

RESEARCH PROJECT: ANALYSIS OF ENERGY USE AND CARBON EMISSIONS FROM HIGH CONSUMPTION HOUSEHOLDS

Aim

To establish the electricity and gas use of a variety of high consumption households.

Background

Modelling for the Carbon Emissions Reduction Target (CERT) illustrative mix is based on a three bedroomed semi-detached home, a heating pattern, insulation, ventilation, and other parameters which are considered typical for the existing housing stock. However, data from BERR shows a large range of electricity and gas consumption per home; for electricity, the highest consuming 0.8% of homes use over 5% of the electricity supplied to the whole of the domestic sector, and for gas, the highest consuming 0.24% of homes use more than 2% of the gas supplied to the domestic sector. Preliminary studies suggest that if the 20% of households with the highest consumption were to reduce their electricity & gas consumption by 10%, the CO₂ savings would be around 4 Mt CO₂/year – roughly equivalent to the savings from CERT. These figures should be taken with some caution, since some small businesses are included in the gas consumption figures. However, the figures indicate that more information is required on households with high consumption.

High consumption has been raised as a significant policy issue by a number of research studies, notably by the Carbon Vision group and by Gastec. In particular, field data from the Carbon Vision group suggests that high income households have increased their electricity demand disproportionately since the 1990's.

The exact form of the Supplier Obligation (the successor to CERT, which will run from 2011-2020) is not yet known. However, one suggestion was that it might include a focus on households with high consumption.

There are many possible reasons for high energy consumption, including:

- Inefficient boilers, poorly controlled gas heating, or electric storage heating)
- Inadequate insulation, single glazing
- Poorly fitting windows, high air infiltration from other air leakage routes
- Solid wall homes
- Householders at home during the day (eg a full-time parent with young children, or a pensioner)
- A greater requirement for warmth – eg pensioner households
- Use of a conservatory as an extension of the living space
- High use of consumer electronics.

Some of these can be addressed by energy efficiency measures, some not. The aim of this work is to estimate the required fuel use in a house in which the most obvious

energy efficiency measures have already been carried out (e.g. condensing boiler, loft insulation, cavity insulation if appropriate).

Objectives

The objectives of this research are:

To estimate the fuel required by a range of houses and households which differ significantly from the "typical". In each case, it is assumed that the most cost effective energy efficiency measures (condensing boiler, loft insulation, cavity insulation if appropriate) have already been carried out.

Work programme

Part 1 – Heating demand for pensioner households with all day heating

Average house size (3 bedroomed semi). Estimate space and water heating for a pensioner household requiring all day heating:

Gas Central Heating

(a) condensing boiler, 270mm loft insulation, cavity wall insulation, double glazing

(b) as (a) except solid wall

(c) as (b) except no double glazing

Electric Storage Heating

As above

Gas Central Heating

As above except demand temperature 1 degree higher (pensioner household requires warmth)

Electric Storage Heating

As above except demand temperature 1 degree higher (pensioner household requires warmth)

Part 2 – Large family house (4 bedrooms), with one parent and small children at home during the day.

Gas central heating:

Solid walled home, single glazed windows, insulated loft (270mm). Condensing boiler.

Cavity insulated home, double glazed, insulated loft (270mm). Condensing boiler.

Electric storage heating:

As above.

Part 2a – Large family house (4 bedrooms), with 'standard' heating hours.

Gas central heating:

Solid walled home, single glazed windows, insulated loft (270mm). Condensing boiler.

Cavity insulated home, double glazed, insulated loft (270mm). Condensing boiler.

Electric storage heating:
As above.

Part 3 – Large family house (4 bedrooms) with conservatory connected to the house by an open door and used as an extension of the living space throughout the year.

Gas central heating

Electric storage heating with secondary on-peak.

Part 4 – Estimation of energy use for lights, appliances & cooking for a family at home during the day, and for a pensioner household at home during the day.

Part 5 – Breakdown of dwelling sizes and number of cases from the English House Condition Survey, as follows:

- 1 bedroom
- 2 bedrooms
- 3 bedrooms
- 4 bedrooms
- 5 bedrooms
- 6+ bedrooms.

Method

The energy consumptions are based on the parameters used for standard dwellings in EEC/CERT.

These are based on data which give typical values for the country's housing stock. All relevant assumptions are identical to those used in the CERT calculations done by BRE for DEFRA and Ofgem in 2007. These can be found in an appendix to the CERT Technical Guidance Manual which is posted on the Ofgem website: www.ofgem.gov.uk/Sustainability/Environmnt/EnergyEff/CERT/Pages/CERT.aspx

The energy consumptions and CO₂ emissions have been calculated using BREDEM. BREDEM is an established and verified model which has been continuously developed and tested by BRE over the past 25 years, and is uniquely suited to this type of requirement.

Heating demand schedule for gas central heating

Standard

- weekday, two period: 07:00 to 09:00 and 16:00 to 23:00
- weekend, single period: 07:00 to 23:00

All day

- weekday, single period: 07:00 to 23:00
- weekend single period: 07:00 to 23:00

Fuel	Emissions / kWh	
	kgC	kgCO ₂
Gas	0.0518	0.1899
Elect	0.1175	0.4308
Oil	0.0680	0.2493
Coal	0.0817	0.2996
LPG	0.0584	0.2140

Table 1 Fuel emission factors used in CERT

1. Heating demand for pensioner households with all day heating

Estimate of space and water heating for a pensioner household requiring all day heating after insulation

The following parameters were used for the modelling:-

- Gas condensing boiler - Efficiency 89.6% (CERT 'typical of stock' value)
- Roof with 270mm loft insulation - U-value 0.185 W/m²K
- Solid wall U-value 2.1 W/m²K
- Insulated cavity wall U-value 0.456 W/m²K
- Single glazing U-value 4.8 W/m²K
- Double glazed U-value 2.8 W/m²K for standard air filled double glazing.
- Occupancy – two person household and singleton household.

BREDEM calculations of annual consumption based on CERT for a 3 bed semi, total floor area 88.8m², with **all day heating**.

Gas Central Heating				Annual Energy Consumption			
Condensing boiler, 270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	9,270	3,630	12,900	2,450
Solid wall	2.1	double glazing	2.8	21,112	3,630	24,742	4,698
Insulated cavity wall	0.456	single glazing	4.8	11,674	3,630	15,304	2,906
Solid wall	2.1	single glazing	4.8	23,722	3,630	27,352	5,194

Electric Storage Heating				Annual Energy Consumption			
270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	9,804	2,250	12,055	5,193
Solid wall	2.1	double glazing	2.8	22,137	2,250	24,387	10,506
Insulated cavity wall	0.456	single glazing	4.8	12,388	2,250	14,638	6,306
Solid wall	2.1	single glazing	4.8	24,911	2,250	27,162	11,701

Figure 1 Two person occupancy with standard demand temperature 21.3°C.

Gas Central Heating				Annual Energy Consumption			
Condensing boiler, 270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	10,146	3,032	13,178	2,502
Solid wall	2.1	double glazing	2.8	22,422	3,032	25,454	4,834
Insulated cavity wall	0.456	single glazing	4.8	12,775	3,032	15,807	3,002
Solid wall	2.1	single glazing	4.8	25,109	3,032	28,141	5,344

Electric Storage Heating				Annual Energy Consumption			
				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Cavity wall	0.456	double glazing	2.8	10,827	1,715	12,541	5,403
Solid wall	2.1	double glazing	2.8	23,520	1,715	25,235	10,871
Cavity wall	0.456	single glazing	4.8	13,518	1,715	15,233	6,562
Solid wall	2.1	single glazing	4.8	26,355	1,715	28,070	12,093

Figure 2 Single occupancy with standard demand temperature 21.3°C.

BREDEM calculations of annual consumption based on CERT for a 3 bed semi, total floor area 88.8m², with **all day heating**. Demand temperature one degree higher than standard.

Gas Central Heating				Annual Energy Consumption		Total	
Condensing boiler, 270mm loft insulation				space heating	water heating	kWh	kgCO ₂
	U-value		U-value	kWh	kWh		
Insulated cavity wall	0.456	double glazing	2.8	10,277	3,630	13,907	2,641
Solid wall	2.1	double glazing	2.8	23,256	3,630	26,886	5,106
Insulated cavity wall	0.456	single glazing	4.8	12,885	3,630	16,515	3,136
Solid wall	2.1	single glazing	4.8	26,113	3,630	29,743	5,648

Electric Storage Heating				Annual Energy Consumption		Total	
270mm loft insulation				space heating	water heating	kWh	kgCO ₂
	U-value		U-value	kWh	kWh		
Insulated cavity wall	0.456	double glazing	2.8	10,826	2,250	13,076	5,633
Solid wall	2.1	double glazing	2.8	24,402	2,250	26,653	11,482
Insulated cavity wall	0.456	single glazing	4.8	13,674	2,250	15,924	6,860
Solid wall	2.1	single glazing	4.8	27,456	2,250	29,707	12,798

Figure 3 Two person occupancy with demand temperature 22.3°C

Gas Central Heating				Annual Energy Consumption		Total	
Condensing boiler, 270mm loft insulation				space heating	water heating	kWh	kgCO ₂
	U-value		U-value	kWh	kWh		
Cavity wall insulation	0.456	double glazing	2.8	11,193	3,032	14,225	2,701
Solid wall	2.1	double glazing	2.8	24,675	3,032	27,707	5,262
Cavity wall insulation	0.456	single glazing	4.8	14,088	3,032	17,120	3,251
Solid wall	2.1	single glazing	4.8	27,623	3,032	30,656	5,821

Electric Storage Heating				Annual Energy Consumption		Total	
270mm loft insulation				space heating	water heating	kWh	kgCO ₂
	U-value		U-value	kWh	kWh		
Cavity wall insulation	0.456	double glazing	2.8	11,952	1,715	13,667	5,888
Solid wall	2.1	double glazing	2.8	25,923	1,715	27,637	11,906
Cavity wall insulation	0.456	single glazing	4.8	14,919	1,715	16,634	7,166
Solid wall	2.1	single glazing	4.8	29,042	1,715	30,756	13,250

Figure 4 Single occupancy with demand temperature 22.3°C

2. Large family house (4 bedrooms), with one parent and small children at home during the day.

House size (4 bedroomed detached). Estimate space and water heating for family household with one parent and small children at home requiring all day heating after insulation.

The following parameters were used for the modelling:-

- Gas condensing boiler - Efficiency 89.6% (CERT 'typical of stock' value)
- Roof with 270mm loft insulation - U-value 0.185 W/m²K
- Solid wall U-value 2.1 W/m²K
- Insulated cavity wall U-value 0.456 W/m²K
- Single glazing U-value 4.8 W/m²K
- Double glazed U-value 2.8 W/m²K for standard air filled double glazing.
- Occupancy – standard BREDEM occupancy based on dwelling size.

BREDEM calculations of annual consumption based on CERT for a large 4 bed detached house, total floor area 148.6m² with **all day heating** and standard demand temperature 21.3°C.

Assumes BREDEM average occupants for size of dwelling (4.5) but with one parent and small children at home during the day.

Gas Central Heating							
Condensing boiler, 270mm loft insulation				Annual Energy Consumption		Total	
	U-value		U-value	space heating kWh	water heating kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	16,482	5,130	21,612	4,104
Solid wall	2.1	double glazing	2.8	41,734	5,130	46,864	8,899
Insulated cavity wall	0.456	single glazing	4.8	19,974	5,130	25,104	4,767
Solid wall	2.1	single glazing	4.8	45,432	5,130	50,562	9,602

Electric Storage Heating							
270mm loft insulation				Annual Energy Consumption		Total	
	U-value		U-value	space heating kWh	water heating kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	16,776	3,594	20,370	8,775
Solid wall	2.1	double glazing	2.8	42,930	3,594	46,524	20,043
Insulated cavity wall	0.456	single glazing	4.8	20,449	3,594	24,043	10,358
Solid wall	2.1	single glazing	4.8	46,877	3,594	50,472	21,743

Figure 5 Family occupancy with standard demand temperature 21.3°C.

BREDEM calculations of annual consumption based on CERT for a large 4 bed detached house, total floor area 148.6m² with **'standard' heating hours** and standard demand temperature 21.3°C.

Assumes BREDEM average occupants for size of dwelling (4.5) but with one parent and small children at home during the day.

Gas Central Heating				Annual Energy Consumption			
Condensing boiler, 270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	14,960	5,130	20,090	3,815
Solid wall	2.1	double glazing	2.8	37,105	5,130	42,235	8,020
Insulated cavity wall	0.456	single glazing	4.8	18,095	5,130	23,225	4,411
Solid wall	2.1	single glazing	4.8	40,219	5,130	45,349	8,612

Electric Storage Heating				Annual Energy Consumption			
270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	16,153	3,594	19,747	8,507
Solid wall	2.1	double glazing	2.8	41,011	3,594	44,605	19,216
Insulated cavity wall	0.456	single glazing	4.8	19,674	3,594	23,268	10,024
Solid wall	2.1	single glazing	4.8	44,711	3,594	48,305	20,810

Figure 6 Family occupancy with 'standard' heating hours and standard demand temperature 21.3°C

3. Large family house (4 bedrooms) with conservatory connected to the house by an open door and used as an extension of the living space throughout the year.

House size (4 bedroomed detached). Estimate space and water heating with conservatory connected to the house by an open door and used as an extension of the living space throughout the year.

The following parameters were used for the modelling:-

- Gas condensing boiler - Efficiency 89.6% (CERT 'typical of stock' value)
- Roof with 270mm loft insulation - U-value 0.185 W/m²K
- Solid wall U-value 2.1 W/m²K
- Insulated cavity wall U-value 0.456 W/m²K
- Single glazing U-value 4.8 W/m²K
- Double glazed U-value 2.8 W/m²K for standard air filled double glazing.
- Occupancy – standard BREDEM occupancy based on dwelling size.
- Conservatory
 - Size 10.4m² floor area
 - UPVC construction
 - Double glazed U-value 2.8 W/m²K for standard air filled double glazing.
 - Translucent roof U-value 3.6 W/m²K

BREDEM calculations of annual consumption based on CERT for a large 4 bed detached house, total floor area 148.6m² with a conservatory connected to the house by an open door and used as an extension of the living space throughout the year. Assumes (a) BREDEM average occupancy for size of dwelling (4.5) but with **all day heating** and one parent and small children at home during the day and (b) average occupancy and '**standard**' heating hours.

Gas Central Heating				Annual Energy Consumption			
Condensing boiler, 270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	22,447	5,130	27,577	5,237
Solid wall	2.1	double glazing	2.8	46,025	5,130	51,155	9,714
Insulated cavity wall	0.456	single glazing	4.8	26,025	5,130	31,155	5,916
Solid wall	2.1	single glazing	4.8	49,529	5,130	54,659	10,380

Electric Storage Heating				Annual Energy Consumption			
270mm loft insulation				space heating	water heating	Total	
	U-value		U-value	kWh	kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	22,397	3,594	25,991	11,197
Solid wall	2.1	double glazing	2.8	47,766	3,594	51,360	22,126
Insulated cavity wall	0.456	single glazing	4.8	25,994	3,594	29,588	12,746
Solid wall	2.1	single glazing	4.8	51,580	3,594	55,174	23,769

Figure 7 Family house with conservatory, all day heating (16 on, 8 off) and standard demand temperature 21.3°C.

Gas Central Heating							
Condensing boiler, 270mm loft insulation				Annual Energy Consumption		Total	
	U-value		U-value	space heating kWh	water heating kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	20,291	5,130	25,421	4,827
Solid wall	2.1	double glazing	2.8	40,551	5,130	45,681	8,675
Insulated cavity wall	0.456	single glazing	4.8	23,461	5,130	28,591	5,429
Solid wall	2.1	single glazing	4.8	43,410	5,130	48,540	9,218

Electric Storage Heating							
270mm loft insulation				Annual Energy Consumption		Total	
	U-value		U-value	space heating kWh	water heating kWh	kWh	kgCO ₂
Insulated cavity wall	0.456	double glazing	2.8	21,473	3,594	25,067	10,799
Solid wall	2.1	double glazing	2.8	45,402	3,594	48,996	21,107
Insulated cavity wall	0.456	single glazing	4.8	24,901	3,594	28,495	12,276
Solid wall	2.1	single glazing	4.8	48,934	3,594	52,528	22,629

Figure 8 Family house with conservatory but 'standard' weekday (2on, 7off, 7on, 8off) and weekend (16 on, 8 off) heating hours and standard demand temperature 21.3°C.

4. Estimation of energy use for lights and appliances (L&A), and cooking, for a family at home during the day, and for a pensioner household at home during the day.

The energy used for water heating, lights & appliances and cooking increase, in general, with occupancy but are independent of building fabric. However, the incidental gains they provide mean that there is a corresponding decrease in space heating.

Unless otherwise specified, BREDEM calculates the energy for domestic hot water, L&A and cooking from a default occupancy based on the floor area of the dwelling. However, when specific household numbers are entered, BREDEM calculates their appropriate energy usage. The corresponding change in space heating is also calculated. The BREDEM algorithms do not, however, distinguish between age of occupants or whether or not they are at home all day.

This contrasts with space heating, which takes into account the pattern of heating through the day. In the examples shown below, space heating is based on a dwelling with:

- Gas condensing boiler - Efficiency 89.6% (CERT 'typical of stock' value)
- Roof with 270mm loft insulation - U-value 0.185 W/m²K
- Insulated cavity wall U-value 0.456 W/m²K
- Double glazed U-value 2.8 W/m²K for standard air filled double glazing
- All day occupancy
- Standard demand temperature 21.3°C

The energy used for water heating, lights & appliances and cooking has been calculated for four levels of occupancy plus the BREDEM 'default'. While the results may not be wholly representative for specific household compositions, they do

provide a useful overall comparative guide to usage at different occupancies and fuel types.

BREDEM calculations of annual consumption based on CERT for a 3 bed semi, total floor area 88.8m².

Occupancy	Space (all) kWh	Water kWh	L&A kWh	Cooking kWh
1	10,146	3,032	1,898	994
2	9,270	3,630	2,455	1,161
Default 2.91	8,558	4,177	2,965	1,314
3	8,488	4,228	3,013	1,328
4	7,587	4,826	3,571	1,494

Figure 9 Incidental consumption for a semi-detached dwelling with gas CH and gas cooking.

Occupancy	Space (all) kWh	Water kWh	L&A kWh	Cooking kWh
1	10,827	1,715	1,795	567
2	9,804	2,250	2,353	661
Default 2.91	9,064	2,740	2,863	747
3	9,000	2,786	2,911	756
4	8,248	3,322	3,468	850

Figure 10 Incidental consumption for a semi-detached dwelling with electric storage heating and electric cooking.

Occupancy	Space (all) kWh	Water kWh	L&A kWh	Cooking kWh
1	21,691	3,032	2,299	994
2	20,053	3,630	3,232	1,161
3	18,455	4,228	4,165	1,328
4	17,065	4,826	5,099	1,494
Default 4.51	16,482	5,130	5,573	1,579

Figure 11 Incidental consumption for a large detached dwelling with gas CH and gas cooking.

Occupancy	Space (all) kWh	Water kWh	L&A kWh	Cooking kWh
1	22,119	1,715	2,171	567
2	20,456	2,250	3,104	661
3	18,912	2,786	4,037	756
4	17,434	3,322	4,970	850
Default 4.51	16,776	3,594	5,445	898

Figure 12 Incidental consumption for a large detached dwelling with electric storage heating and electric cooking.

5. Breakdown of dwelling sizes and number of cases from the English House Condition Survey, as follows:

The English House condition survey provides a snapshot of the size and number of bedrooms for different dwelling types. From this the number of cases in the survey can be weighted and grossed up to represent and estimate the number of cases in the housing stock. In addition the mean floor area for the different properties are shown against number of bedrooms. However, as the first floor area occupied by stairs is not recorded in the EHCS, an additional 2m² has been added where required.

Dwelling	Number of cases from the 2005 EHCS survey						
	0	1 bedroom	2 bedrooms	3 bedrooms	4 bedrooms	5 bedrooms	6+ bedrooms
Flat	10	889	667	189	29	8	7
Mid-Terrace	.	94	592	879	130	30	6
End-Terrace	.	57	297	452	68	16	4
Semi-bungalow	.	91	166	25	1	.	.
Det-bungalow	.	20	179	160	29	1	.
Semi-house	.	16	373	1,468	249	51	14
Det-house	.	6	56	427	534	132	18

Figure 13 Number of cases from the 2005 English House Condition Survey

Dwelling	Estimated housing stock from the 2005 EHCS survey						
	0	1 bedroom	2 bedrooms	3 bedrooms	4 bedrooms	5 bedrooms	6+ bedrooms
Flat	16,665	1,607,167	1,532,555	404,805	63,976	13,079	12,126
Mid-Terrace	.	175,398	1,392,533	2,159,201	342,125	78,837	16,029
End-Terrace	.	94,945	692,997	1,082,422	182,116	48,358	7,362
Semi-bungalow	.	150,470	416,723	75,960	2,964	.	.
Det-bungalow	.	52,910	576,664	515,611	88,489	2,014	.
Semi-house	.	46,098	934,969	4,023,013	746,218	155,975	41,498
Det-house	.	16,291	164,690	1,403,442	1,758,152	462,915	55,232

Figure 14 Estimated dwelling stock from the 2005 English House Condition Survey

Dwelling	Mean Floor Area (m ²)						
	0	1 bedroom	2 bedrooms	3 bedrooms	4 bedrooms	5 bedrooms	6+ bedrooms
Flat	38.24	42.24	61.13	81.77	108.12	145.77	246.08
Mid-Terrace	.	44.22	63.76	81.53	113.33	160.32	134.32
End-Terrace	.	44.74	66.24	82.58	114.14	149.60	210.81
Semi-bungalow	.	46.20	58.83	76.14	152.00	.	.
Det-bungalow	.	58.51	70.04	89.28	116.91	84.86	.
Semi-house	.	76.15	67.35	83.19	122.33	161.16	171.49
Det-house	.	78.11	100.36	110.14	145.89	214.72	250.00

Figure 15 Mean floor area¹ per dwelling type and number of bedrooms

CONCLUSIONS

The calculations carried out assume that all standard measures (condensing boilers and insulation) have been applied wherever possible. However, double glazing is not always assumed.

BRE's figures suggest that it is possible for a solid walled, 3 bedroomed semi detached home with single glazing occupied all day to reach the required standards

¹ Additional 2m² floor area added for stairs where appropriate.

of heating and comfort with < 30,000 kWh gas per year, provided that it has a condensing boiler and 270mm loft insulation. The BERR energy statistics for 2006 show almost 2.5 million households with higher consumption than this (although a small number of these may be businesses).

This suggests that the additional gas use may be due to:

- Larger homes
- Heating to higher temperatures
- Inefficient boilers
- Inadequate insulation
- Greater use of hot water
- Possibly conservatories.

In principle, then, the adoption of standard measures such as loft insulation and condensing boilers should allow the majority of solid walled properties to reduce their gas consumption to < 30,000 kWh/year.

Households that are at home during the day and who heat their conservatory and use it as another room are expected to increase their gas consumption from 20,090 kWh per year (table 6) to 27,577 kWh/year (table 7). This represents a significant increase (37%). Conservatories would appear to increase demand dramatically, if used as an additional room in the house.

For a fully insulated 3 bed semi with double glazing and a condensing boiler, and occupied by two pensioners who require all day heating, increasing the demand temperature could increase the gas use from 12,900 kWh/year to 13,907kWh/year. The needs of elderly householders should be taken into consideration when calculating demand.