Appendix A - Energy Purchase Records

BLOGGSVILLE MOTOR INN - ELECTRICITY USE FROM BLOGGSPOWER INVOICES

(numbers in shaded areas are original data from invoices; numbers in unshaded areas are calculated results)

Reading	Monthly kWh use - by category				Price (¢/kWh)			
date	Weekday	Weekend	Night	Demand (kVA)	Week day	Week end	Night	Peak $/kVA
1-Aug-99	21,856	8,260	10,988	100	6.32	6.12	3.10	8.68
1-Sep-99	20,103	8,664	10,680	95	6.32	6.12	3.10	8.68
2-Oct-99	21,407	8,421	11,232	94	6.32	6.12	3.10	8.68
1-Nov-99	19,899	7,807	10,688	88	5.94	5.88	3.10	8.68
2-Dec-99	19,010	7,491	8,879	82	5.94	5.88	3.10	8.68
1-Jan-00	18,842	7,179	8,958	77	5.94	5.88	3.10	8.68
1-Feb-00	16,442	5,984	8,590	80	5.94	5.88	3.10	8.68
3-Mar-00	16,987	7,126	7,927	81	5.94	5.88	3.10	8.68
1-Apr-00	20,463	7,471	9,826	86	5.94	5.88	3.10	8.68
3-May-00	21,226	8,506	10,962	92	5.94	5.88	3.10	8.68
2-Jun-00	21,896	8,114	10,179	95	6.06	6.02	3.43	8.88
3-Jul-00	21,420	7,787	10,090	107	6.06	6.02	3.43	8.88
2-Aug-00	21,531	8,732	11,808	100	6.06	6.02	3.43	8.88
1-Sep-00	22,790	9,114	11,492	102	5.88	5.88	3.34	9.14
2-Oct-00	20,289	7,744	10,232	99	5.88	5.88	3.34	9.16
1-Nov-00	20,812	8,382	11,125	95	5.88	5.53	3.34	9.18
2-Dec-00	18,860	8,194	10,362	93	5.88	5.53	3.34	9.21
1-Jan-01	21,062	7,501	9,394	96	5.88	5.53	3.34	9.23
1-Feb-01	17,827	6,799	8,851	92	5.88	5.53	3.34	9.25
4-Mar-01	16,393	6,421	8,042	80	5.88	5.53	3.34	9.25
1-Apr-01	21,169	8,432	10,634	92	5.88	5.53	3.34	9.25
2-May-01	23,104	8,803	10,249	98	5.55	5.52	2.60	12.08
1-Jun-01	24,820	9,520	11,695	102	5.94	5.85	2.60	12.08
2-Jul-01	25,043	9,736	11,856	100	5.94	5.85	2.60	12.08
1-Aug-01	24,606	10,346	11,963	105	5.94	5.85	2.60	12.08
1-Sep-01	24,379	9,823	11,354	103	5.94	5.85	2.60	12.08
2-Oct-01	24,996	9,504	12,257	99	5.94	5.85	2.60	12.08
1-Nov-01	22,594	9,656	10,826	101	5.55	5.85	2.60	12.08
2-Dec-01	21,216	8,709	11,136	93	5.55	5.85	2.60	12.08
1-Jan-02	20,294	8,874	10,767	84	5.55	5.85	2.60	12.08
1-Feb-02	19,395	8,049	10,742	81	5.55	5.85	2.60	12.08
4-Mar-02	17,515	6,515	8,239	84	5.55	5.85	2.60	12.08
Annual kWh	**269,131**	**107,967**	**131,718**					

Month	*days*	Usage					
		Weekday	Weekend	Night	Total	Demand	Cost
		kWh/d	*kWh/d*	*kWh/d*	*kWh/d*	*kVA*	*$/mo*
Aug-99	*31*	705	266	266	1,326	100	$3,095
Sep-99	*31*	648	279	345	1,272	95	$2,956
Oct-99	*30*	714	281	374	1,369	94	$3,032
Nov-99	*31*	642	252	345	1,239	88	$2,736
Dec-99	*30*	634	250	296	1,179	82	$2,557
Jan-00	31	608	232	289	1,128	77	$2,487
Feb-00	31	530	193	277	1,001	80	$2,289
Mar-00	29	586	246	273	1,105	81	$2,377
Apr-00	32	639	233	307	1,180	86	$2,706
May-00	30	708	284	365	1,356	92	$2,899
Jun-00	31	706	262	328	1,296	95	$3,008
Jul-00	30	714	260	336	1,310	107	$3,063
Aug-00	30	718	291	394	1,402	100	$3,123
Sep-00	31	735	294	371	1,400	102	$3,192
Oct-00	30	676	258	341	1,276	99	$2,897
Nov-00	31	671	270	359	1,301	95	$2,931
Dec-00	30	629	273	345	1,247	93	$2,765
Jan-01	31	679	242	303	1,224	96	$2,853
Feb-01	31	575	219	286	1,080	92	$2,571
Mar-01	28	585	229	287	1,102	80	$2,328
Apr-01	31	683	272	343	1,298	92	$2,917
May-01	30	770	293	342	1,405	98	$3,219
Jun-01	31	801	307	377	1,485	102	$3,567
Jul-01	30	835	325	395	1,555	100	$3,573
Aug-01	31	794	334	386	1,513	105	$3,646
Sep-01	31	786	317	366	1,470	103	$3,562
Oct-01	30	833	317	409	1,559	99	$3,555
Nov-01	31	729	311	349	1,390	101	$3,320
Dec-01	30	707	290	371	1,369	93	$3,100
Jan-02	31	655	286	347	1,288	84	$2,940
Feb-02	31	626	260	347	1,232	81	$2,805
Mar-02	28	626	233	294	1,152	84	$2,582

Total= 508,816 **365** *(thru 4 Mar 2002)* **Annual cost =** **$38,788**

BLOGGSVILLE MOTOR INN - GAS USE FROM BLOGGSGAS

(numbers in shaded areas are data from invoices; those in unshaded areas are

Reading date	Invoice usage	Price $/day	Price ¢/kWh ex GST	Month	days	Usage kWh/d	Average ¢/kWh	$/bill
8-Mar-99	62 580	$8 50	2 10	Mar-99	60	1 043	2 91	$1 824
8-May-99	88 389	$8 50	2 10	May-99	61	1 449	2 69	$2 375
5-Sep-99	283 400	$8 50	2 10	Sep-99	120	2 362	2 46	$6 971
4-Nov-99	123 180	$8 50	2 10	Nov-99	60	2 053	2 51	$3 097
4-Mar-00	148 467	$5 20	2 52	Mar-00	121	1 227	2 94	$4 371
3-May-00	82 805	$5 20	2 52	May-00	60	1 380	2 90	$2 399
1-Nov-00	442 022	$5 20	2 52	Nov-00	182	2 429	2 73	$12 085
30-Nov-	40 065	$5 20	2 52	Nov-00	29	1 382	2 90	$1 160
4- Jan-01	46 795	$6 25	3 10	Jan-01	35	1 337	3 57	$1 669
1-Feb-01	27 006	$6 25	3 10	Feb-01	28	965	3 75	$1 012
28-Feb-	30 073	$6 25	3 10	Feb-01	27	1 114	3 66	$1 101
31-Mar-	41 093	$6 25	3 10	Mar-01	31	1 326	3 57	$1 468
29-Apr-	48 476	$6 25	3 10	Apr-01	29	1 672	3 47	$1 684
31-May-	57 106	$6 25	3 10	May-01	32	1 785	3 45	$1 970
30- Jun-	81 223	$6 25	3 10	Jun-01	30	2 707	3 33	$2 705
29- Jul-01	78 103	$6 25	3 10	Jul-01	29	2 693	3 33	$2 602
31-Aug-	81 300	$6 25	3 10	Aug-01	33	2 464	3 35	$2 727
30-Sep-	67 853	$6 25	3 10	Sep-01	30	2 262	3 38	$2 291
31-Oct-	62 715	$6 25	3 10	Oct-01	31	2 023	3 41	$2 138
30-Nov-	46 230	$6 25	3 10	Nov-01	30	1 541	3 51	$1 621
31-Dec-	44 733	$6 25	3 10	Dec-01	31	1 443	3 53	$1 580
30- Jan-	41 070	$6 25	3 10	Jan-02	30	1 369	3 56	$1 461
28-Feb-	31 929	$6 25	3 10	Feb-02	29	1 101	3 67	$1 171
Annual	**681 831 2001-**			days –	365 (29/2/01 -			**$23 418**
	668 766			days –	361 (5/3/00 -			$19 427
–>	**676 176 2000-2001**				extrapolated to 365			**$19 642**
	643 436			days –	362 (9/3/99 -			$16 813
	648 768 1999-2000				extrapolated o 365			**$16 953**

Appendix B - Energy Pricing Details

Natural Gas

Natural gas, available only from BloggsGas, is priced at $6.25/ day (fixed charge) plus 3.10¢/ kWh. These prices are exclusive of GST.

> Note: because gas is burned at an efficiency lower than 100% - typically about 70% - there are two gas prices used in calculations of energy savings.
>
> The ***gross*** price, used when evaluating measures from energy purchases, is 3.10¢/ kWh. This is the marginal cost of saving one kWh of gas from being purchased.
>
> The ***net*** price, used when evaluating measures from heating energy end-uses, is 4.43¢/ kWh. This is equal to 3.10¢/ kWh divided by 70% boiler "stack" efficiency, and represents the marginal cost of saving one kWh of gas heat from being used.

Electricity

The following tariffs are the choices available from BloggsPower as of February 2002. These prices are all exclusive of GST. The Bloggsville Motor Inn is presently on the Time of Use tariff.

Standard Tariff

All units (energy plus demand)	9.95 ¢/ kWh

Day/Night Tariff

Day Time units (7 AM - 11 PM, energy plus demand)	11.52 ¢/ kWh
Night Time units (11 PM - 7 AM, energy plus demand)	5.25 ¢/ kWh

Time of Use

Summer Weekend Energy (October-April, 7 AM–11 PM, Saturdays, Sundays and statutory holidays)	5.52 ¢/ kWh
Summer Weekday Energy (October-April, 7 AM–11 PM, weekdays, statutory holidays excluded)	5.55 ¢/ kWh
Winter Weekend Energy (May-September, 7 AM–11 PM, Saturdays, Sundays and statutory holidays)	5.85 ¢/ kWh
Winter Weekday Energy (October-April, 7 AM–11 PM, weekdays, statutory holidays excluded)	5.94 ¢/ kWh
Night Time Energy (11 PM–7 AM, all days)	2.67 ¢/ kWh
Monthly Maximum Demand (highest half-hourly average load)	$12.08/ kVA (per month)

For calculations, the price of electricity is taken as **7.62¢/kWh** for units used across all 24 hours. This is the average price of electricity, including network charges, on the present tariff.

For units used only at night, a cost of **2.67¢/kWh** is used. This is the energy only price, as night time demand is well below the peak and therefore does not affect network charges.

For units used only during peak hours (not at night) a cost of **9.0¢/kWh** is used. This is the cost of electric energy at the daily high price, and includes the effect on network charges.

Appendix C - Lighting equipment and energy use

The types of lamps and luminaires in use are tabulated below for each major area, as well as their power demand and how the switching of lights in each area is done. There are also comments on whether any fixtures contain PCBs.

Location	Switching	Lighting type	PCBs?
Guest rooms (35)	Switched manually by guests	6 incandescent bulbs (40W average), fabric/glass shades	No
Guest bathrooms	Switched manually by guests	1 1-lamp (38 x 1200 mm) batten fluorescent, no diffusers (50 W each)	Yes
Guest room corridors	Always left on	8 1-lamp (38 x 900 mm) batten fluorescents, no diffusers (41W each)	Probably
Reception lobby	Always left on	9 PAR-100 recessed in "can" fixtures (100 W each) 2 halogen spotlights (50 W each) 2 1-lamp (26 x 1200 mm) tubular fluorescents with reflectors (45 W each) 2 1-lamp (26 x 1200 mm) batten fluorescents with diffusers (45 W each)	No
Public bar	Left on when open (Mon.-Sat 10 AM-10 PM)	20 incandescent bulbs (60W), fabric/glass shades 5 Thorn "2D" compact fluorescents in glass shades (28 W each) 4 1-lamp (26 x 1200 mm) batten fluorescents, with diffusers (45 W each)	No
Function room (not in use)	On only when room is used	60 incandescent bulbs (40W–60W), in yellow glass shades 8 1-lamp (26 x 1800 mm) batten fluorescents, no diffusers (85 W each)	No
Night club (not in use)	Thurs., Sat: 9PM - 3AM, Friday 4PM - 3AM	63 incandescent bulbs (40W), in "can" downlights 4 R-80 reflector incandescent bulbs (80 W each) Show lighting: "black" light, strobes, spotlights (estimated 500 W)	No
Bottle shop	M,T,W 1PM -10PM Th.-F 11AM-11PM, Sat 9AM-11PM	6 1-lamp (38 x 1500 mm) batten fluorescents, no diffusers (77 W each) 10 R-80 reflector incandescent bulbs (80 W each)	Probably[5]
Restaurant	Left on when open (7 AM-10 PM daily)	65 incandescent bulbs (60W), fabric/glass shades 6 PAR-100 lamps in "can" downlights (100 W each) 6 100W halogen lamps illuminating blackboard menus	No

5 One of these luminaires was opened and found to contain an ATCO EC65-EO ballast, and no visible external capacitor. It is not clear whether these contain PCBs or not.

Restaurant kitchen	Left on when open (1 hours before and after restaurant)	23 1-lamp (38 x 1200 mm) batten fluorescents, no diffusers[6] (50 W each) 3 Phillips SL-18 compact fluorescents above the stovetop (18 W each) 6 (~150W) "heat lamps" above serving counter	Apparently not[7]
Dish washing corridor, between the public bar and storage	Always left on	5 2-lamp (38 x 1200 mm) batten fluorescents, no diffusers (100 W each) 4 2-lamp (38 x 600 mm) batten fluorescents, no diffusers (62 W each)	Yes[8] (1200 mm fixtures only)[9]
Kitchen corridor	Always left on	4 2-lamp (38 x 1500 mm) batten fluorescents, no diffusers (154 W each)	Probably[10]

Some incandescent bulbs were also used in storage areas for the hotel. This is acceptable in terms of energy efficiency, as they would not be used as much as the public areas.

The lighting energy use in each area is totalled and summarized in the table below, from the description of the lighting in Section 3.1. The fraction of the lights operating at each of three times is estimated, and the total lighting power load at these three times is calculated.

	Power	Fraction of lights on (average)			Total power (kW) at each time		
Space	(kW)	Night	Noon	Evening	Night	Noon	Evening
Guest corridor	0.34	100%	100%	100%	0.34	0.34	0.34
Guest room/bath	10.15	5%	10%	50%	0.51	1.02	5.08
Lobby	1.18	100%	100%	100%	1.18	1.18	1.18
Public bar	2.06	10%	85%	85%	0.21	1.75	1.75
Restaurant	5.10	10%	100%	100%	0.51	5.10	5.10
Kitchen	2.10	20%	100%	100%	0.42	2.10	2.10
Function room	3.56	5%	5%	15%	0.18	0.18	0.53
Night club	3.50	10%	10%	50%	0.35	0.35	1.75
Bottle shop	1.26	10%	50%	85%	0.13	0.63	1.07
Dish corridor	0.75	100%	100%	100%	0.75	0.75	0.75
Kitchen corridor	0.62	100%	100%	100%	0.62	0.62	0.62
Total	30.62				5.19	14.01	20.27

6 At the time of the survey, only about half the lamps were operational., and many "burned-out" tubes were still in place. This appears to imply that lighting maintenance is minimal.

7 The ballasts in one of these fixtures was examined for PCBs and found to contain a "Thorn/ EMI EC36/ 40 EO" ballast, with no separate capacitor. As far as is known, these ballasts do not contain PCBs (they are not on the Ministry of Health list).

8 These luminaires were disassembled to look for potential PCB containing ballasts. They were found to contain the same GEC/ AEI MPM4R (resonant start) ballasts, and Thorn SRS 40 capacitors #2344 as the guest bathrooms, and therefore presumably contain PCBs.

9 These were also disassembled and found to contain GEC/ AEI MPM4S ballasts with plastic capacitors, which apparently would not have contained PCBs. (PCBs are thought to be found in metal jacketed capacitors only.)

10 One of these luminaires was opened and found to contain an ATCO EC65-EO ballast, and no visible external capacitor. It is not clear whether these contain PCBs or not.

Appendix D - Calculation of Energy Balance

The energy balance, as shown in Figure 10, is a technique whereby all the observed energy end-uses in the building are quantified and matched to the purchases, to ensure that all the energy flows are understood.

First, the observed electrical end-uses are analysed, totaled and adjusted to balance with the observed electrical load for each time of the day, as noted from the "time-of-use" electricity purchase data, as in Figure 4 for summer (February) and Figure 7 for winter (August).

Second, this is estimated for the gas purchases (as no time-of-use gas data is available).

As can be seen from Figures 4 and 7, the electrical loads are different winter and summer, and there are three main levels of use:

Time interval	Summer	Winter
Night time (10 PM-6 AM)	33 kW	50 kW
Mid day (6 AM-4 PM)	55 kW	65 kW
Evening (4 PM-10 PM)	65 kW	85 kW

The observed electric energy use at each of these three times of day will be balanced with observed and estimated end-uses, to form the electrical portion of the energy balance.

The kitchen electrical load and the chiller load were measured at their individual distribution boards, as described in Section 2, and shown in Figure 11. The average lighting power demand at each of these times of day is calculated in Appendix C. The laundry dryer load is assumed to be on almost all the time at night, and about half the time during the rest of the day. All these loads are assumed to be constant month to month.

Thus, the observed electric energy end-uses at each time of day are listed in the Table below.

Time interval	Kitchen	Chillers	Lighting	Laundry	Total
Night time (10 PM-6 AM)	4 kW	2 kW	5 kW	20 kW	31 kW
Mid day (6 AM-4 PM)	20 kW	7 kW	14 kW	10 kW	51 kW
Evening (4 PM-10 PM)	25 kW	7 kW	20 kW	10 kW	62 kW

These totals are slightly lower than the observed electrical demand for the corresponding times in summer, and well below the corresponding times in winter. The difference between the observed summer purchases and end-uses is taken as "miscellaneous electrical load" (photocopiers, computers, cash registers, small refrigerators and beverage coolers, etc.), and the difference between the summer and winter loads is taken as electrical heating in the guest rooms.

Thus, the estimated electrical energy balance for these three times of day, for summer and winter, as shown in the two tables below. These data are then used to form Figures 5 and 8, in the main body of the report.

Summer (February) Energy end-use distribution

Time of day	Night	Noon	Evening
Kitchen electrical	4 kW	20 kW	25 kW
Electric chillers	2 kW	7 kW	7 kW
Electric lights	5 kW	14 kW	20 kW
Laundry	20 kW	10 kW	10 kW
Electrical heating	0 kW	0 kW	0 kW
Misc. electrical	2 kW	4 kW	3 kW
Total electrical load	**33 kW**	**55 kW**	**65 kW**

Winter (August) Electricity use distribution

Time of day	Night	Noon	Evening
Kitchen electrical	4 kW	20 kW	25 kW
Electric chillers	2 kW	7 kW	7 kW
Electric lights	5 kW	14 kW	20 kW
Laundry	20 kW	10 kW	10 kW
Electrical heating	17 kW	10 kW	20 kW
Misc. electrical	2 kW	4 kW	3 kW
Total electrical load	**50 kW**	**65 kW**	**85 kW**

To form an annual (electrical) energy balance, the average winter electrical energy use is calculated for each end-use, then the heating (and any other end-use that varies by season) is multiplied by a weighting factor that converts its winter use to its year-round use. In this case, a weighting factor of 0.41 for space heating electricity allows the total electric end-uses to total 509,000 kWh/ year, which matches the observed electric energy purchases of 508,816 kWh/ year.

Electrical End-use	Average kW	Daily kWh	Weighting	Annual kWh
Kitchen electrical	17.0	408	1.00	148,920
Electric chillers	5.3	128	1.00	46,720
Electric lights	13.0	312	1.00	113,880
Laundry dryers	13.3	320	1.00	116,800
Electrical heating	15.7	376	0.41	56,400
Misc. electrical	3.0	72	1.00	26,280
Total				**509,000**

The next step is to develop a similar energy balance for the gas use.

As shown in Figure 1 the gas usage was about 1,000 kWh/ day in summer and 2,500 kWh/ day in winter. The summer gas use can be assumed to be all for kitchen cooking and water heating, and the difference between summer and winter as energy use for space heating.

The water heating energy use can be estimated by noting the different areas that have water heaters, and their usage at different times of the day. As their is no time-of-use gas consumption data available, these estimates will be less accurate than electrical, but should be still sufficient.

The guest rooms have three 6 kW storage water heaters. These are expected to have a peak load in the morning, as guest have showers and the heaters are completely depleted. The demand will continue until about noon, as the storage heaters recharge. There will be a smaller peak in the evenings, as guests have showers after the day.

The laundry has two 6 kW storage water heaters. It will have a peak starting at 10 PM, when the night shift starts washing laundry, lasting until about 6 AM. This load will almost be at the limit of the heaters. It will continue for about two hours after the night shift, as the heaters recharge. There will be a small laundry hot water load in the afternoon, as some laundry is done then, and will drop to zero in the evening, before the night shift starts.

The kitchen will have a small load in the morning, as the leftover dishes from the previous night are washed, building to a peak during the noon and evening meal times. There will usually be some dishes washed after the restaurant is closed, but none during the night.

The bars will have a similar load to the kitchen, but of lesser intensity, and starting later.

The table below lists the four areas which have separate gas water heaters, in the first column, with the sizes of those heaters. Then, for each two-hour period of the day (Midnight until 2 AM, etc.), the average water heating demand (in kW) is listed for each area, and totalled in the bottom row.

Area (Heater Size)	M-2	2-4	4-6	6-8	8-10	10-N	N-2	2-4	4-6	6-8	8-10	10-M	Total
Rooms (18 kW)	2	0	0	18	18	14	3	6	8	6	6	4	170 kWh/d
Laundry (12 kW)	10	10	10	10	2	4	6	6	2	0	0	12	144 kWh/d
Kitchen (6 kW)	2	0	0	4	4	6	6	3	2	6	6	4	86 kWh/d
Bars (6 kW)	2	0	0	0	4	2	2	4	1	2	4	4	50 kWh/d
Total (kW)	**16**	**10**	**10**	**32**	**28**	**26**	**17**	**19**	**13**	**14**	**16**	**26**	**450 kWh/d**

The total gas energy use is 450 kWh/ day. This leaves 550 kWh/ day for cooking. Both of these loads are assumed to be constant month-to-month, and not vary summer to winter. Although this may not be strictly true, it is as close as can be determined at this level of audit.

Finally, the 1,500 kWh/ day of space heating energy is multiplied by an appropriate weighting factor, to allow the total to balance with the observed purchases. A weighting factor of 0.58 allows the observed gas end-uses to balance the purchases to within 1%. This factor seems reasonable, as the building is heated warmer than is customary (23°C), and the electric heaters would only be used when guest felt cold - less often than the gas heating would be used.

With this information, the estimated distribution of gas energy end-uses are presented below:

End-use	Winter kWh/day	Weighting	Annual kWh
Water heating	450	1.00	164,250
Cooking	550	1.00	200,750
Gas heating	1,500	0.58	317,550
Total			**682,550**

This information is used to prepare the overall energy balance, as presented in Figure 10.