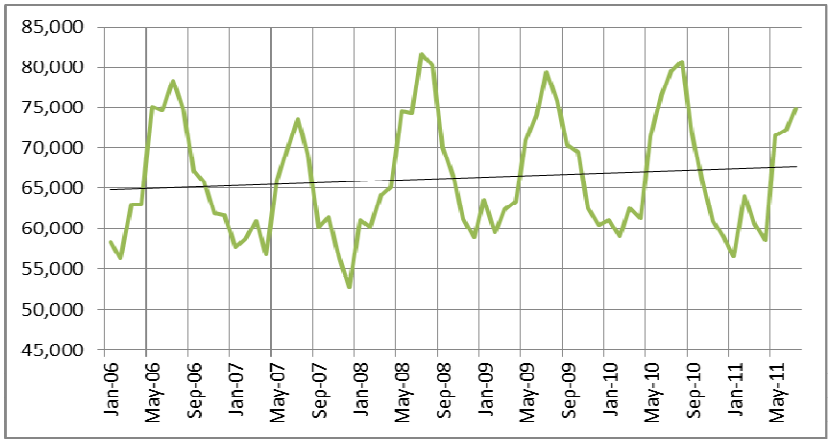


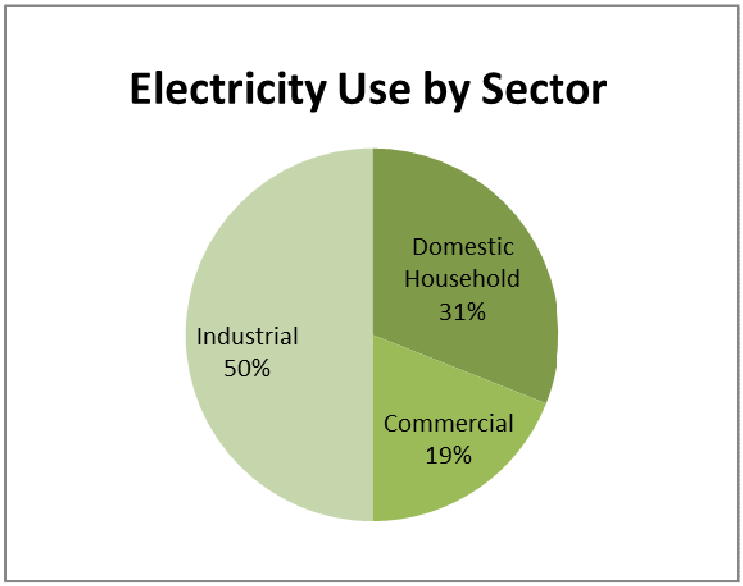
Figure 2: Historical Electricity Usage for Ballarat Jul 2010 – Jun 2011 (MWh/month) ***(Powercor)***

Data obtained from Powercor has shown a growth in total electricity use by the City of Ballarat for 2010 by 9.3 % compared to the same period in 2009. This compared with a total growth in electricity consumption of 9% between 2007 and 2008 compared, (BREAZE, 2009).

(As for previous comment on contradictory energy figures - Ballarat's total electricity use was 801 GWh (91.4 MW) in 2010/11 based on one set of data provided by Powercor).

Total <u>domestic</u> energy consumption:

According to Breaze, (2009), domestic household energy usage makes up 31% of the total energy usage in the CoB. Business/other commercial accounts for ~ 19% and Industry accounts for ~ 50% of the total energy usage of electricity.



Gas: The total domestic gas consumption for the CoB in 2007 was 547 GWh, according to DSE, (2009). This equates to 551 GWh in 2010 (62.9 MW).

LPG: LPG is sold in the Ballarat region by a number of suppliers. According to anecdotal evidence from the main LPG distributor, Elgas who have 60% of the commercial and 75% of the residential market share, (2011) the total domestic gas consumption for the CoB in 2010/11 was 4.25 million litres or 30.5 GWh (at 26 MJ/l), so equivalent to 3.5 MW (anecdotal information from main supplier Elgas). This volume was principally sold as 88 litre bottles.

Commercial use of LPG was 8.6 million litres, so 62.7 GWh or 7.2 MW. This volume was mainly as distribution to bulk tanks.

Coal briquettes and coke: the amount used has been declining since the 1950s when coke and briquettes made from brown coal were brought into Ballarat and other distribution points in the region by the trainload in bulk and bagged form. Volumes traded for the domestic market are now too small to be included in this report.

Firewood/ Pellets/wood briquettes. Firewood is the main form of wood for domestic fuel, and almost entirely for space heating. Despite the population increase the use of wood is on a slow decline, with it being first displaced by heating oil and coal briquettes through the 1970s and more recently by mains natural gas or LPG.

The total figure for wood sold through registered outlets in the municipal area is in the order of 35-40,000 tonnes/year for 2011 (pers comm, and DPI estimates), with those households using wood as the primary form of space heating using 3-10 tonnes/year (estimates in dry tonnes vary widely due to varying moisture content of wood at sale and difficulty of conversion from loose or stacked cubic metre volumes of varying densities to dry tonnes).

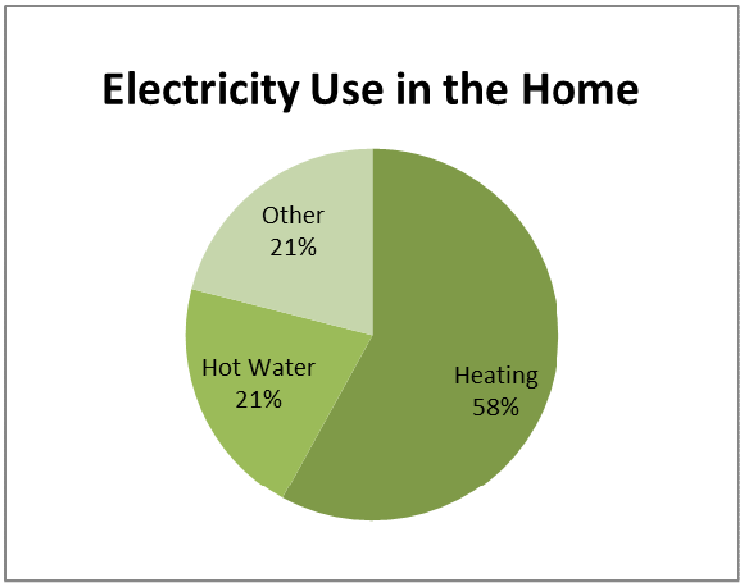
Total number of domestic energy customers:

Electricity: The total number of electricity customers in 2011 was estimated at 36,790 (the estimated total number of households) according to ABS projection.

Gas: The total number of natural gas customers in 2007 was 33,601, according to DSE, (2007).
LPG: The total number of domestic LPG customers in 200X was xxx, according to xxx, (200x)

Average household domestic energy consumption:

Electricity: According to the Environment and Natural Resources Committee (2005), the average Victorian household uses 5330 kWh of electricity / annum, spends an average of $1,300/yr on energy and uses 58% of the total energy consumption on household heating and 21% of the total household energy is used to heat water.



Department of Sustainability and Environment (DSE) electricity consumption figures for City of Ballarat households in 2007 total 196.2 GWh, or about 22.4 MW over the year. This extrapolates to a figure for 2011 of about 208.9 GWh (23.8 MW).

According to the Ballarat Sustainability Strategy, the figure for average household energy use in Ballarat in 2007 is 5770 kWh/household, (DSE, 2009).

Gas: The figure for most of Ballarat in 2007 is 59.1GJ/gas customer, excluding the Ballarat North area, (DSE,2007), where gas consumption is far lower at 8.2 GJ/ gas customer. An explanation given for this is that natural gas reticulation occurred there later, and less space heating has been converted to gas.

In general, conversion of space heating to be fuelled by natural gas has been driven by its relatively lower price (compared to LPG or heating oil) and its convenience as a fuel. The Australian Electricity Market Operator, (AEMO) reports provide detail of peak demand requirements in the Ballarat zone showing a marked winter peak due to domestic gas heating requirements. A cold snap can increase daily demand for natural gas by over 50% (Breaze, 2008).

Commercial/retail energy use in the CoB

Table 1 below summarises the various forms of stationary energy consumption for the Commercial/retail energy users in the CoB. See note 2 in the appendix for the explanation of how the energy use figures were derived.

Table 1 - Energy usage of commercial and retail properties in the CoB:

		Floor Space	Fossil Fuel	Electricity	Fossil Fuel	Electricity
		m²	kWh/m²/a	kWh/m²/a	GWh/a	GWh/a
2010	**Total**	**616000**			**99.6** (11.4MW)	**127.4** (14.5 MW)
	Food Grocery Liquor	56000	200	915	11.2	51.2
	Household Goods	74000	194	237	14.4	17.5
	Bulky Goods	74000	103	53	7.6	3.9
	Retail Services	54000	194	237	10.5	12.8
	Commercial Professional and Business Services	210000	97	128	20.4	26.9
	Community Services	40000	97	128	3.9	5.1
	Entertainment and Recreation	36000	264	96	9.5	3.5
	Leisure	30000	264	96	7.9	2.9
	Healthcare and Medical	42000	339	86	14.2	3.6

Table 2 below summarises the various forms of stationary energy consumption for the largest energy users in the CoB managed by local government. The energy use figures are derived from supplied data from the CoB facility manager.

Table 2 - The major energy users in the CoB Local Government sector:

	Electricity	Natural Gas	LPG	Firewood	Other
	MWh/annum	MWh/annum	MWh/annum	Tonnes/annum	
Ballarat Art Gallery	694				
Phoenix Building	444				
Town Hall	319				
Her Majesty's Theatre	222				

NOTE: The provision of potable water to the CoB is a large energy user. According to BREAZE, figures suggest it used 16,000 MWh of electrical power to pump 12.1 gigalitres of water through the new pipeline connecting Ballarat to the Goulburn system in 2008. This was about 2.5% of the total electrical energy use for the City.

Projections for total domestic energy consumption:

Table 3 is based on an extrapolation of data provided by the ABS for households in regional Victoria: It assumes a growth in population and consequent growth in demand for energy services along the current trend lines.

Building Type	Electricity	Natural Gas	LPG	Firewood	Other	Total
	GWh/a	GWh/a	GWh/a	GWh/a	GWh/a	GWh/a
2010						
Residential	177	551				**727**
Commercial and Retail	127	100				**227**
2031						
Residential	228	700				**928**
Commercial and Retail	149	191				**341**
2050						
Residential	274	842				**1116**
Commercial and Retail	194	249				**443**

A report titled *Energy Use in the Australian Residential Sector 1986-2020* produced by the Department of the Environment, Water, Heritage and the Arts, (2008) provides detail on energy use trends for typical Australian households. It highlights the expected growth in energy use for electrical appliances. Energy use for cooling is projected to rise by a factor of five for the period 1990-2020 and the report states this growth is expected to be accelerated by climate change effects.

Appendix

Note 1:
From Powercor re Figure 2: *Explanation/Disclaimer from Powercor: "Further to your request for electricity usage for the City of Ballarat customer base I have collected the data below based on monthly MWh usage for 2009/2010 period.*

Because our distribution feeders do not follow the City of Ballarat council boundaries the actual usage shown in the table below has been calculated based on a percentage split for the feeders that travel into other council/shire areas. Therefore this data is an estimate only for all the domestic, commercial and industrial customers in the City of Ballarat. Powercor makes no representation or warranty as to the accuracy, reliability or completeness of the material contained in this table and shall have, and accept, no liability for any statements, opinions or matters (expressed or implied) arising out of this report, or any written or oral communication transmitted to any other party in relation to the subject matter of this report."

There are 2 zone substations in Ballarat - BAS and BAN. These 2 zone substations service the areas enclosed in the red line on the diagram below. This includes the entire City of Ballarat area but also covers municipalities surrounding the City of Ballarat. The table of data is the monthly MWh electricity usage for BAS and BAN per month from 2006 until July 2011. As mentioned, we are unable to provide this information into sectors.

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Note 2:
Commercial & retail energy usage calculations and predictions:

		Floor Space	Fossil Fuel	Electricity	Fossil Fuel	Electricity
		m²	kWh/m²/a	kWh/m²/a	GWh/a	GWh/a
		(1)	(2)	(2)		
2010	**Total**	**616000**			**99.6**	**127.4**
	Food Grocery Liquor	56000	200	915	11.2	51.2
	Household Goods	74000	194	237	14.4	17.5
	Bulky Goods	74000	103	53	7.6	3.9
	Retail Services	54000	194	237	10.5	12.8
	Commercial Professional and Business Services	210000	97	128	20.4	26.9
	Community Services	40000	97	128	3.9	5.1

	Entertainment and Recreation	36000	264	96	9.5	3.5
	Leisure	30000	264	96	7.9	2.9
	Healthcare and Medical	42000	339	86	14.2	3.6
2031	**Total**	**924000**			**149.3**	**191.2**
	Food Grocery Liquor	84000	200	915	16.8	76.9
	Household Goods	111000	194	237	21.5	26.3
	Bulky Goods	111000	103	53	11.4	5.9
	Retail Services	81000	194	237	15.7	19.2
	Commercial Professional and Business Services	315000	97	128	30.6	40.3
	Community Services	60000	97	128	5.8	7.7
	Entertainment and Recreation	54000	264	96	14.3	5.2
	Leisure	45000	264	96	11.9	4.3
	Healthcare and Medical	63000	339	86	21.4	5.4
2050	**Total**	**1202667**			**194.4**	**248.8**
	Food Grocery Liquor	109333	200	915	21.9	100.0
	Household Goods	144476	194	237	28.0	34.2
	Bulky Goods	144476	103	53	14.9	7.7
	Retail Services	105429	194	237	20.5	25.0
	Commercial Professional and Business Services	410000	97	128	39.8	52.5
	Community Services	78095	97	128	7.6	10.0
	Entertainment and Recreation	70286	264	96	18.6	6.7
	Leisure	58571	264	96	15.5	5.6
	Healthcare and Medical	82000	339	86	27.8	7.1

Source:
(1): Ballarat Economic Strategy 2010 - 2014: *Selected Development Opportunities p4*
(2): Ref: Table 20.1 of CIBSE Guide F: *Energy efficiency in buildings "Annual energy consumption good practice benchmark for existing buildings".* NOTE: The CIBSE, (Chartered Institute of Building Service Engineers) is a UK institution, therefore the energy consumption figures represent a best estimate and there is likely to be a difference between the UK and Australian figures.

The floor areas have been worked out using the following methodology:
Ref (1) lists the net additional floor areas of certain commercial activities in 2031.
Section 9.5, p26 of the same document states that a 50% increase in retail space is required by 2031.
It has been assumed that all sectors increase by 50% and this assumption has been used to calculate the figures for both 2010 and 2031.

Note 3

Firewood

Reliable estimates of firewood usage in Victoria, let the alone Ballarat area, are difficult to obtain so based on earlier studies and some observed trends of firewood usage in Australia, some estimates of firewood usage in the CoB area have been made as follows:

In 1988, FORTECH undertook a comprehensive firewood study for each state drawing on earlier 1985/86 ABS estimates and their own telephone survey which focussed on Melbourne and Ballarat. FORTECH estimated that the average use of firewood outside of Melbourne was $10m^3$/yr and that 42% of households outside of Melbourne use firewood.

However, in a more recent report prepared on firewood in Victoria, it was estimated that around 33% on non-farm households use firewood and that the average usage was around $5.5m^3$/yr, Read, Sturgess,(1995).

Driscoll et al, (2000) undertook a comprehensive survey of firewood usage across Australia and concluded that in households that burn firewood, the average consumption is around 3.7 tonnes/year - outside of capital cities.

Todd, (2006) estimated that, across Australia, firewood usage has been declining by 35,000 households/yr, since around 1997. Todd also estimated that 94% of firewood burnt is for space heating.

According to DEHWA, (2008), wood space heating was significant in 1990; (21%) but its share has been declining slowly and by 2020 wood space heating is projected to account for only 8% of total residential energy use.

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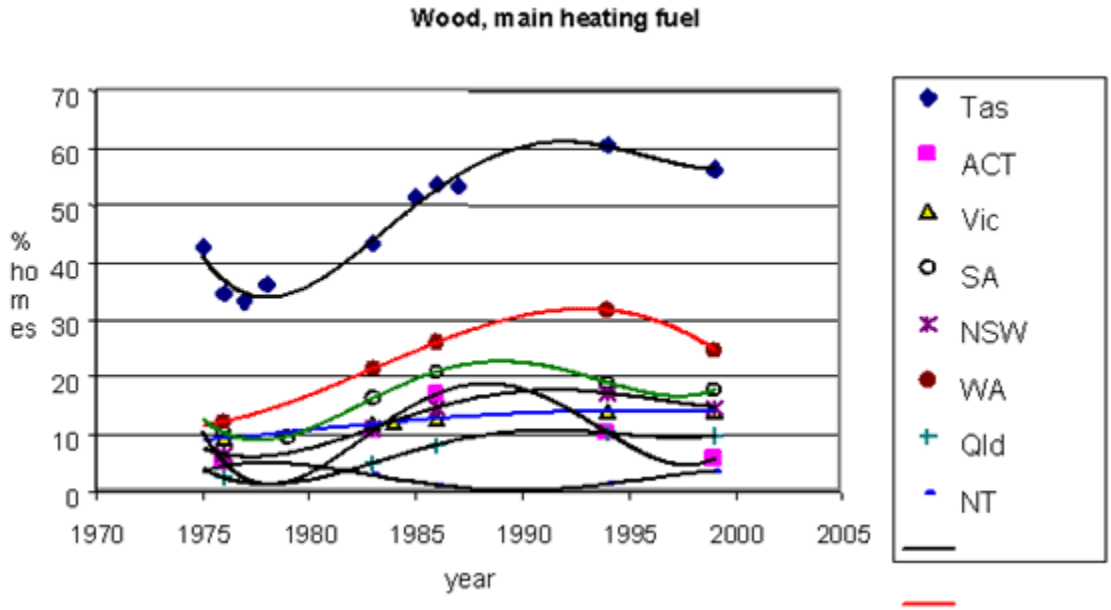
ABS data suggests that the proportion of households using firewood as their main heating source has dropped from about 18.5% in 1992 to 15.5% in 2000. This is a significant fall (about 3 percentage points or 16% in relative terms). But when growth in the total number of households is included, the fall in the actual number of wood-burning households is much smaller, around 2% in relative terms. The annual decrease in the number of households using firewood as their main heating fuel is only around 3000 to 4000 across Australia.

Hence, based on the ABS estimate that 15.5% of households used firewood in 2000 and the Driscoll figure that the average firewood use in 2000 was around 3.7 tonnes/year (outside of capital cities) and the estimate for the number of households using firewood in the CoB, (which had a total of around 27,000 households in 2000), it could be assumed that around 4185 CoB households each used around 3.7 tonnes of firewood = around 15,500 tonnes of firewood/yr in 2000. Also, Todd's estimate that 94% of firewood is used for space heating. Hence, in 2000, it could be assumed that around 14500 tonnes of firewood were used for space heating. If the actual decline in firewood usage is around 2%/yr since 2000, then it can be assumed that the total amount of firewood consumed in the CoB in 2011 is around 12,000 tonnes/yr.

Table CC.. Graphs showing the proportion of households in each state and territory using firewood as their main heating fuel, source, Environment Australia, (2002).



The ABS data show a clear change in heating preferences commencing around 1992/3. The proportion of households using firewood as their main heating fuel has dropped significantly. However, the increase in total number of households in Australia means that a relatively small decrease in the total number of firewood using households has occurred. The expected life of a woodheater (15 to 20 years) suggests that many heaters installed from the mid-1980s onwards will require replacement from 2000 onwards. This could lead to a more rapid fall in woodheater use because of growing public concern about wood-smoke and firewood collection. However, other factors such as increases in electricity or gas prices, or interruptions to supply could see a revival in woodheater use. Environment Australia, (2002).

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