



Energy Management
Association of New Zealand

Bloggs' Hardware
Sample Level One Energy Audit Report

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Executive Summary

This report analyses the energy consumption patterns of all Bloggs' Hardware sites within New Zealand. It is based on the energy database, which was created by Energy Solutions Ltd, from the spreadsheets of historical information provided by Bloggs' Hardware.

In 2003/ 04 there were 112 tariff meters. Many of these meters are grouped into 'locations' (there are 60 locations). The locations are then grouped together into 'divisions' (there are 15 divisions).

Table 1 below, shows the energy use for the 12-month period ending 30 June 2004.

Energy Source	Energy Consumption	Average Cost	Energy Expenditure
Electricity	49,835,841 kWh/ yr	11.53 c/ kWh (including network charges)	\$5,744,955/ yr
Gas	33,645,871 kWh/ yr	3.89 c/ kWh	\$1,308,824/ yr
Coal	5,321,678 kWh/ yr	1.32 c/ kWh	\$70,246/ yr
Total	88,803,390 kWh/yr	8.02 c/kWh	\$7,124,025/yr

Table 1: Summary of annual energy use

The Mega Centre at Auckland uses a large proportion of both the electricity consumption and expenditure.

Recommendations:

- Consider grouping meters. We estimate this could save about \$10,400/ yr;
- Investigate the gas consumption over summer at the two Mega Centres. This may save up to \$116,700/ yr;
- Negotiate a better tariff for locations with high prices. We estimate this could save about \$41,600/ yr;
- Perform energy audits to at least level 2 standard. The Auckland Mega Centre could save over \$600,000/ yr and the other 9 locations listed in Table 6 could save a further \$250,000/ yr;
- Investigate the potential of using renewable energy at the smaller projects;

1. Introduction

This report analyses the energy consumption patterns of all Bloggs' Hardware sites within New Zealand. It is based on the energy database, which Energy Solutions Ltd, created from spreadsheets of historical energy consumption information provided by Bloggs' Hardware. We have investigated the trends of consumption and expenditure and identified any anomalies. From this analysis, preliminary recommendations for energy cost savings are provided.

Bloggs' Hardware uses electricity, gas and coal as purchased forms of energy for its operations. Every site uses electricity, the Mega Centres in Auckland and Christchurch use gas, and Christchurch uses coal.

Bloggs' Hardware has a number of 'sites' around New Zealand being billed for electricity consumption. Because there are so many a hierarchy of sites has been established. In 2003/ 04 there were 112 tariff meters (meters used by the electricity supplier to issue an invoice). Each meter has a consumer number, issued by the electricity supplier. Many of these meters are grouped into 'locations'. Each location has a Bloggs' Hardware location code number established by Bloggs' Hardware. There are 60 locations. The locations are then grouped together into 'divisions'. There are 15 divisions. The following chart summarises the organisation hierarchy of the sites.

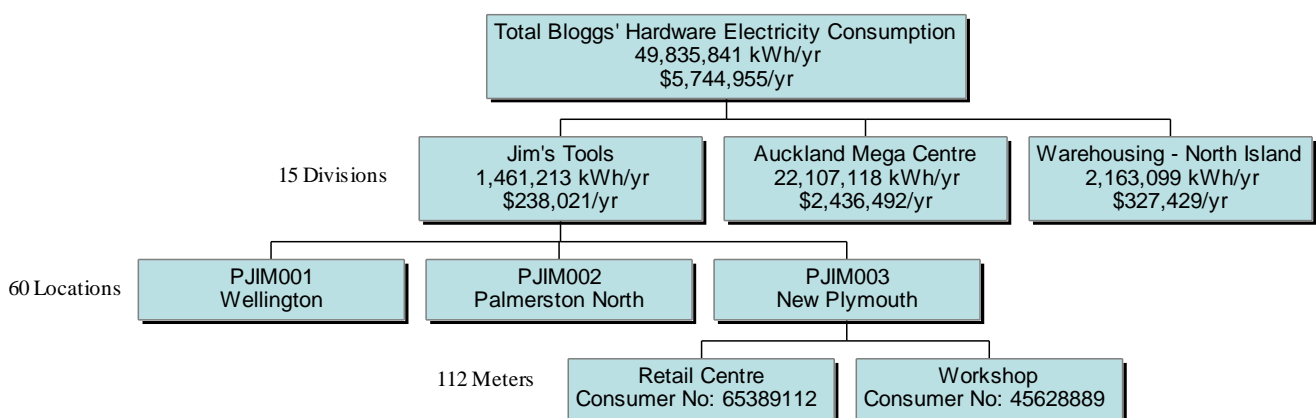


Figure 1: Sample of the Bloggs' Hardware site organisational hierarchy

There may be potential to combine some meters, thus reducing the amount paid in metering fees.

This report will first outline the energy use of Bloggs' Hardware as a whole, then breakdown the electricity use into divisional consumption. Most of the analysis will be at the location level, only occasionally referring to specific meters when necessary.

2. Nationwide Energy Consumption

The data used to generate the energy database for Bloggs' Hardware gave a breakdown of the electricity invoices received for each tariff meter. Table 2 below, provides a fairly accurate indication of the energy use for the 12 month period ending 30 June 2004.

Energy Source	Energy Consumption	Average Cost	Energy Expenditure
Electricity	49,835,841 kWh/ yr	11.53 c/ kWh (including network charges)	\$5,744,955/ yr
Gas	33,645,871 kWh/ yr	3.89 c/ kWh	\$1,308,824/ yr
Coal	5,321,678 kWh/ yr	1.32 c/ kWh	\$70,246/ yr
Total	88,803,390 kWh/yr	8.02 c/kWh	\$7,124,025/yr

Table 2: Summary of annual energy use

At this stage the information regarding gas and coal consumption is very limited. The following graphs indicate their consumption patterns.

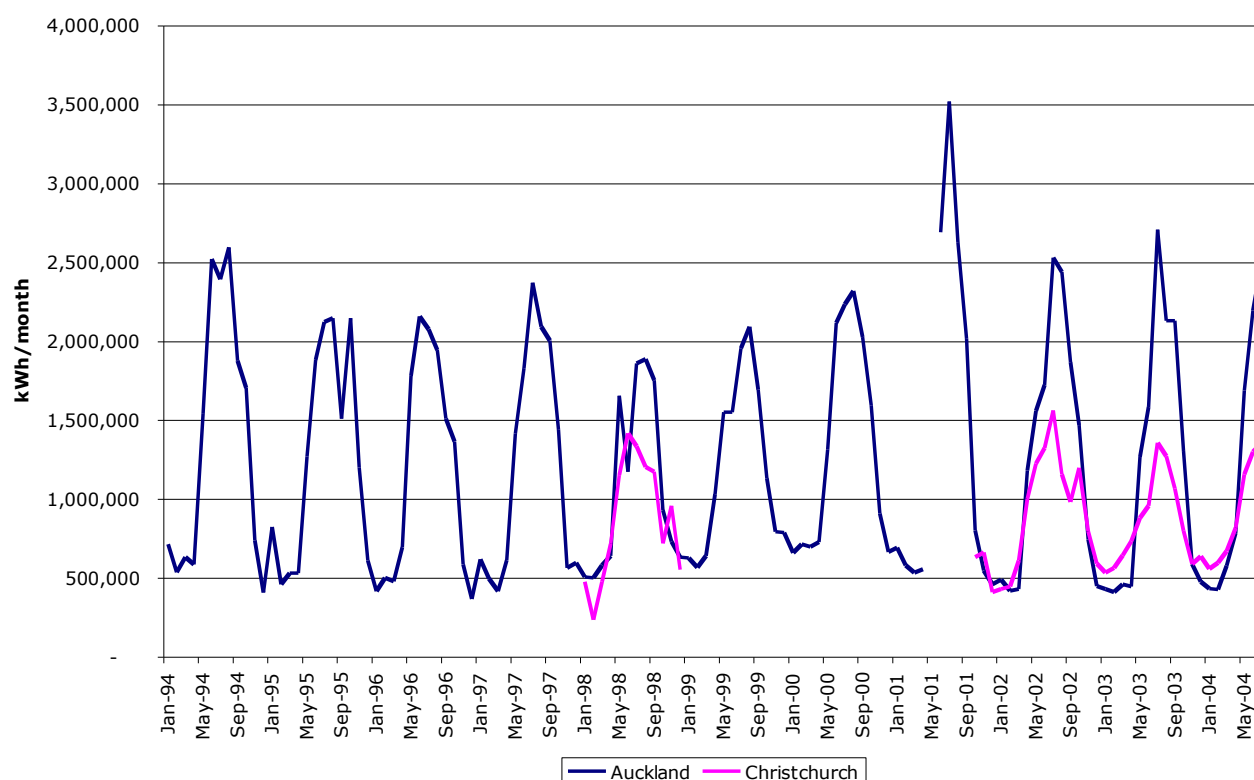


Figure 2: Monthly gas consumption

The gas use is highly seasonal – peaking every winter. This suggests the gas is used largely for space heating. However, there is a residual use over summer of about 500,000 kWh/ month at each Mega

Centre. This summertime gas use should be investigated, as there should be no need for heating over summer at these sites. If the Mega Centres do not use gas for anything other than heating then during the three months of summer 3,000,000 kWh could be being wasted.

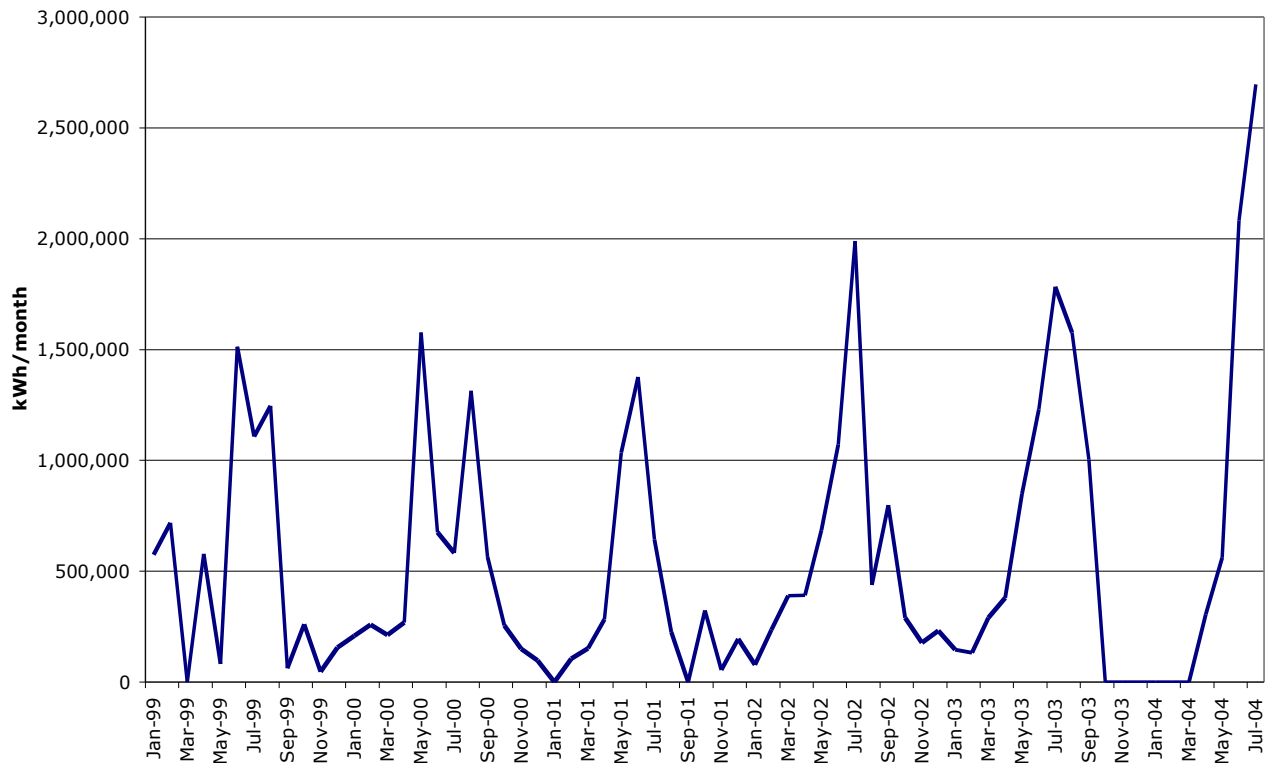


Figure 3: Monthly coal consumption

The use of coal at the Christchurch Mega Centre is also seasonal, suggesting that it too is used for space heating. It is a concern that the peak for the 2004 is so far considerably higher than any of the previous 5 winters.

Bloggs' Hardware has provided far more detailed data for the electricity consumption. The rest of the report will focus on electricity, not gas and coal.

3. Divisions

There are 15 divisions that contribute to the total electricity consumption of Bloggs' Hardware. Table 3 and Figure 4 summarise the electricity use of each division.

Division	sq.m	kWh/yr	\$/yr	EUI (kWh/yr.m ²)	c/kWh
Retail Centres	4,152	592,285	\$99,431	143	16.79
International Relations	4,309	597,725	\$86,353	139	14.45
Network Logistics	912	279,320	\$43,389	306	15.53
Manufacturing - Auckland	7,978	1,216,763	\$164,259	153	13.50
NZ Call Centre	1,701	387,421	\$101,939	228	26.31
Manufacturing - Christchurch	3,919	694,821	\$157,127	177	22.61
Exports	158	239,901	\$36,821	1518	15.35
Corporate	23,079	10,076,777	\$1,006,965	437	9.99
New Zealand Saws	3,231	485,219	\$75,187	150	15.50
Jim's Tools	9,738	1,461,213	\$238,021	150	16.29
Warehousing – South Island	10,543	370,851	\$50,567	35	13.64
Manufacturing - Wellington	3,440	461,989	\$69,494	134	15.04
Warehousing – North Island	27,641	2,163,099	\$327,429	78	15.14
Christchurch Mega Centre	35,903	8,701,339	\$851,481	242	9.79
Auckland Mega Centre	67,425	22,107,118	\$2,436,492	328	11.02
Total	204,129	49,835,841	\$5,744,955	244	11.53

Table 3: Electricity use of each division

The benchmark for existing commercial buildings in New Zealand is 200 kWh/ yr.m², and for new (commercial) buildings, 100 kWh/ yr.m². The fact that Warehousing is so low probably reflects that a lot of this division is used for storage and not conditioned for people. The high figures for the NZ Call Centre and Network Logistics probably represent 24/ 7 operation, a high density of people and equipment (per m²) and tightly controlled space conditions. The high EUIs for the Mega Centres probably represent specialised work being carried out there. The biggest concern is the very high usage seen in the Exports and Corporate divisions. If these values are accurate, energy use there is much higher than normal and there will probably be significant, cost effective energy saving opportunities.

Next, we look at the distribution of annual energy costs.

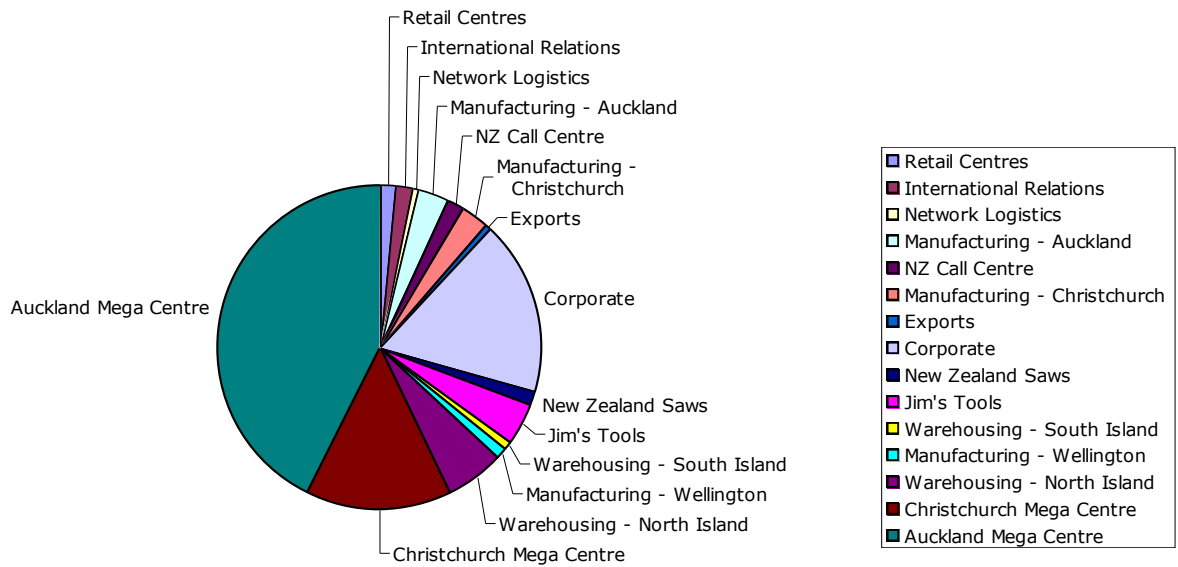


Figure 4: Distribution of annual expenditure, division by division

The Auckland Mega Centre division dominates the electricity expenditure and consumption, using nearly half of all of Bloggs’ Hardware’s electricity. Surprisingly, the Corporate division is larger than Christchurch Mega Centre.

Analysing the data at the location level provides a better understanding of what the electricity usage patterns at individual physical sites are.

4. Locations

The majority of the electricity consumption and expenditure is made up from only a few locations. Figure 5 shows all the locations in order of electricity expenditure.

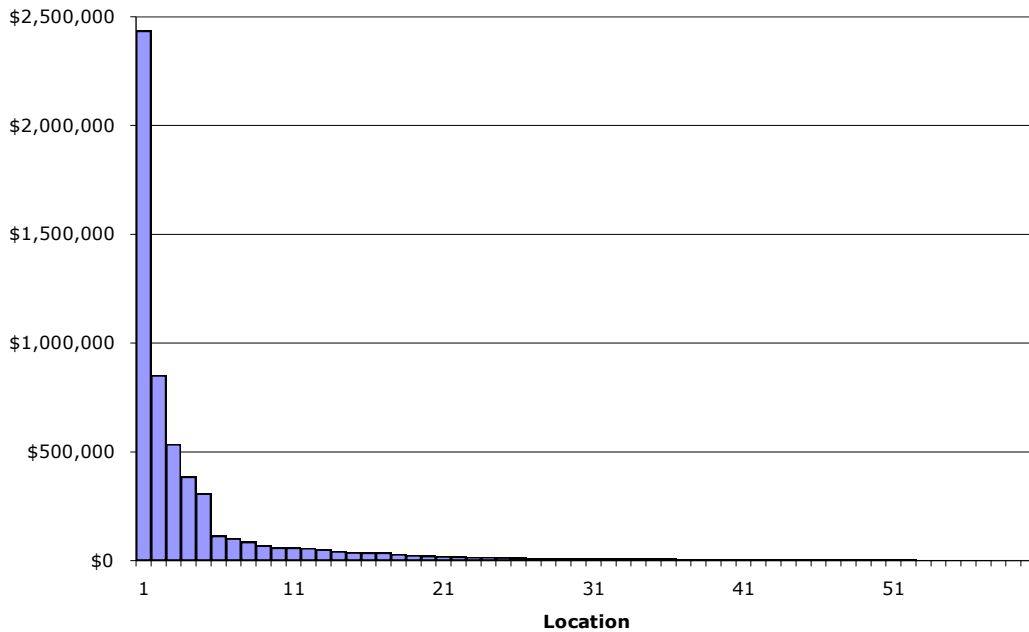


Figure 5: Electricity expenditure of locations 2003/ 04

If the data is presented cumulatively, as in Figure 6, it shows that the 10 largest locations generate nearly 90% of the annual expenditure.

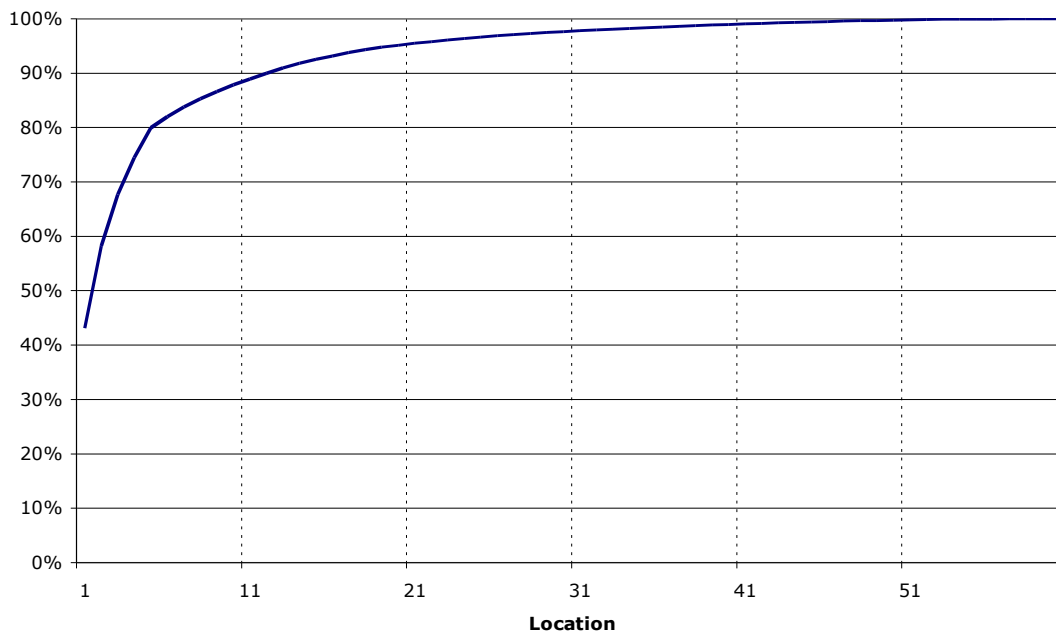


Figure 6: Cumulative fraction of electricity expenditure

It is best to focus on the largest locations for three reasons:

- i) The largest locations will probably offer the largest energy saving opportunities;
- ii) It is most cost effective to analyse the larger locations where more energy can be saved, with a similar amount of work to uncover the savings as smaller projects; and
- iii) It is more straightforward to work with a smaller data set.

The ten locations with the highest electricity expenditure in 2003/ 04 are summarised in Table 4.

Division	Description	kWh/yr	\$/yr	c/kWh
Auckland Mega Centre	Auckland Mega Centre	22,107,118	\$2,436,492	11.02
Christchurch Mega Centre	Christchurch Mega Centre	8,701,339	\$851,461	9.79
Corporate	Howick Data Centre Auckland	5,748,243	\$536,361	9.33
Corporate	Queen St Auckland	3,559,039	\$385,499	10.83
Warehousing – North Island	Assorted Auckland Goods Facilities	2,047,045	\$308,193	15.06
Manufacturing - Auckland	Hand Tools	854,526	\$113,871	13.33
NZ Call Centre	Colombo St, Christchurch	656,722	\$101,917	15.52
Corporate	Albert St Auckland	769,488	\$85,111	11.06
Manufacturing - Wellington	Electrical	461,946	\$69,471	15.04
International Relations	L3 Roose House	393,235	\$59,824	15.21

Table 4: Summary of locations with highest electricity expenditure in 2003/ 04

Figures 7 – 10 graphically show the sites with (i) the highest electricity expenditure, (ii) the highest electricity consumption, (iii) the highest electricity price and (iv) the highest electricity use index.

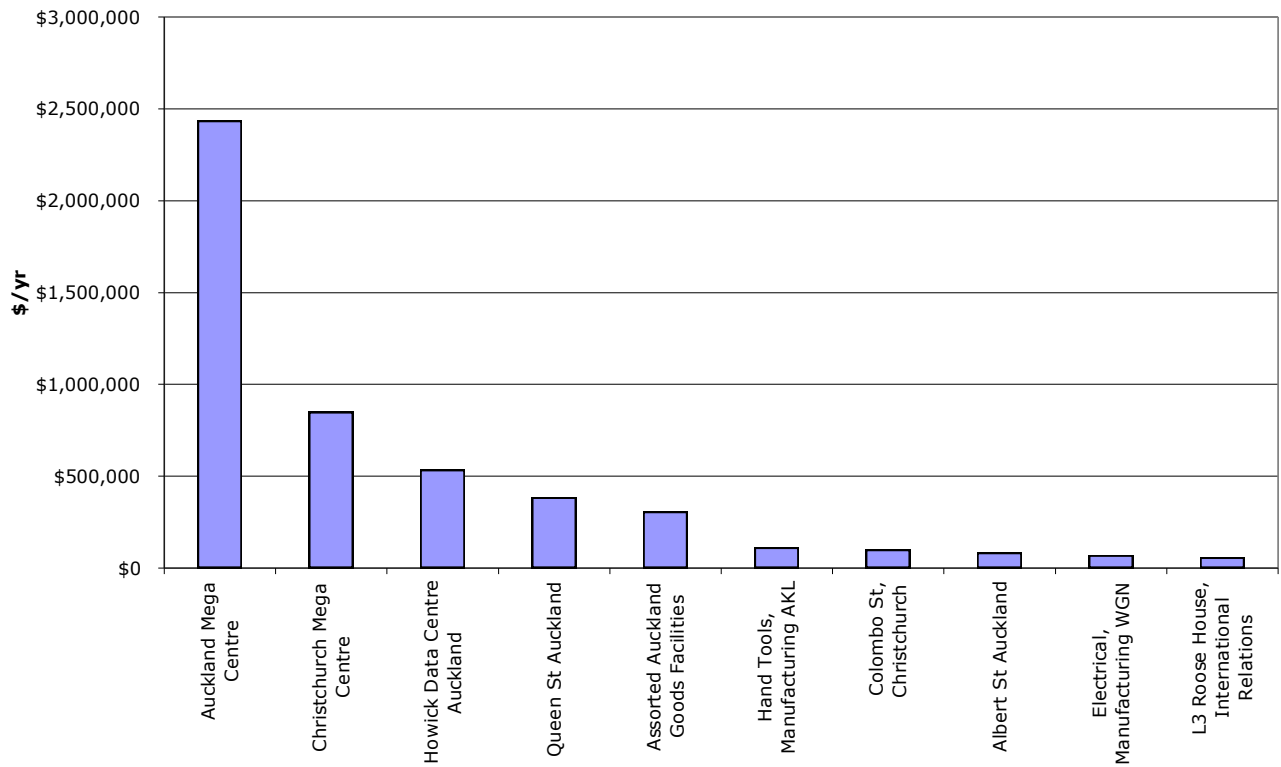


Figure 7: Locations with the highest electricity expenditure

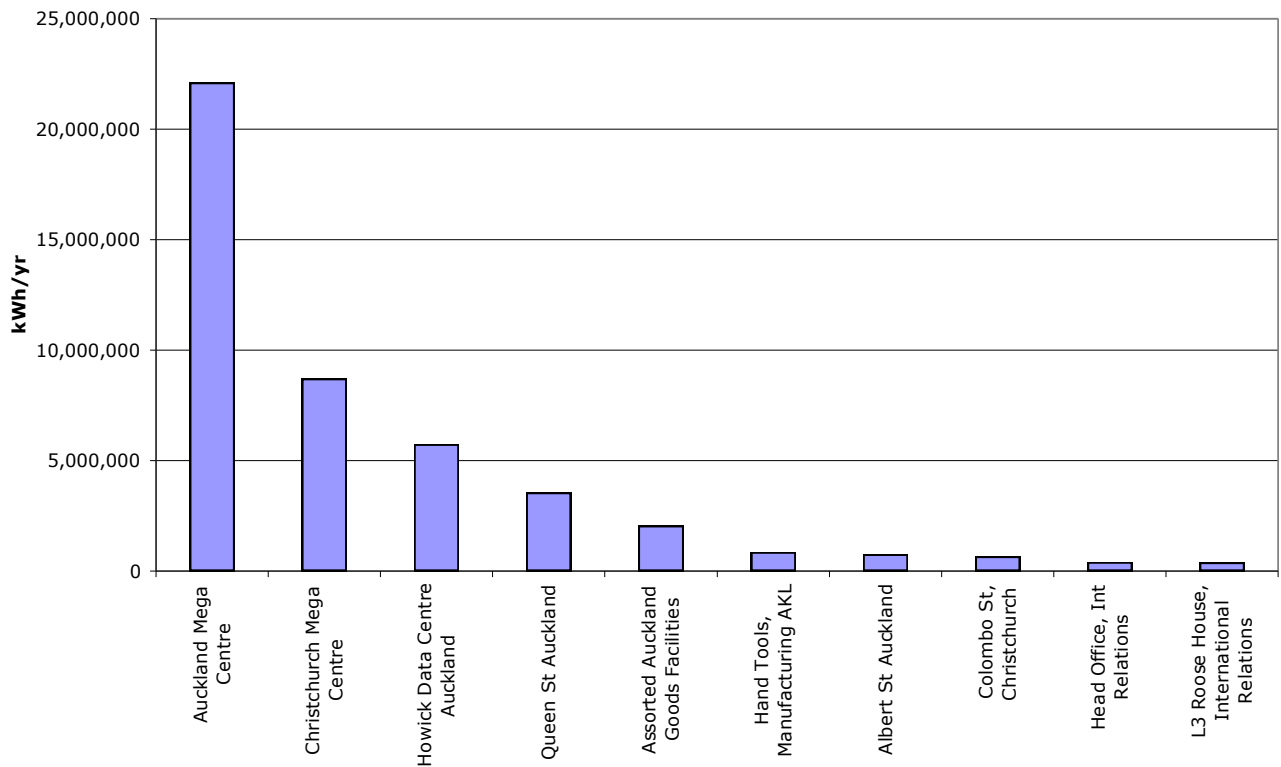


Figure 8: Locations with the highest electricity consumption

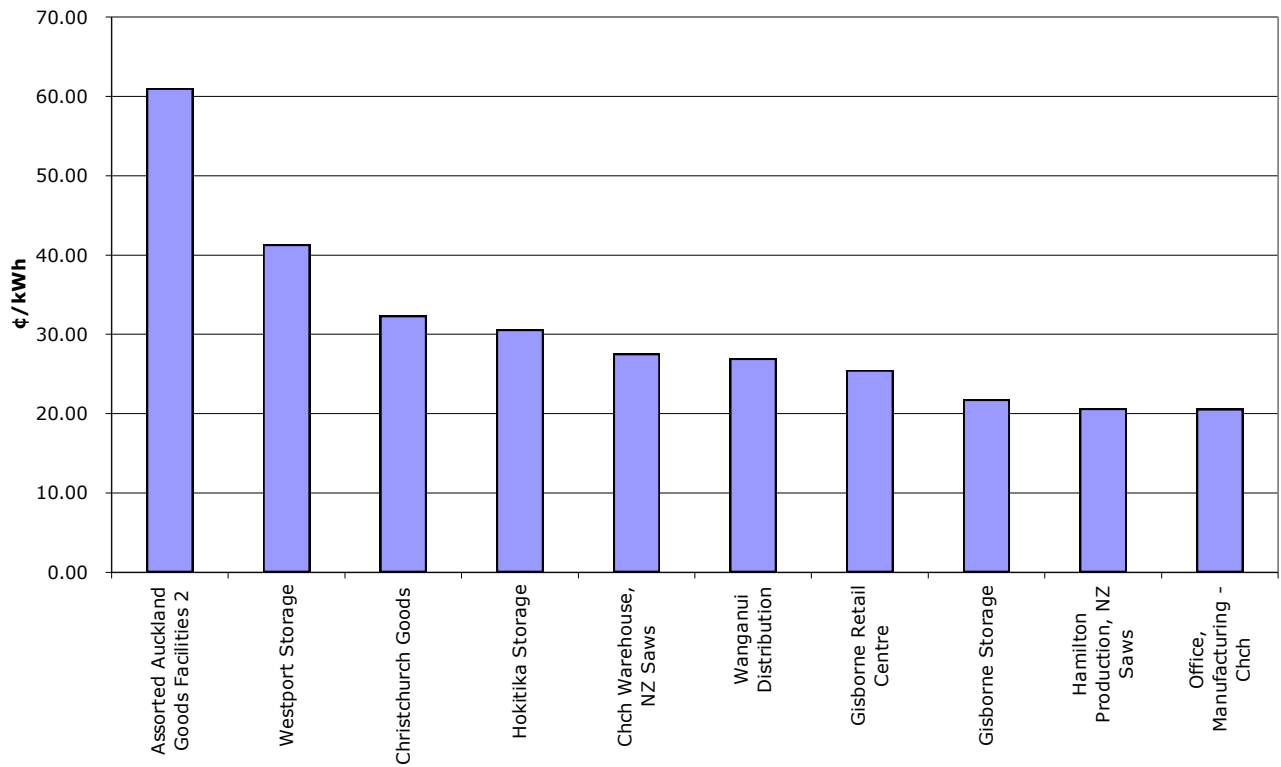


Figure 9: Locations with the highest electricity price

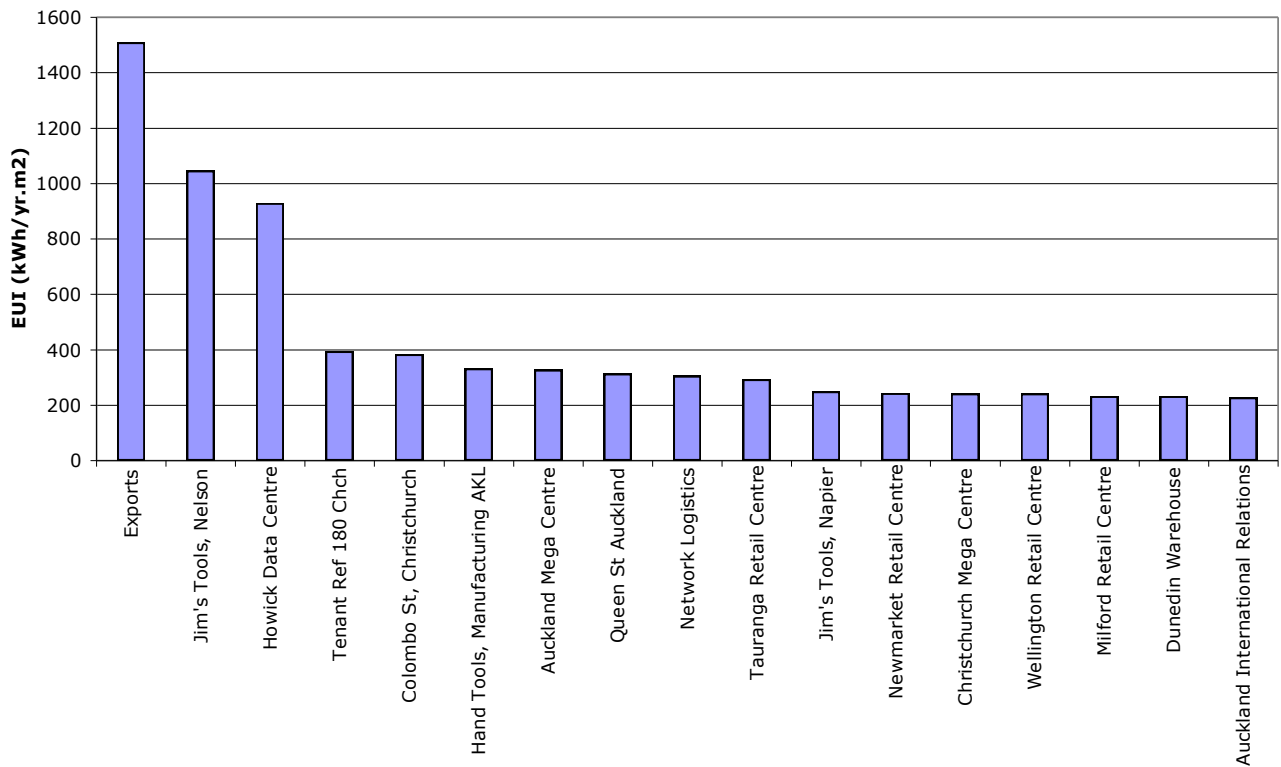


Figure 10: Locations with the highest energy use index

Figures 7 to 10 highlight several relevant points:

- Not surprisingly, the expenditure is closely related to the consumption. The ten locations with the highest expenditure are also the locations with the highest consumption, with one exception: Colombo St pays a higher price (15.52c/ kWh) than Albert St (11.06c/ kWh) and therefore has slightly higher total expenditure despite having lower consumption.
- It is clear that the Auckland Mega Centre dominates both the electricity consumption and expenditure. It also rates as the fifth highest location in terms of energy intensity (328 kWh/ yr.m²), which is significantly higher than the Christchurch Mega Centre (242 kWh/ yr.m²). This suggests that the Auckland Mega Centre should be targeted for energy savings.
- Many of the locations with high electricity prices are in relatively remote parts of the country and therefore a higher electricity price can be expected. The locations shown in Figure 9 are all the locations with a price above 20c/ kWh. However, even for the most remote locations, 20c/ kWh should be treated as a maximum reasonable price at this time (NB: energy prices are expected to increase).
- None of the locations with the high electricity prices also have high consumption. This suggests that the price paid for electricity has a good correlation with the consumption. Locations which consume more electricity can command a lower price. This is investigated in more detail in Figure 11.
- The Auckland goods facilities, as indicated in Figure 9, pay 60.84 c/ kWh, which is particularly concerning, given its size and geographic location.
- There are 15 locations with an EUI higher than 200 kWh/ yr.m².
- The Howick Data Centre has an exceptionally large EUI – 931 kWh/ yr.m². It is likely to have a lot of very energy intensive equipment, which would cause the high EUI. However, there may still be potential for significant energy savings.
- Of the 15 locations with an EUI of more than 200 kWh/ yr.m², 7 also appear as projects with the highest expenditure: Howick Data Centre, Colombo St Christchurch, Hands Tools Manufacturing Auckland, Auckland Mega Centre, Queen St Auckland, Network Logistics and Christchurch Mega Centre. If the operations at these projects do not require such a high energy intensity, then there is potential to significantly reduce the overall electricity consumption of Bloggs' Hardware.

To determine which locations have the most potential for energy cost savings the three most important considerations are the annual expenditure, the price paid and the energy intensity of each project.

Figures 11 and 12 are scatter graphs which can be used to identify the projects where the most energy cost savings are likely to be available. Figure 11 is used for savings from tariff negotiations and Figure 12 is used for savings from reductions in electricity consumption.

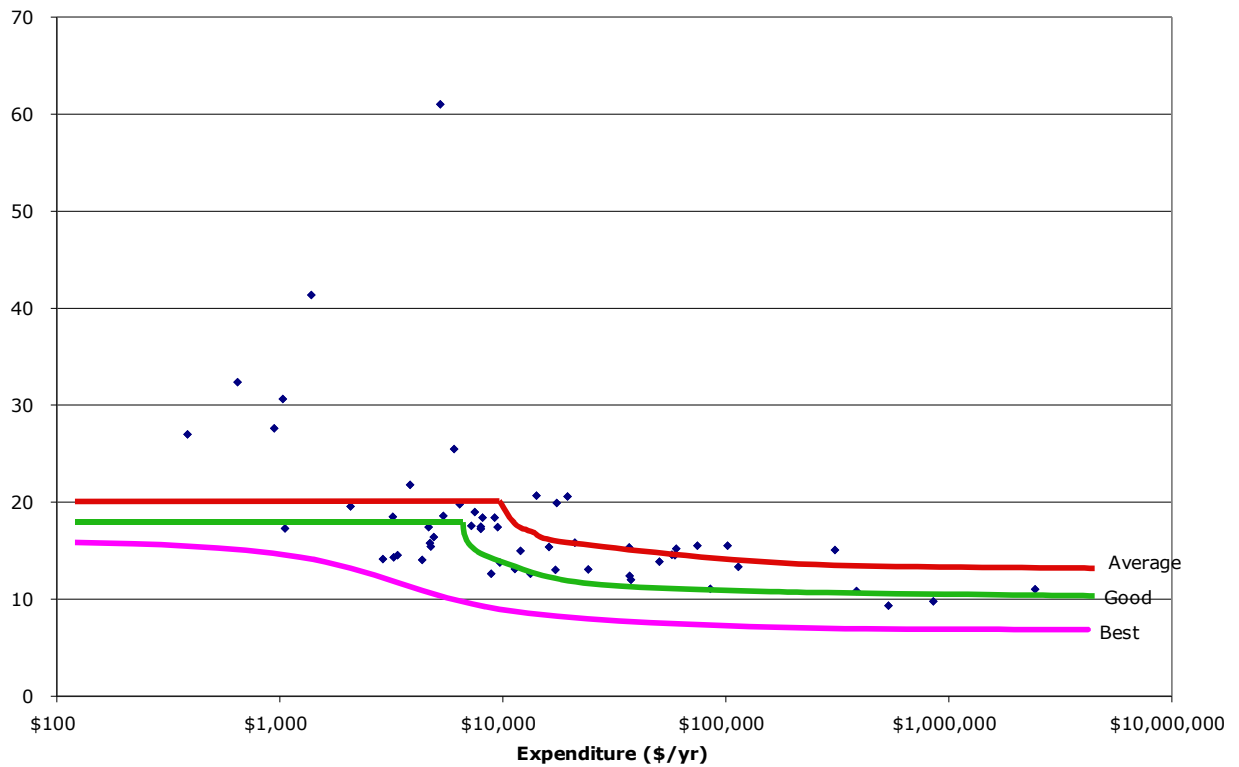


Figure 11: Price vs. expenditure for each project

NB: The scale of the expenditure axis is logarithmic, in order to better display the data.

The red line indicates what we would expect to be an average price to pay for electricity as a general rule. It indicates a maximum of 20 c/ kWh and when the project gets large enough the expected price will drop. The green line indicates a good price, and the pink line indicates what we believe would be the best price on the market today.

If the 15 locations with prices in excess of this line had their tariffs renegotiated to an acceptable level significant energy cost savings would be made as shown in Table 5.

Project	c/kWh	\$/yr	Reasonable c/kWh	Reasonable \$/yr	Savings \$/yr
Assorted Auckland Goods Facilities 2	61.09	\$5,252	20	\$1,719	\$3,533
Westport Storage	41.57	\$1,391	20	\$669	\$722
Christchurch Goods	32.26	\$643	20	\$399	\$244
Hokitika Storage	30.65	\$1,030	20	\$672	\$358
Chch Warehouse, NZ Saws	27.34	\$934	20	\$683	\$251
Wanganui Distribution	26.78	\$383	20	\$286	\$97
Gisborne Retail Centre	25.56	\$6,063	20	\$4,744	\$1,319
Gisborne Storage	21.12	\$3,723	20	\$3,525	\$197
Hamilton Production, NZ Saws	20.39	\$13,975	18	\$12,337	\$1,638
Office, Manufacturing - Chch	20.35	\$19,335	17	\$16,120	\$3,215
New Plymouth, Jim's Tools	19.27	\$16,882	17	\$14,893	\$1,989
Network Logistics	15.45	\$74,729	15	\$71,901	\$2,828
Colombo St, Christchurch	15.59	\$100,087	15	\$98,510	\$1,576
Assorted Int. Relations Meters	15.24	\$59,931	15	\$58,987	\$944
Assorted Auckland Goods Facilities	15.11	\$309,310	14	\$286,587	\$22,722
Total					\$41,632

Table 5: Savings from tariff negotiations

The savings from the locations which should have the prices negotiated down to 20 c/ kWh only contribute savings of \$6,721/ yr. The more significant savings come from negotiating a slightly better price for the projects with higher annual expenditure – in particular the Auckland goods facilities.

For the smaller, more remote, locations such as the buildings at Westport, Hokitika, Wanganui and Gisborne, renewable energy sources be may a viable source of electricity. Further investigation would be required to determine if renewable energy sources could realistically be used to provide the electricity.

Once the price of electricity has been negotiated to a reasonable level for all the locations, the next step in achieving energy cost savings is to reduce the electricity consumption. The biggest savings of consumption are likely to come from the locations which have a high energy intensity (EUI) and a high expenditure. The locations illustrated with a blue diamond in Figure 12 are numbered in order of likelihood of finding significant savings. This order is determined by multiplying the expenditure by the EUI – the Auckland Mega Centre is ranked first because its expenditure and EUI multiplied to give the highest product.

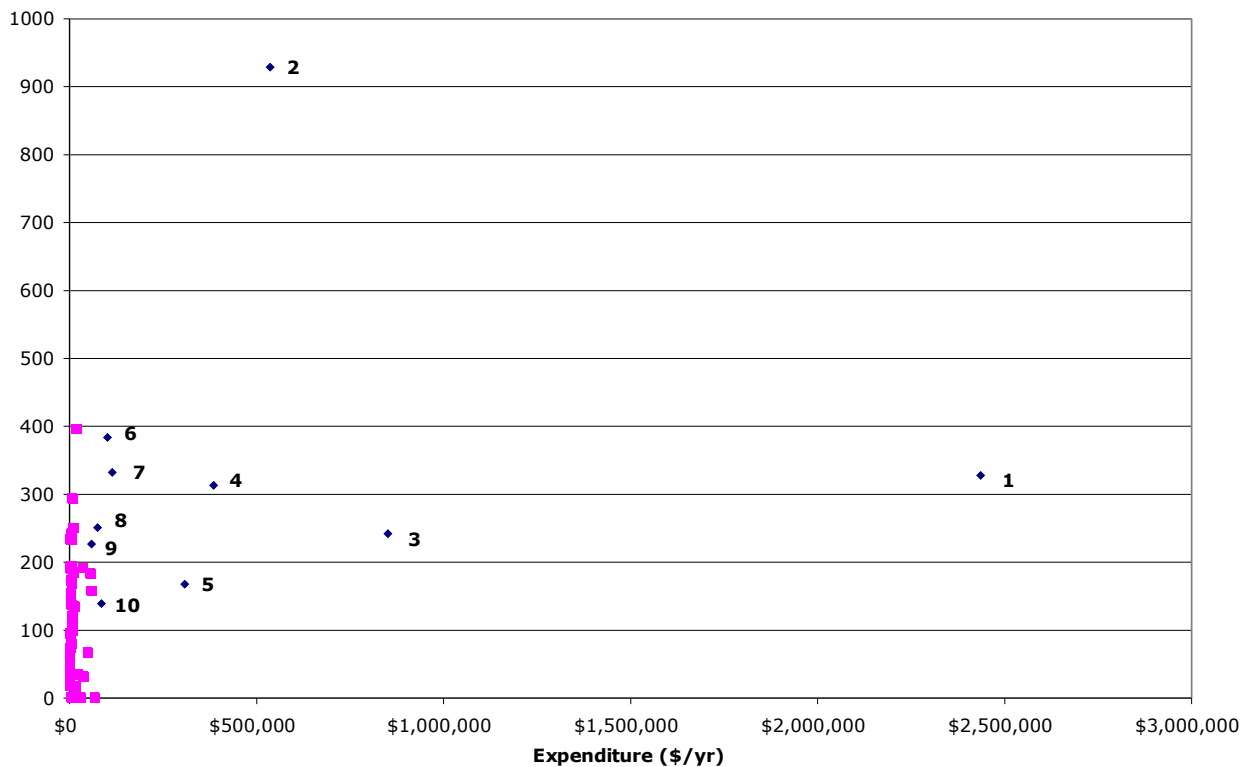


Figure 12: EUI vs. expenditure for each location

The ten locations most likely to give savings are listed in Table 6.

Rank	Description	kWh/yr.m²	\$/yr
1	Auckland Mega Centre	328	\$2,436,492
2	Howick Data Centre Auckland	929	\$536,361
3	Christchurch Mega Centre	242	\$851,461
4	Queen St Auckland	313	\$385,499
5	Assorted Auckland Goods Facilities	168	\$308,193
6	Colombo St, Christchurch	384	\$101,917
7	Hand Tools, manufacturing AKL	332	\$113,871
8	Head Office, Int. Relations	227	\$59,242
9	Network Logistics	306	\$43,351
10	Albert St, Auckland	139	\$85,111

Table 6: Locations most likely to offer significant savings of electricity consumption

As discussed earlier, the Auckland Mega Centre is the prime candidate for targeting energy savings – it has a high electrical EUI and by far the most expenditure. It is also substantially more energy intensive than the Christchurch Mega Centre.

The other nine locations are also candidates for energy audits, however the savings from these locations are unlikely to be as large the savings indicated at the Auckland Mega Centre.

5. Recommendations

Consider grouping meters. There are several locations which have more than one meter but are in the same physical location. There are 112 meters and only 60 locations. This suggests there is the potential to reduce the number of tariff meters by 52, so that there is only one tariff meter for each location. (NB: It is beneficial to have sub meters beyond the tariff meters, so the existing meter does not necessarily have to be removed. Rather the metering structure should be adjusted so that there is only one tariff meter per location).

If we assume that the meters are non-time-of-use, they will cost approximately \$200/ yr each in metering charges. Restructuring the meters will therefore save:

$$52 \text{ meters} \times \$200/\text{ yr} = \mathbf{\$10,400/\text{yr}}$$

For practical reasons, some meters may not be able to be grouped together. It is likely there will be some cost to either purchase new tariff meters or re-wire the existing meters.

Investigate the gas consumption over summer at the two Mega Centres. Together they use about 3 GWh of gas during the 3-month summer period. During the summer there should be no need for heating in either Auckland or Christchurch. If the gas is being used for heating it should be shut off, the savings could be:

$$3,000,000 \text{ kWh/ yr} \times 3.89 \text{ c/ kWh} = \mathbf{\$116,700/\text{yr}}$$

It is likely that the gas is being used for legitimate reasons, but it is worth checking – probably as part of an energy audit of these facilities.

Negotiate a better tariff for locations with high prices. In the past year there were 10 sites paying more than 20c/ kWh. In addition to this there were another 5 sites with an electricity price significantly higher than what could be considered a ‘reasonable’ price, as shown in Table 5. If these sites could negotiate a better electricity price the savings would be about **\$41,600/yr.**

Perform energy audits to at least level 2 standard. The locations ranked in order of the most likely to offer significant energy savings in Table 6, should be systematically audited starting with the Auckland Mega Centre.

The Auckland Mega Centre has, by far, the largest electricity expenditure (\$2,436,492/ yr) and an electrical EUI significantly higher than that for the Christchurch Mega Centre – 328 kWh/ yr.m² as opposed to 242 kWh/ yr.m² for the latter. If the Auckland Mega Centre could drop its EUI to 250 kWh/ yr.m², to match Christchurch, it would save:

$$\begin{aligned}
 328 \text{ kWh/ yr.m}^2 - 250 \text{ kWh/ yr.m}^2 &= 78 \text{ kWh/ yr.m}^2 \\
 78 \text{ kWh/ yr.m}^2 \times 67,416 \text{ m}^2 &= 5,258,448 \text{ kWh/ yr} \\
 5,258,448 \text{ kWh/ yr} \times 11.47 \text{ c/ kWh} &= \mathbf{\$603,140/yr, say \$600,000/yr}
 \end{aligned}$$

There may be operations that are performed at Auckland and not at Christchurch, which cause it to be more energy intensive. However, basic principles would suggest that the two Mega Centres should have a similar EUI.

The remaining nine locations on Table 6 could expect to have energy savings of at least 10% identified from energy audits. They currently spend a total of \$2,485,081/ yr. Therefore the expected savings to be identified would be about:

$$\$2,485,006/ \text{ yr} \times 10\% = \mathbf{\$248,501/yr, say \$250,000/yr}$$

Combined, these give a total electricity cost saving potential of about \$750,000/ yr.

NB: Electricity users who consume more than 10 GWh/ yr are eligible for a significant subsidy on level 2 energy audits from the Energy Efficiency and Conservation Authority (EECA). The “Large Electricity Users’ Audit Grant” provides a subsidy of up to 75% of the cost the audit.

Investigate the potential of using renewable energy at the smaller locations. The buildings at Westport, Hokitika, Wanganui and Gisborne may be suited to using renewable energy sources. If so, it could be a good opportunity to generate publicity for Bloggs’ Hardware.