Chapter 8

Conclusions

January 2021

This chapter should be cited as
Study team (2021), 'Conclusions', in Mongolian Energy Institute and ERIA (eds.), *Mongolia's Energy Efficiency Indicators 2019.* ERIA Research Project Report FY2020 no. 17, Jakarta: ERIA, pp.73-74.

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Energy efficiency indicators (EEIs) are different from energy intensities defined by energy consumption per gross domestic product (GDP). Usually energy intensity is calculated as TPES (total primary energy supply (TPES)/GDP or TFEC (total final energy consumption)/GDP; it basically shows the energy performance nationwide and the result of socio- economic activities in a year. The energy intensities never suggest appropriate energy efficiency policies and action plans. Thus, we need EEIs to plan appropriate energy efficiency and conservation (EEC) activities.

All energy is finally consumed by final users – industry, transport, commercial, and residential sectors. The agriculture, forest, and fishery sector consumes energy for its production activities but its energy consumption is very small compared to the four sectors mentioned above. In addition, an electricity-generation sector as a typical transformation sector consumes fossil fuels, such as coal, to generate electricity. The energy performance of this sector is gauged by thermal efficiency which depends on power generation technologies such as clean coal technologies (CCT) and combined cycle gas turbine (CCGT), etc. Similarly, we need EEIs to gauge the energy performance of each final sector and, based on these EEIs, the government can plan and set up appropriate and implementable EEC activities and action plans. If we want to get EEI benchmarking by each final sector, we must conduct a detailed energy consumption survey in the respective sectors.

The industry sector consists of several sub-industry sectors. We obtained the EEI of each sub-sector defined as energy consumption (tonne of oil equivalent [toe]) per main production amount (tonne) or sectoral GDP (monetary unit). If the EEI is very high, we classify this sub-sector as energy intensive and need to apply EEC action plans to mitigate its energy consumption.

For transport, generally since the road transport sector is dominant in terms of fuel consumption, such as gasoline and diesel oil, we get the overall or national average of fuel economy defined as litre/100 km by each type of vehicle – car (mainly sedan), bus, and truck – as the EEI of the road transport sector. If we increase the number of more efficient cars, such as those with small internal combustion engines, and hybrid cars, the EEI of the road sector surely improves. Also, idling stop technology is another option to mitigate transport fuel consumption. Based on the EEI of the road sector, government can apply appropriate and effective policies and action plans to mitigate transport fuel consumption.

The EEIs of the residential and commercial sectors are defined as energy consumption (toe or kWh) per floor area (m^2). In addition, what kinds of energy are consumed for what purpose, and how electricity is consumed for what purpose (heating space, lighting, refrigerator, etc.) are important feedback from the survey. Space heating is the main energy used in Mongolia and its energy consumption depends on attributes of houses and buildings. Thus, we get the EEI by types of house (standalone, apartment, and *ger*) and building types

(hotel, office, restaurant, shopping mall, and hospital). Based on the EEIs of both sectors, government can apply various EEC policies and action plans to mitigate energy consumption, especially electricity consumption, including the Minimum Energy Performance System for appliances and Building Energy Code, such as Green Building Index for commercial buildings.

In order to get indicative EEIs of each final sector, the Mongolian Energy Economics Institute (MMEI), with support of the Economic Research Institute for ASEAN and East Asia (ERIA) conducted a detailed energy consumption survey in whole of Mongolia in 2019. The sample size of each final sector is as follows: 88 samples from the industry sector (14 samples for mining and 75 for manufacturing); 203 samples from the transport sector including rail, air, and ship but mainly from the road sector (170 samples); 400 samples from the residential sector (140 samples in Ulaanbaatar as an urban area, 260 from the rest of the country as rural and herder areas); and 200 from the commercial sector (108 samples for offices, 23 for hotels, 23 for shopping malls, 22 for restaurants, and 24 for hospitals). The sample sizes are not significant but, of course, not too small. The MEEI, with some local consultants, conducted the survey in significant parts of Mongolia, so that experience and skill on the energy consumption survey would remain with MEEI staff. In case of sample surveys, minimising bias is very important. Consequently, random sampling is usually applied in the sample survey. But the limited population of the industry and the commercial sectors makes random sampling unavailable to these sectors.

The energy consumption survey usually uses a specific questionnaire for each sector, and ERIA provided the MEEI four questionnaires for the four final sectors. The questionnaires consist of mainly two parts: (i) fact sheet and (ii) energy consumption sheet. The fact sheet contains attributes of each four sectors – International Standard Industry Classification number of employees; production amount of main product or gross revenue in the industry sector; vehicle type, engine capacity, and driving distance in the road transport sector; house type, family size, and floor area in the residential sector; and type of building and floor area in the commercial sector. On the other hand, the energy sheet contains the kind of energy, energy consumption, and its usage. These questionnaires from ERIA were accepted by the MEEI and used for the energy consumption survey in Mongolia.

After collection of the questionnaires, all collected data from the survey were entered in an Excel file for validation and analysis. Through validation, outliers are removed through statistical application, with charts. Basically, outliers are due to mistyping, misunderstanding of units, etc. After validation, the EEIs are calculated based on the screened sample data. After this calculation, we evaluated the indicators. But for this evaluation, we needed overall knowledge to cover energy consumption, economic growth, industrial transition, and change of lifestyle. In addition, an international comparison of the EEIs is also a good way to evaluate them. But these EEIs are not well produced globally and can refer only to indicators of the Organisation for Economic Co-operation and Development.

Through this project, the MEEI obtained lots of experience on the EEIs and the technical skill in producing and assessing the EEIs. The EEIs will be changed year by year due to changes in social behaviour, economic growth, lifestyle, and technology development. In this regard, the MEEI should continue to produce EEIs every 3 to 5 years to reflect or improve current EEC

policies and action plans with greater effectiveness and economic benefits. ERIA would like to support the MEEI continuously and technically in terms of promoting EEC in Mongolia.

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