

Chapter 2

Outline of Energy Consumption Survey in Mongolia

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Chapter 2

Outline of Energy Consumption Survey in Mongolia

1. Current Situation of Each Sector

1.1. Residential sector

In terms of the highest level of administrative division unit, Mongolia is divided into 21 provinces and the capital city Ulaanbaatar. In 2018, Mongolia had 894,496 households, of whom 44% or 387,453 households lived in Ulaanbaatar city and 56% or 507,043 households lived in the rest of the country. A total of 605,796 households (or 67.7% of the country's total) lived in permanent dwellings, whilst 288,700 households (or 32.3% of the country's total) were herder families with portable homes. These portable homes are Mongolian traditional dwellings called *gers*. *Gers* use a stove, which burns wood, coal, dry dung fuel, etc., for space heating and cooking. They are also used as permanent dwellings by some residents of the cities who are not herders. Moreover, many residents of the cities live in standalone houses with a stove as a means of space heating. Other types of space heating are district heating, low-pressure boilers, and electric heaters. In terms of type of space heating, 69.9% of Mongolia's total households live in *gers* and houses with stove heating; 27.5% live in houses and apartments with district heating; 2% live in houses and apartments with a low-pressure boiler heating; and 0.6% live in dwellings with electric heating systems. Table 2-1 shows the number of households in each province and in Ulaanbaatar city.

Table 2-1. Number of Households in Mongolia's Provinces and Ulaanbaatar

Provinces/Capital	2000	2005	2010	2015	2018	Percentage
Total	553,990	611,026	742,274	859,106	894,496	100
Western region						
Bayan-Ulgii	20,805	21,328	20,696	23,082	24,306	
Uvs	20,713	19,800	19,732	21,212	22,047	
Khovd	18,505	19,478	20,299	21,706	22,863	
					69,216	7.73
Altai-Uliastai region						
Gobi-Altai	15,351	15,473	15,683	16,072	16,711	
Zavkhan	21,992	19,929	20,079	20,695	21,785	
					38,586	4.31
Khangai region						
Bayankhongor	20,909	20,935	23,157	24,821	26,643	
Arkhangai	25,612	24,276	26,452	26,727	27,912	
Uvurkhangai	29,489	28,793	32,646	33,438	34,652	
					89,207	9.97
Central region						
Khuvsgul	29,595	29,655	35,105	37,773	39,449	
Selenge	21,757	22,193	28,416	29,316	30,123	
Darkhan-Uul	18,500	22,238	28,340	29,971	30,503	
Orkhon	17,315	20,870	24,334	28,089	28,959	
Bulgan	15,931	15,016	16,786	18,479	19,072	
Tuv	23,678	23,309	26,635	28,622	30,509	
					17,8615	19.9
Eastern region						

Khentii	17,498	17,941	21,158	23,484	25,172	
Sukhbaatar	12,920	13,339	15,486	17,251	18,268	
Dornod	17,265	18,087	21,565	22,916	24,552	
					67,992	7.59
Gobi region						
Umnugobi	11,616	12,798	16,112	20,098	21,980	
Dundgobi	12,506	12,628	13,092	13,900	14,863	
Dornogobi	11,956	13,968	17,796	20,018	21,286	
Gobisumber	2,896	3,245	4,289	5,017	5,388	
					63,517	7.1
						56.6
Ulaanbaatar	167,181	215,727	294,416	376,419	387,453	43.31

Source: National Statistics Office of Mongolia (2018b).

1.2. Transport sector

Being a landlocked country between Russia and China, Mongolia has prioritised the development of its land transport network. From 1992 to 2012, a total of 21,000 km of vehicle roads was built nationwide, whilst 37,000 km were built from 2012 to 2017. In 2018, 476.6 km of vehicle roads were built, of which 370 km were paved roads.

The total length of Mongolia's vehicle road network was 110.1 thousand km in 2018. From this, 9.0 thousand km were paved roads, whilst 101.1 thousand km were ordinary or improved dirt roads. The length and share of roads by the type of surface were as follows: asphalt concrete roads, 8,706.4 km or 7.8% of the total length of vehicle road network; gravel roads, 1,207.9 km or 1.1%; minimally paved roads, 205.2 km or 0.2%; cement concrete roads, 81.7 km or 0.1%; ordinary or improved dirt roads, 101.1 thousand km or 90.3%.

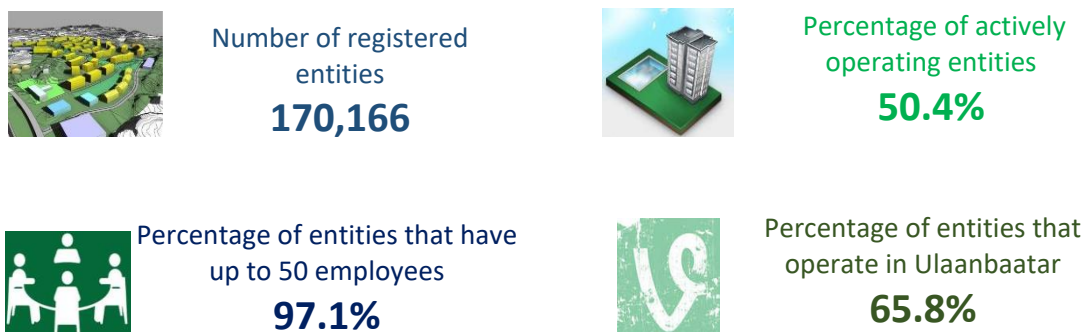
Mongolia has air connections with Russia and China through 15 air border-crossing points, and 62 total air routes are in operation. In 2018, there were 20 international routes and 13 domestic routes with regular flights. The number of domestic flights reached 6,394, boosted by the demand from the mining industry. The number of mining industry-chartered flights is constantly increasing.

In the railroad transport sector of Mongolia are two entities in operation: Mongolian and Russian jointly owned UBTZ company and Mongolian railroad state-owned joint-stock company.

The length of the UBTZ company's main route is 1,110 km. Other routes include Salkhit–Erdenet route with 164 km length, Darkhan–Sharin Gol route with 63 km length, Bagakhangai–Baganuur route with 96 km length, Tolgoit–Songino with 21 km length, Khonkhor–Nalaikh route with 13 km length, Airag–Bor Undur route with 60 km length, Sainshand–Zuunbayan route with 50 km length, and Ereentsav–Bayantumen route with 238 km length. The total length of the railroad network is 1,815 km. There are five routes from the north border to the south border, with a total of 63 stations and 45 passing loops. There are 38 stations from Ulaanbaatar to the south border, 25 stations from Ulaanbaatar to the north border.

1.3. Commercial sector

Figure 2-1. Statistics on Registered Entities in Mongolia



Source: National Statistics Office of Mongolia (2018b).

The number of registered entities in Mongolia had risen by 9.7% from 2017 to 2018, reaching a total of 170,166 entities. However, only 50.4% of these registered entities were actively operating entities.

From 85,749 entities actively operating nationwide, 97.1% of the entities have less than 50 employees, and 65.8% of entities are in Ulaanbaatar city. Table 2-2 shows the classification of registered business entities in the annual report of the National Statistics Office (2018b).

Table 2-2. Registered Entities in the Business Registry Database, by International Standard Industrial Classification

Division	2018
Wholesale and retail trade	71,486
Hotels and restaurants	4,282
Public administration and defence, compulsory social security	1,494
Education	5,671
Health and social work	4,817
Others	82,416
Total	170,166

Source: National statistical office of Mongolia (2018b).

In the field of economic activity, the percentage of business entities and organisations operating in the wholesale and retail sectors, including shopping malls across the country, was high and accounted for 42% of the economy in 2018.

The number of state hospitals decreased from 399 in 2000 to 386 in 2018. However, the number of private hospitals was 1,583 in 2018, i.e. an increase of 3.4 times since 2000.

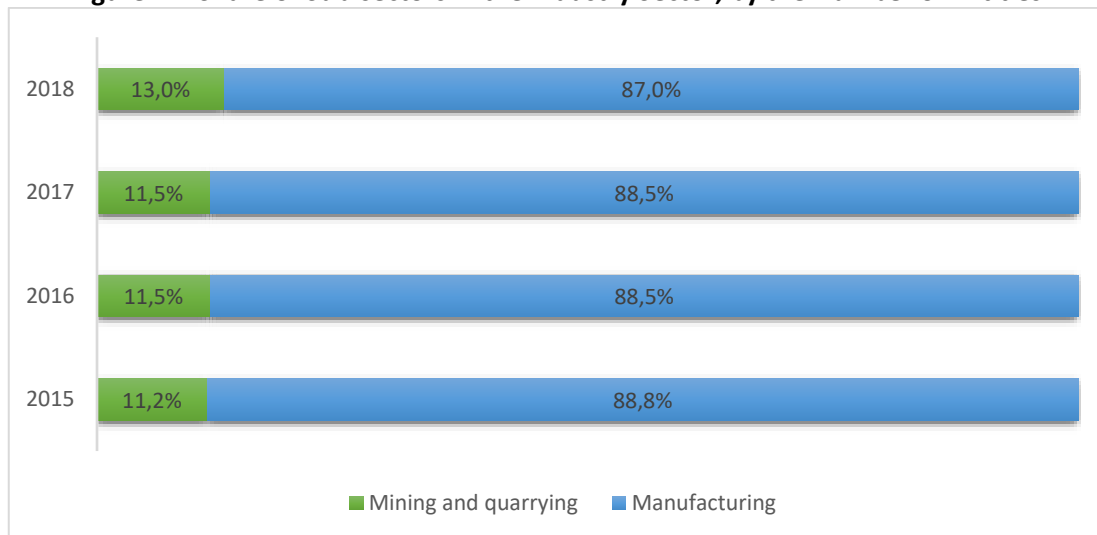
In 2018, 803 secondary schools were active: 80 (10%) elementary schools, 115 (14.3%) secondary schools, 563 (70.1%) high schools, and 45 (5.6%) comprehensive schools. State-owned schools total 81.7% and 18.3% are private schools.

As of 2018, 85,749 entities were actively operating according to the Statistical Business Registry database (National Statistics Office of Mongolia, 2018b); 2,410 or 2.8% were actively operating in the hotel, accommodation, and catering services.

1.4. Industry sector

Mongolia’s industry sector is divided into the mining and quarrying, and manufacturing sub-sectors. Figure 2-2 shows the share of the above two sub-sectors of the industry sector by the number of entities operating in these sub-sectors.

Figure 2-2 Share of Sub-sectors in the Industry Sector, by the Number of Entities



Source: National Statistics Office of Mongolia (2018b).

1.4.1 Mining and quarrying sub-sector

The mining and quarrying sub-sector is important in the industry sector in terms of gross industrial output. This sub-sector has the following five divisions according to the International Standard Industrial Classification: (i) mining of coal and lignite, (ii) extraction of crude petroleum, (iii) mining of metal ores, (iv) other mining and quarrying, and (v) mining support service activities.

Mining and quarrying have rapidly developed in recent years to become one of the leading sectors in the economy of Mongolia. This is largely due to the start of mining activities at the largest mineral deposits of a strategic level, such as Oyu tolgoi and Tavan tolgoi.

1.4.2 Manufacturing sub-sector

The country's manufacturing sub-sector is divided into the following:

- Manufacture of food products
- Manufacture of beverages
- Manufacture of tobacco products
- Manufacture of textiles
- Manufacture of wearing apparel
- Manufacture of leather and related products
- Manufacture of wood and cork products, except furniture
- Manufacture of paper and paper products
- Manufacture of printing and reproduction of recorded media
- Manufacture of coke and refined petroleum products
- Manufacture of chemicals and chemical products
- Manufacture of pharmaceuticals, medicinal chemical and botanical products
- Manufacture of rubber and plastics products
- Manufacture of other non-metallic mineral products
- Manufacture of basic metals
- Manufacture of fabricated metal products, except machinery and equipment
- Manufacture of computer, electronic and optical products
- Manufacture of electrical equipment
- Manufacture of machinery and equipment n.e.c.
- Manufacture of motor vehicles, trailers and semi-trailers
- Manufacture of other transport equipment
- Manufacture of furniture
- Other manufacturing
- Repair and installation of machinery and equipment

2.1.5 Electricity, thermal energy, and water supply (ETEWS) sector

This sub-sector has the following divisions:

- Electric power generation
- Thermal energy generation
- Water supply activities

In 2018, 8.2 billion kWh of electric power was consumed, of which 6.5 billion kWh (or 79.7% of total) was generated domestically and 1.7 billion kWh (or 20.3% of total) was imported from China and Russia.

From the total number of electric power consumers, 52,200 (or 7.6%) are entities and 633,100 (or 92.4%) are households. A total of 41,300 entities (79.2% from total entities that consume electric power) get their electric power from the Central Electric Power System (EPS), 4,600 (or 8.8%) from the WEPS, 2,200 (or 4.2%) from the Eastern EPS, 1,900 (or 3.7%) from the Southern EPS, and 2,100 (or 4.1%) from the Altai-Uliastai EPS (AUEPS).

In 2018, a total of 12.5 million gigacalorie (GCal) of thermal energy was generated, which was an increase of 1.2 million GCal or 10.7% from 2017. Entities and households consumed 10.6 million GCal (85.1% from total) produced in 2018 were consumed by entities and households, whilst 1.38 million GCal (or 11.0% from total) were consumed by CHP thermal power plants (TPPs) for internal use and 0.5 million GCal (or 3.9%) were lost in transmission and distribution.

From the total number of consumers of thermal energy from CHP TPPs, 25,200 (or 7.7%) are entities and 300,300 (or 92.3%) are households. From the total number of entities that get their thermal energy from CHP TPPs, 14,800 (or 58.7%) are in Ulaanbaatar city; 1,800 (or 7.1%) are in Darkhan-Uul province; 1,400 (or 5.5%) are situated in Orkhon province; 1,000 (or 4.0%) are in Dornogobi province; 800 (or 3.2%) are in Dornod province; the remaining 5,400 (or 21.5%) are situated elsewhere.

In 2018, gross industrial output of water supply and sewerage and waste management remediation activities amounted to ₮0.4 trillion.

In terms of the share of sub-activities by their gross industrial output, in 2018, water accumulation, purification, and supply activities had a share of 63.8%; waste collection and processing activities had a share of 35.3%; wastewater collection and treatment activities had a share of 0.5%; and other waste management activities and remediation activities had a share of 0.4%.

2. Implementation of the Survey by Each Sector

To determine Mongolia's energy efficiency indicators (EEIs), an energy consumption survey covering the whole country was conducted in 2018–2019 with the technical assistance of the Economic Research Institute for ASEAN and East Asia (ERIA). Through this survey, the actual energy consumption in each final energy consumption sector – consisting of industry, transport especially road, and the residential and commercial sectors – is extracted. Based on the survey results, the country's EEIs are estimated as benchmarking numbers of each sector. The major points of this survey focused on how and how much each sector used energy, i.e. the end-use energy consumption amounts.

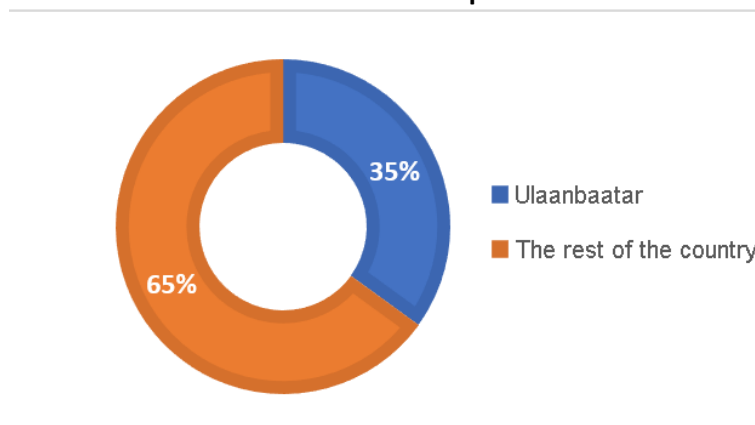
A total of 800 samples were taken from four sectors: residential (400), commercial (200), industry (100), and transport (200).

The survey was conducted by the employees of MEEI, as well as some contractor organisations: Western EPS, AUEPS, Eastern EPS, and Mongolian association of specialised consulting engineers. The MEEI employees travelled to Darkhan, Erdenet cities and locations in 14 different provinces, in addition to conducting a survey in Ulaanbaatar.

2.1. Residential sector sample survey

From a total of 400 samples taken from the residential sector, as shown in Figure 2-3, 140 samples (or 35% from total) were taken from Ulaanbaatar and 260 samples (or 65%) were taken from the rest of the country.

Figure 2-3 Share of Residential Sector Samples Taken from Ulaanbaatar



Source: MEEI's survey.

Based on energy consumption characteristics, Mongolia's total territory was divided into the following six regions:

- Western region (which included Bayanulgi, Uvs, Khovd provinces)
- Altai-Uliastai region (which included Gobi-Altai, Zavkhan provinces)
- Khangai region (which included Bayankhongor, Uvurkhangai, Arkhangai provinces)
- Central and northern region (which included Khuvsgul, Bulgan, Orkhon, Selenge, Darkhan-Uul, Tuv provinces)
- Eastern region (which included Khentii, Dornod, Sukhbaatar provinces)
- Gobi region (which included Umnugobi, Dornogobi, Dundgobi, Gobisumber provinces)

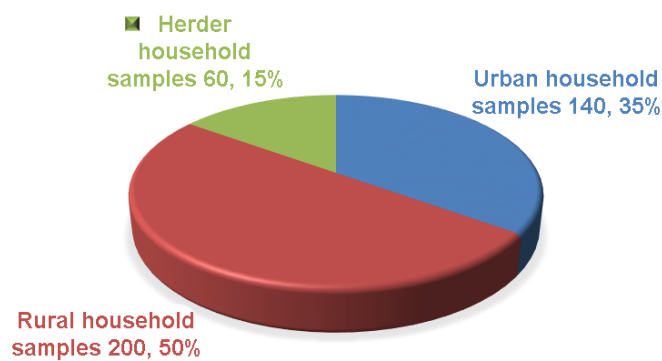
By type of location, the households were divided into three categories: urban, rural, and herder. Urban households are located in Ulaanbaatar city. Rural households are in provincial

and *soum* centres. Urban and rural households have permanent dwellings. Herder households are located in pasturelands of various provinces. They do not have a permanent place of living. They move their mobile homes (*ger*) with their livestock whenever there is a need to move to another pastureland.

The survey conducted was on electricity, heat, and other fuel consumption such as wood, dry dung, coal, etc. The survey also included information on electric appliances of houses, apartments and *gers*.

As shown in the Figure 2-4, on the number of samples, 140 samples were from urban households; 200, from rural households; and 60, from herder households.

Figure 2-4 Number and Share of Residential Sector Samples, by Type of Location



Source: MEEI.

2.2. Transport sector sample survey

The sample survey was conducted on 170 road vehicles, 20 locomotives, 11 aircraft, and 2 ships. Questionnaires asked information on vehicle model, engine capacity, age, standard fuel consumption, winter and summer fuel consumption, unloaded fuel consumption, daily and monthly travel distance, etc.

Road vehicles were divided into the following three categories:

- Cars (with 55 samples)
- Buses (with 45 samples)
- Trucks (with 70 samples)

The 55 car samples were manufactured in Russia, Republic of Korea (henceforth Korea), and Japan, with vehicles aged 4–30 years.

Table 2-3. Cars Included in the Survey, by Engine Displacement

Engine Displacement, cm ³	Number of Samples
1500 and lower	13
1501–2500	34
2501–3500	5
3501–4500	3
Total	55

Source: MEEI's survey.

Table 2-4. Cars Included in the Survey, by Fuel Type

Fuel Type	Number of Samples
diesel	4
gasoline	51
AI-80	1
AI-92	48
AI-95	2
Total	55

Source: MEEI.

From the total of 45 samples, 26 samples were buses manufactured by Hyundai, and 19 samples were manufactured by Daewoo, both of Korea. Engine displacement ranged from 11,051 cm³ to 11,149 cm³, with an average displacement of 11,108 cm³. All buses had diesel engines, and their ages ranged from 7 to 11 years.

According to a sample study, the average standard technical consumption of 70 trucks is 62.1 litres/100 km, with a heavy-duty diesel engine from Nord Benz, Howo, and Beiben factories.

Twenty railway surveys were collected from the locomotive sector: fourteen locomotives were manufactured in Russia, six (*Zzagal*¹) locomotives were manufactured in Mongolia, with age up to 30 years. The survey collected data on fuel consumption, daily and monthly routes, and technical characteristics. There is no data in the railway sector statistics for locomotives classified as freight and passenger. In 2018, the railway sector, comprising public and private companies, provided freight and passenger services – with 138 locomotives, 3,571 freight wagons, and 608 freight cars.

Eleven survey questionnaires were collected to gather information on aircraft model, age, fuel consumption, daily and monthly mileage, etc.

In 2018, the volume of water transport was 25,638 people, with a passenger turnover of 0.4 million man/km, increasing the number of passengers by 5,082 people or 24.7% from the previous year, which is 0.01% of the total passenger traffic in the 2018 traffic. Waterway study is not included since Mongolia is a landlocked country, has not been involved in cargo transport since 2006, and uses only 0.01% of passenger traffic.

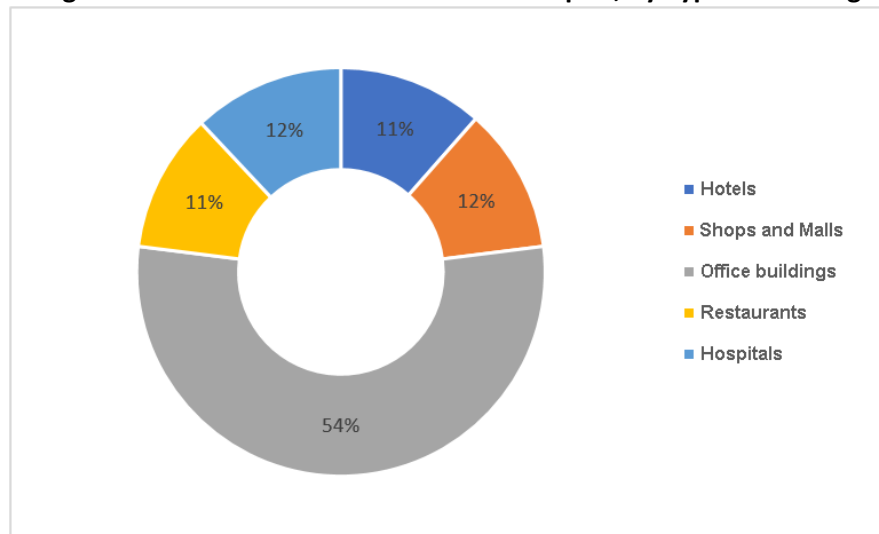
¹ Mongolia-built double diesel engine locomotive.

2.3. Commercial sector sample survey

The commercial sector sample survey was conducted for five types of buildings: hotels (23 samples), shops and malls (23), office buildings (108), restaurants (22), and hospitals (24), as per the percentage breakdowns shown in Figure 2-5. A total of 200 samples were taken, of which majority of the buildings were located in Ulaanbaatar city.

The survey also collected information on energy consumption, including electricity, heat, and other fuels. Heat consumption was calculated due to the lack of information.

Figure 2-5 Share of Commercial Sector Samples, by Type of Building



Source: MEEI.

2.4. Industry sector sample survey

The National Statistics Office of Mongolia (2018b) divides the industry sector into the following sub-sectors: mining and quarrying, manufacturing, and electricity thermal energy and water supply (ETEWS). Originally, 100 samples were taken from these sub-sectors: mining and quarrying (18), manufacturing (62), and ETEWS (20).

However, some entities returned incomplete questionnaires that were unusable for the purposes of this study. ETEWS sub-sector's entities were also viewed as a separate category because they are not energy consumers, but energy transformers.

Therefore, in terms of energy consumer entities, the industry sector comprises the mining and quarrying sub-sector and the manufacturing sub-sector. Additional samples were taken from these two sub-sectors, making the total number of usable samples as follows:

- Mining and quarrying sub-sector, which has a total of 927 entities – 14 samples
- Manufacturing sub-sector, which has a total of 6,219 entities – 75 samples

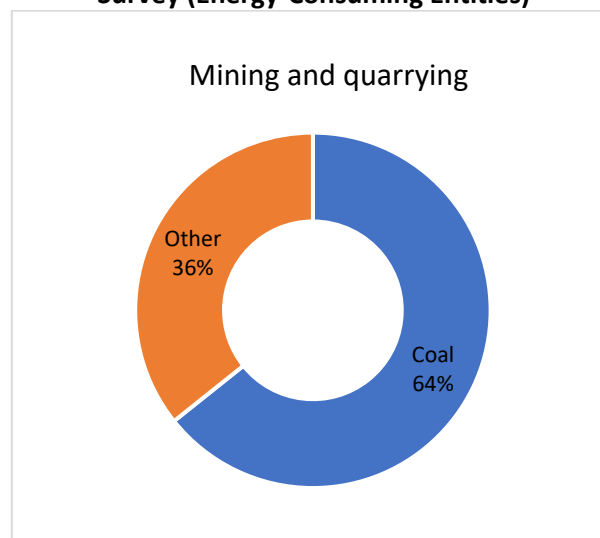
Samples from the manufacturing sub-sector amounted to 78% of the total sample, whilst those from the mining and quarrying sub-sector amounted to 22% of the total sample. Table 2-5 gives the number of samples included in each types of industry whilst Figure 2-6 shows the share of the number of samples in each Sub-sector in the industry sector survey.

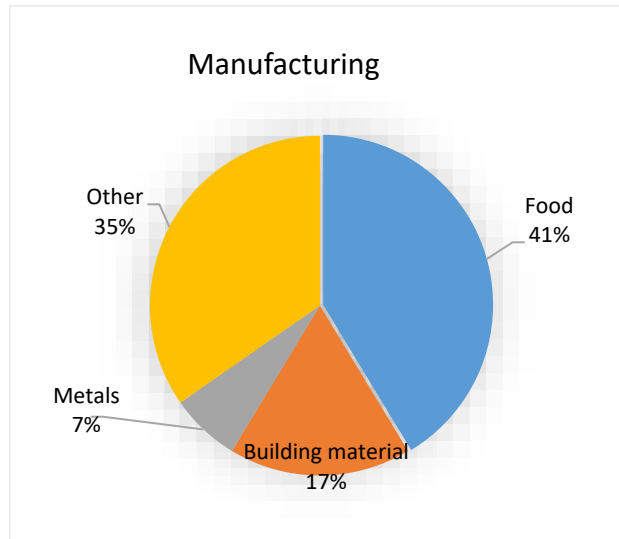
Table 2-5. Types of Industries and Number of Samples Included in the Industry Sector Survey (Energy-Consuming Entities)

Types of Industries	Number of Samples
Mining and quarrying	14
Coal	9
Other	5
Manufacturing	75
Food	31
Building materials	13
Metals	5
Other	26
TOTAL	89

Source: MEEI.

Figure 2-6 Share of the Number of Samples in Each Sub-sector in the Industry Sector Survey (Energy-Consuming Entities)





Source: MEEI.

The sample survey questionnaire for industry included:

- Name, address, year of establishment, number of employees, and direction of activities in the organisation's description
- Construction information that includes information on the year of construction, purpose, size, operation status, total area, and heating area
- Production summary information such as product name, production volume, and price.

Power source and consumption data include data on electricity and heat sources, annual electricity consumption, heat consumption, price and consumption, price of fuel, and fuel and lubricants.

Two questionnaires were developed for the industry sector survey: (i) industrial and mining, geological exploration, and farming companies; and (ii) a sample survey randomly conducted from urban and rural industrial enterprises.

Within the framework of the research work, we concluded agreements with the energy companies of the western sector of the energy system (Western EPS), Altai-Uliastai power system (UAEPS), the Eastern region (Eastern EPS) energy system companies, and industry consultants for conducting sample surveys.

2.5 Electricity, heat, and water supply sector sample survey

Two questionnaires were developed for the electricity, heat, and water supply sector survey.

Within the framework of the research work, we concluded agreements with the energy companies of the western sector of the energy system, Altai-Uliastai power system, the Eastern region energy system companies, and industry consultants for conducting sample surveys.

Table 2-6. Types of Industries and Number of Samples included in the Electricity, Thermal Energy, and Water Supply Sub-sector of the industry Sector Survey (Energy-Transforming Entities)

Types of Industry	Number of Samples
Electricity, thermal energy, and water supply	11
Electricity, thermal energy	5
Other	6

Source: MEEI.

Twenty samples were taken from the ETEWS sector, which has 268 entities. Only 11 sample entities returned a questionnaire form with usable data.