

Chapter 3

Residential Sector

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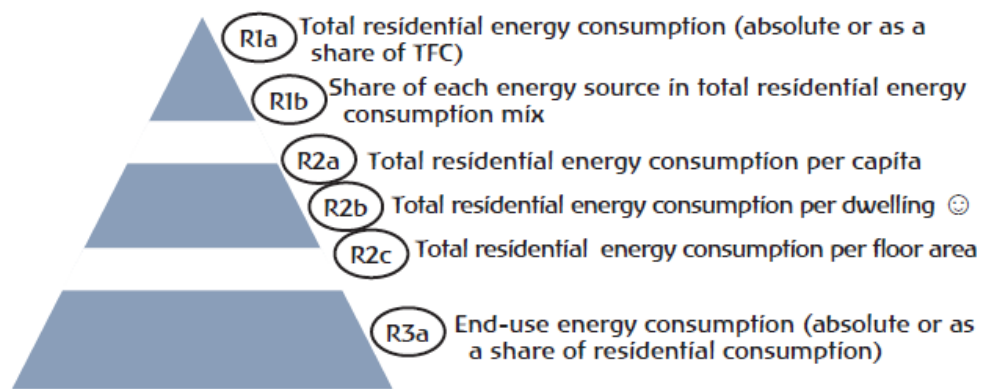
Chapter 3

Residential Sector

1. Energy Efficiency Indicators in the Residential Sector

Based on the International Energy Agency's concept of energy efficiency indicators (EIs) (Figure 3-1, the simplest indicator is level 1, which is the overall consumption of energy for the residential sector expressed either in absolute value or in percentage of the country's total final consumption. The second indicator of level 1 is the share of each energy source in the total residential consumption mix (R1b) as reported in section 3.4. However, the focus of this survey is the energy consumption in households and end-use of energy. Therefore, this chapter reports mainly on the total energy consumption per dwelling (R2b), total energy consumption per floor area (R2c), and share of end-use consumption by appliance (R3a).

Figure 3-1 Pyramid of Residential Indicators



TFC = total final consumption.

Source: International Energy Agency (2014a).

2. Effective Samples

A total of 430 survey samples were taken from six regions of Mongolia. However, 30 survey samples were excluded due to inadequately filling out of questionnaires. Considered in data analysis were 400 survey samples.

Table 3-1. Number of Households and Type of Dwelling

Type	Urban			Rural			Herder	
Type of dwelling	Apartment	House	Ger	Apartment	House	Ger	House	Ger
Number of households	70	63	7	43	110	47	4	56

Source: MEEI.

3. Characteristics of Households

Energy consumption is caused by extraterritorial, climatic conditions, and ethnic customs. The majority of urban households are relatively energy efficient, and have access to the centralised energy system, whilst the decentralised individual houses and *gers* are relatively energy-inefficient due to the lack of infrastructure facilities connecting to the centralised heating system. Depending on the location of the dwellings and type of houses, large heat losses are common. The heat losses in homes are substantial and can be equivalent to large consumption of fuel, coal, and wood.

The average area of houses is 35–70 m², whilst that of *gers* is 27– 34 m².

Most of the herder households are not connected to the electricity system, but generate electricity from small-scale power generation systems such as diesel generators and solar PV systems, as well as burning natural wood, dung, *khurzun* (which is dung- and animal-derived fuel) for space heating.

4. Fuel Consumption of the Residential Sector

Table 3-2 shows the average annual consumption of fuel used in heating and cooking in households.

Table 3-2. Household Fuel Consumption

		Coal (ton)	Wood (m ³)	Dung (m ³)	Khurzun (m ³)	Number of Households Surveyed
Herder	Fuel consumption	0.76	1.25	8.3	8.3	60
	Number of households consumed	48 80%	22 36.6%	52 86.6%	46 76.6%	
Rural	The amount of fuel used	45.9	50.1	8.7	7	200
	Number of households consumed	120 60%	121 60,5%	41.2 20,6%	38 19%	

Urban	The amount of fuel used	4.56	3.3	6.4	3	140
	Number of households consumed	67 47.8%	43 30.7%	9 45%	8 4%	

Source: MEEI.

Households use coal, wood, dung, and briquettes for heating and cooking. Most herders use 0.76 tonnes of coal and 8–12 m³ of dung annually, whilst Ulaanbaatar and rural area use 4.5–5.5 tonnes of coal, 3–7m³ of wood and dung.

Households are divided into three sections: connected to centralised (district) heating system, decentralised heating system, and *ger*. House- heating consumption is expressed in terms of gigacalorie (Gcal) and megawatt based on field and volume methodology. Those living in houses use electric heaters and most of them use natural wood and coal, whilst herder households use wood and dung.

Gases and other types of fuels are used in small quantities and, therefore, are not included in the survey analysis.

3.5. Residential Sector Energy End-Use

Table 3-3, Table 3-4 and Figure 3-2 show the annual average consumption of households and the average annual energy consumption per household.

Table 3-3. Average Annual Electricity Consumption of Households (kWh/year)

Type	Urban			Rural			Herder	
	Apartme nt	House	<i>Ger</i>	Apartme nt	House	<i>Ger</i>	Hous e	<i>Ger</i>
Surveyed households	70	63	7	43	110	47	4	56
Total electricity consumption kWh/y	225,973	272,212	16,972	121,284	719,996	104,960	1,885	17,932

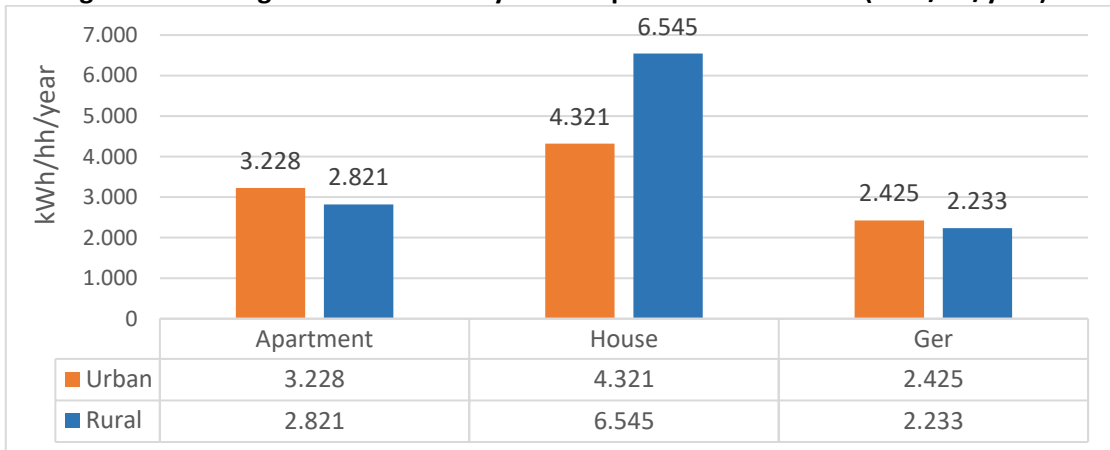
Source: MEEI.

Table 3-4. Average Electricity Consumption per Household

Type	Urban			Rural			Herder	
Type of dwelling	Apartment	House	Ger	Apartment	House	Ger	House	Ger
One household per year (kWh/y)	3,228	4,321	2,425	2,821	6,545	2,233	471	320
One household per month (kWh/month)	269	360	202	235	545	186	39	27
%								
Lighting	13	10	11	10	5	9	12	14
Refrigerator	16	12	20	16	8	20	0	15
Freezer	7	5	2	14	6	11	63	35
Washing machine	2	1	2	2	1	1	1	1
TV	7	5	9	8	4	12	25	34
Rice cooker	3	3	4	4	2	3	0	1
Computer	2	1	2	1	1	1	0	0
Electric stove	32	21	37	27	13	19	0	0
Iron	3	2	3	3	2	4	0	1
Electric kettle	14	9	10	14	5	10	0	0
Water heater	0	1		0	2	0	0	0
Electric heater	0	28		0	16	9	0	0
Fan	1			0	0	0	0	0
Vacuum cleaner	1	1		2	1	0	0	0

Source: MEEI.

Figure 3-2 Average Annual Electricity Consumption of Households (kWh/hh/year)



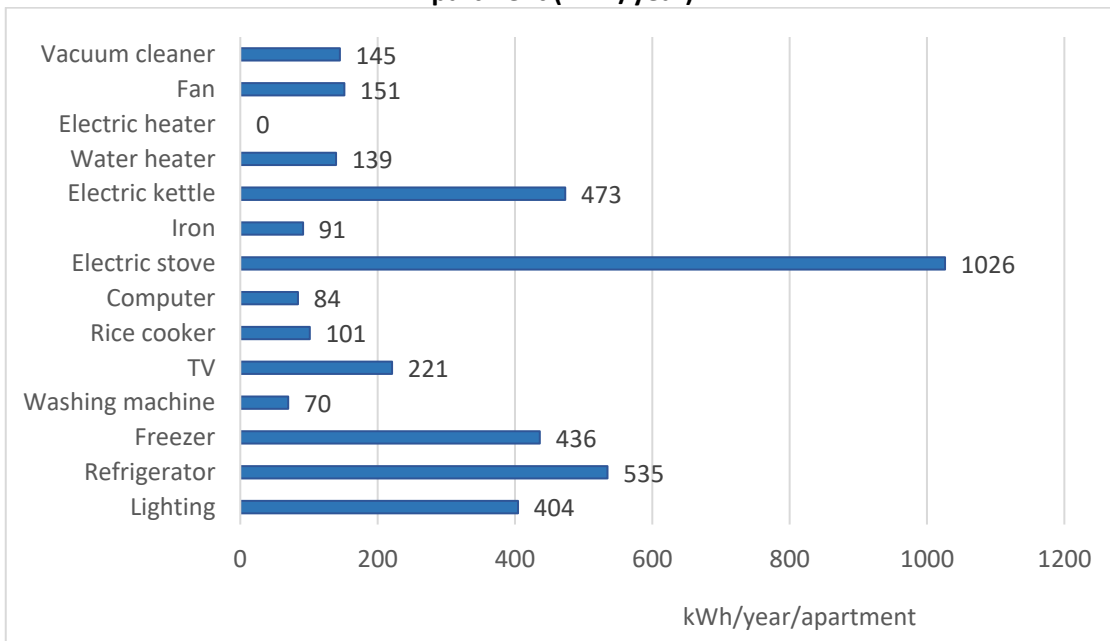
hh = household.

Source: MEEI.

Figure 3-2 compares the average annual electricity consumption per household (hh) between urban and rural areas for the three types of housing: apartment, house, and *ger*.

Figure 3-3 shows the average annual electricity consumption of electrical appliances per apartment in Ulaanbaatar. Figure 3-4 illustrates the average share of electricity consumption of household electrical appliances in a typical Ulaanbaatar apartment.

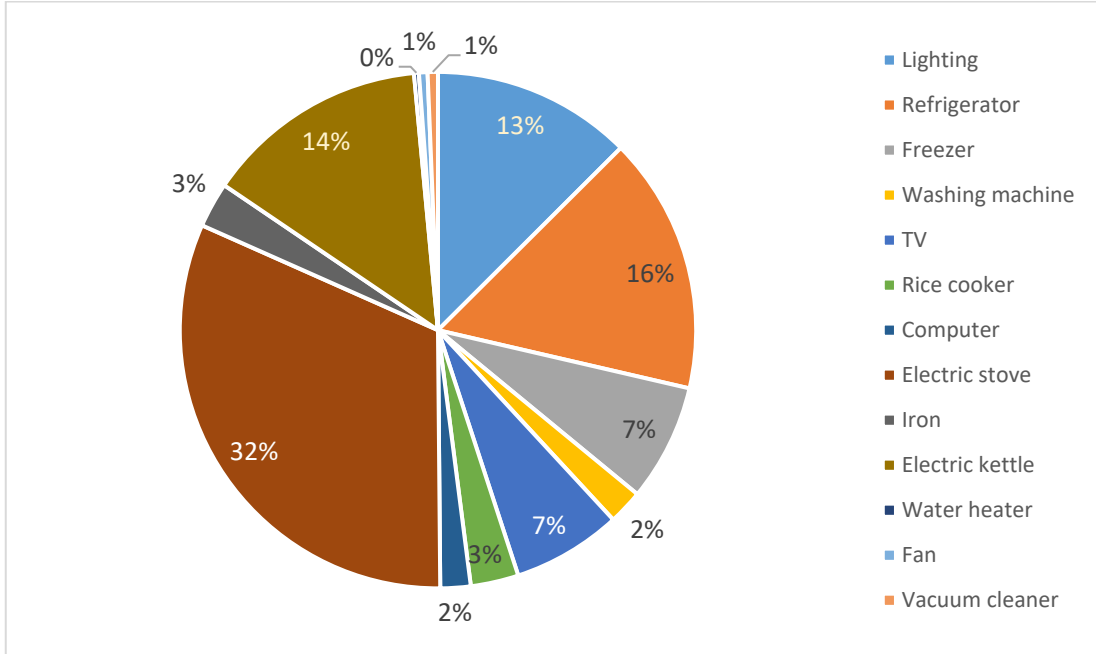
Figure 3-3 Average Annual Electricity Consumption of Appliances in Ulaanbaatar, per Apartment (kWh/year)



Source: MEEI.

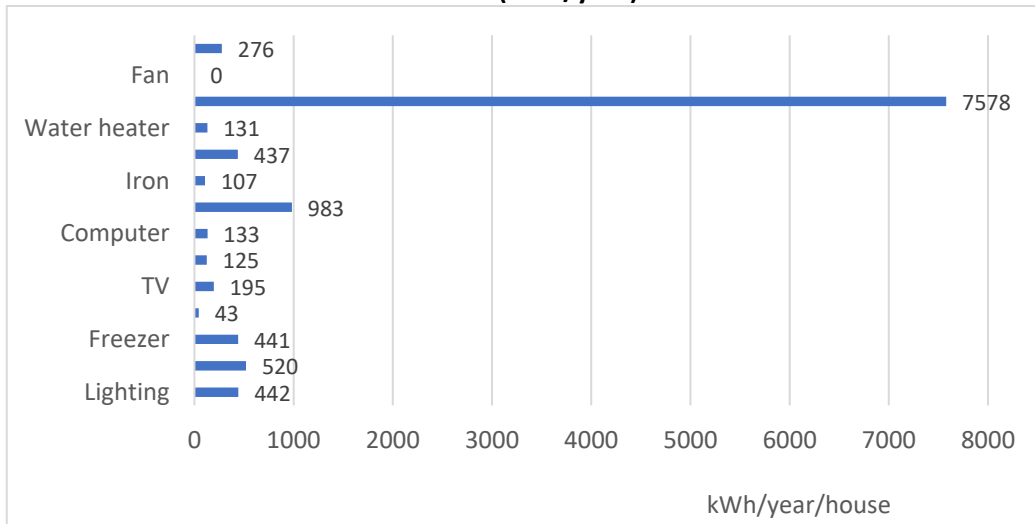
Annual household electricity consumption in Ulaanbaatar apartments shows that 32% of the total electricity comes from electric stoves; 16%, from refrigerators; 7%, from freezers; 13%, from lighting; 14%, from electric kettle, and the remaining 18%, from other electric appliances.

Figure 3-4. Share of Electricity Usage in a Typical Urban Apartment, by Appliances (%)



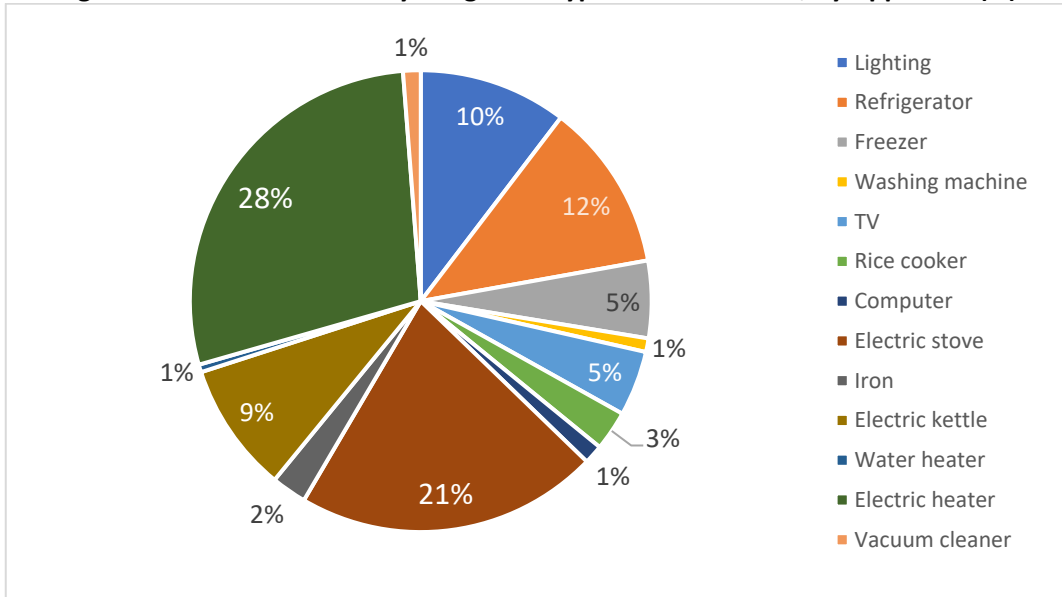
Source: Author based on MEEI's data.

Figure 3-5 Average Annual Electricity Consumption of Appliances in Ulaanbaatar, per House (kWh/year)



Source: MEEI.

Figure 3-6 Share of Electricity Usage in a Typical Urban House, by Appliance (%)



Source: Author based on MEEI's data.

Figure 3-7 Average Annual Electricity Consumption of Appliances in Urban Areas, per Ger (kWh/year)

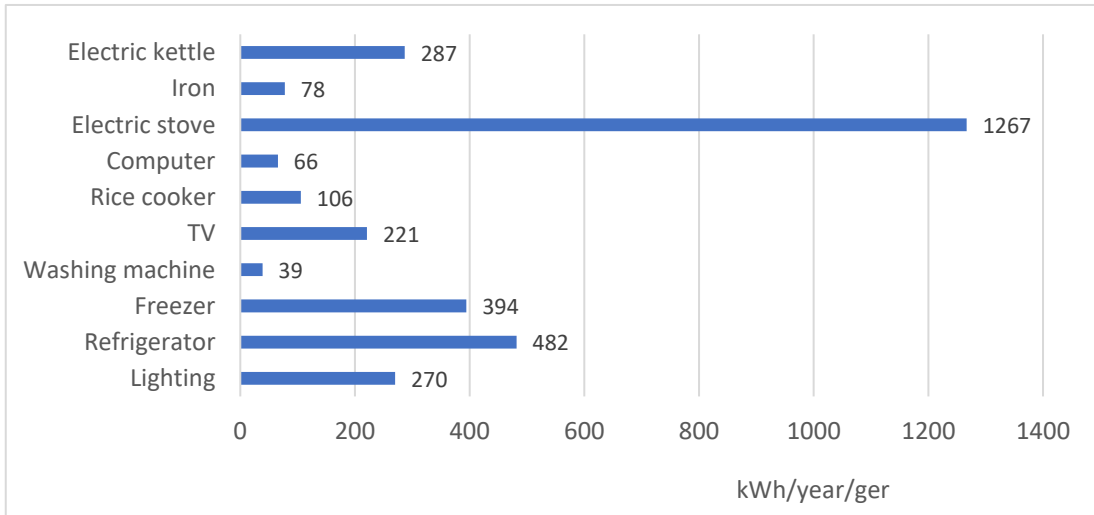
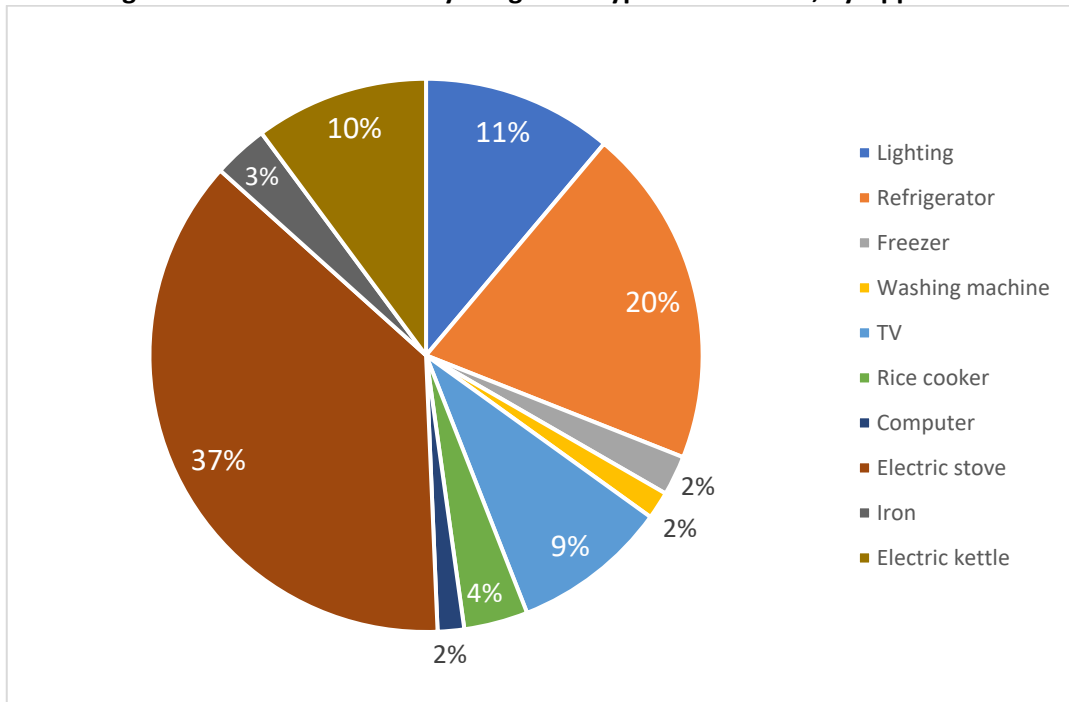


Figure 3-8 Share of Electricity Usage in a Typical Urban Ger, by Appliance



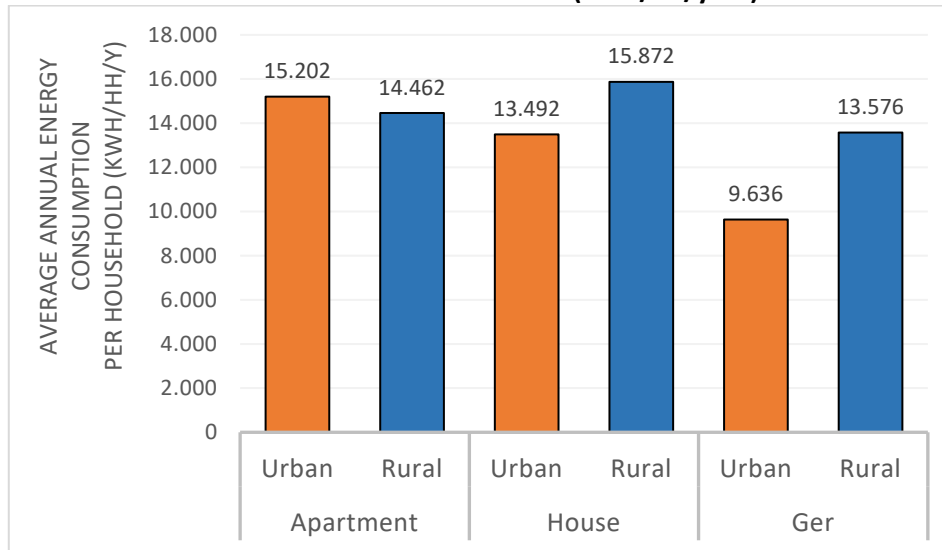
Source: Author based on MEEI's data.

The survey results show that all households use lights, refrigerators, washing machines, televisions, irons, electric tiles, rice cookers, water boilers, freezers, and vacuum cleaners. Few households use electric heaters, boilers, fans, and computers. Figure 3-3, Figure 3-5, and). In urban households, electric stoves and heaters consume the majority share of the household energy usage. Other significant energy users are refrigerators, freezers, lighting, and electric kettles. Urban houses mainly use electric heaters for heating instead of electric stoves as in urban apartments and *gers*.

Herder households not connected to the central energy system use 150–158 kW of electricity per year from their own power using solar panels, small wind turbines, and electric generators. Electricity consumption is very low compared to settled households; electricity is used only for lighting, TV, and space antenna feed. On average, one household uses solar panels with 100–130 watts, which are typically used in herder areas. Heat energy consumption is almost the same with urban and rural households.

Figure 3-9 compares the total average annual consumption of electricity and heat energy consumed by each surveyed household, expressed in kWh per household per year. Table 3-5 and Table 3-9, respectively, show the average total energy consumption of each household in urban and rural areas.

Figure 3-9. Comparison of Total Average Annual Energy Consumption per Household between Urban and Rural Areas (KWh/hh/year)



^a Includes electricity and heat energy.

Source: Author based on MEEI's data.

Table 3-5. Average Total Energy Consumption of Each Urban Household (kWh/hh/year and Percentage Share of Energy Source)

Type of Dwelling	Total	Electricity		Heat	
Apartment	15,202	3,228	21%	11,974	79%
House	13,492	4,321	32%	9,171	68%
<i>Ger</i>	9,636	2,425	25%	7,211	75%

Source: Author based on MEEI's data.

Table 3-6. Average Total Energy Consumption of Each Rural Household (kWh/hh/year and Percentage Share of Energy Source)

Type of Dwelling	Total	Electricity		Heat	
Apartment	14,462	2,821	20%	11,641	80%
House	15,872	6,545	41%	9,327	59%
<i>Ger</i>	13,576	2,233	16%	11,343	84%

Source: Author based on MEEI's data.

5. Energy Intensity

The average annual consumption of combined electricity and heat energy in the surveyed households and dwellings, calculated per household and per square meter floor area, is shown in Table 3-7 to Table 3-9. Unlike the commercial sector, where the EEI is based on energy intensity defined as building energy intensity (BEI) (which is a ratio of energy

consumption to gross floor area), energy intensity for the residential sector is more appropriate if based on average annual energy consumption per household because more appliances are used in dwellings. Appliances such as refrigerators, freezers, washing machines, TV sets, rice cookers, etc. are used only in certain parts of a dwelling. Unlike in the commercial sector, the energy usage in commercial buildings is more evenly distributed. Therefore, it is more accurate to compare the values of energy intensity based on the average annual energy consumption per household to determine energy efficiency in the residential sector. However, for practical purposes in terms of feedback to household residents, average monthly energy consumption per household would provide more realistic comparison of energy intensities to household owners, who can relate them to their monthly energy bills.

In addition, household composition data are found in the national statistics. Therefore, it will be useful to establish energy intensity in terms of annual energy consumption per household, which can facilitate the compilation of energy statistics for the residential sector. To promote energy efficiency in the residential sector, it would be useful to establish the monthly energy intensity based on the monthly energy consumption per household for residents to more easily understand and monitor their respective monthly energy usage.

Table 3-7. Average Annual Energy Consumption of Each Typical Urban Household in Ulaanbaatar, per household and per floor area comparisons

Type of Dwelling	Description	Electricity	Heat	Total Energy
Apartment Average area: 54.5	Average annual energy consumption per household (kWh/hh/y)	3,228	11,974	15,202
	Average annual energy consumption per floor area (kWh/m ² /y)	58	220	278
House Average area: 65.5	Average annual energy consumption per household (kWh/hh/y)	4,297	9,171	13,195
	Average annual energy consumption per floor area (kWh/m ² /y)	65	140	201
Ger Average area: 34.4	Average annual energy consumption per household (kWh/hh/year)	2,352	7,211	9,564
	Average annual energy consumption per floor area (kWh/m ² /y)	77	236	313

Source: MEEI.

Table 3-8. Average Annual Energy Consumption of Each Typical Rural Household, per household and floor area comparisons

Type of Dwelling	Description	Electricity	Heat	Total Energy
Apartment Average area:48.1 m ²	Average annual energy consumption per household (kWh/y)	2,828	11,641	14,607
	Average annual energy consumption per floor area (kWh/m ² /y)	58	242	303
House Average area:59.2 m ²	Average annual energy consumption per household (kWh/hh/y)	4,294	9,327	13,185
	Average annual energy consumption per floor area (kWh/m ² /y)	72	157	222
Ger Average area: 30.5 m ²	Average annual energy consumption per household (kWh/hh/y)	2,210	11,343	13,553
	Average annual energy consumption per floor area(kWh/m ² /y)	72	371	444

Source: MEEI.

Table 3-9. Average Annual Energy Consumption of Herder Households, Intensity per Year

Type of Dwelling	Description	Electricity	Heat	Total Energy Consumption
House Average area: 70.2 m ²	Average annual energy consumption per household (kWh/hh/y)	150	10,670	10,820
	Intensity (kWh/m ² /y)	2	152	154
Ger Average area: 30.5 m ²	Average annual energy consumption per household (kWh/hh/y)	158	13,631	13,789
	Average annual energy consumption per floor (kWh/m ² /y)	5	451	456