# Chapter 5

# Energy Efficiency Regulations

October 2021

**This chapter should be cited as**
Study Team (2021), 'Energy Efficiency Regulations', in Kimura, S. and L.S.Meng (eds.), *Technical Guidelines for Energy Efficiency and Conservation in Commercial Buildings.* ERIA Research Project Report FY2021 No. 14, Jakarta: ERIA, pp.22-28.

# Chapter 5

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## 5.1 Introduction

The DOE (2016) formulated the 'Implementing Guidelines on Philippine Energy Standards and Labeling Program (PESLP) for Energy-Consuming Products'. These guidelines stipulate the rules, procedural requirements, and imposition of penalties. The PESLP provides particular product requirements for air conditioners, refrigerating appliances, television sets, and lighting products. It also specifies performance and testing requirements for energy-consuming products, effectively defining the maximum amount of energy consumed by a product in performing a specified task. The PESLP details specific minimum energy efficiency levels to the respective products.

Labelling programmes for electrical appliances and equipment are widely recognised as highly cost-effective energy efficiency policy measures and are part of EEC measures. However, the PESLP should have a greater impact on the residential sector than the commercial sector. Nevertheless, this programme will contribute to the energy efficiency targets of the commercial sector in terms of promoting greater use of energy efficiency–labelled appliances in commercial buildings.

The sections below discuss the effective promotion of EEC in commercial buildings through possible regulatory measures in EEI building labelling. Through EEI building labelling, building energy performance and benchmarking can be quantified and measurable. It can be established as a dedicated tool for driving the energy efficiency agenda in commercial buildings.

## 5.2 Energy Standards and Labelling Programme

The PESLP has been well established for energy-consuming products. The author opines that the PELSP by itself may not be able to achieve high impacts in energy savings. The objectives of energy savings can be greatly enhanced if EEI building labelling is established.

In the overall context, EEI building labelling can be established as a dedicated tool that can set benchmark targets to achieve greater energy savings in commercial buildings. This energy efficiency building labelling programme should be developed as a regulatory requirement, similar to the PESLP for appliances.

## 5.3 Energy Efficiency Indicators (EEIs)

In the overall context of building energy performance, what is the appropriate energy efficiency benchmarking tool? Buildings can be benchmarked and compared using the EEI method. The EEI concept is best explained by a pyramid of indicators presented by the International Energy Agency (IEA, 2014a) (Figure 5.1). IEA (2014a) aims to provide the necessary tools to initiate or further develop in-depth indicators to support the development of effective energy efficiency policies. This method can be adapted and established as an energy efficiency benchmarking tool to quantify and monitor national

building energy performance for commercial buildings exceeding a certain size, which the DOE should determine after deliberation and consultation with stakeholders in the Philippines.

Figure 5.1 explains the various levels of indicators and shows how indicators are organised into a hierarchy. The top of the pyramid shows the total energy consumption of the commercial sector or share of each energy source of the total commercial sector energy consumption mix as an aggregated indicator. The IEA's concept of EEIs is a 'pyramidal approach' starting from the most aggregated level at level 1 to the most disaggregated level at end-use energy consumption by services, e.g. ACMV, lighting, lifts and elevators, and escalators, etc. at level 3. The level 2 indicator computation is recommended to be used as a rating tool for building energy performance. For this purpose, the term 'building energy intensity' (BEI) is used instead of EEI to differentiate the indicators from other sectors, such as the industry sector EEI, which has a different definition. The IEA defines EEI as follows:

$$EEI = \frac{Energy\ Consumption}{Activity\ Data} \quad \text{---------- (3)}$$

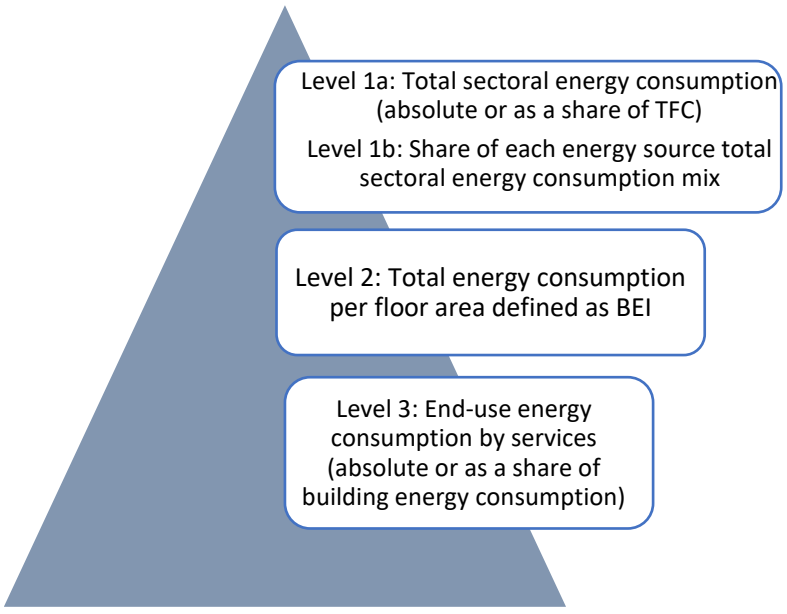
Where:

*EEI* = energy efficiency indicator

Energy consumption is measured in energy units.

Activity data are measured in physical units (e.g. gross floor area [GFA] for buildings)

**Figure 5.1: Pyramid of the Commercial Sector, EEI**




BEI = building energy intensity, TFC = total final consumption.
Source: Adapted from IEA (2014a).

BEIs are a ratio of yearly energy consumption (measured in energy unit, kWh) to the GFA (measured in square metres) under level 2 in Figure 5.1. For a meaningful comparison, the BEI values should be compared with buildings within the same building subsector or category. In other words, the BEIs of office buildings, retail malls, hotels, hospitals, etc. should be compared within the same category or type of building because different building categories have different operating functions and durations. Based on IEA's definition of EEI, it is possible to establish building energy performance benchmarking for each respective category or subsector of the commercial sector provided that sufficient relevant data are disclosed by the respective subsectors and analysed by the DOE.

The BEIs of buildings are computed at the subsector level and are calculated by the formula in equation 4 below.[1] The BEI is essentially a ratio of yearly energy consumption to GFA. However, to accurately represent and fairly compare the energy intensity throughout the building, energy use in the car park area, which is usually not air-conditioned, and in the data centre, where a high concentration of continuous energy use is expected, are excluded in the computation. The floor vacancy rate is only considered when the BEI is computed for an occupied building after completion and occupancy. For design submission, the building is usually considered fully occupied. The ratio of average weekly working hours to weighted weekly operating hours is used to adjust buildings with different weekly operating hours from the national average weekly operating hours, such as office and retail buildings. This adjustment or normalisation aims to fairly compare energy performance between different buildings of the same category. Key variables to be considered for normalisation include operating hours and floor occupancy rate.

$$BEI = \frac{(TBEC - CPEC - DCEC)}{(GFA - CPA - DCA) - (GLA\ x\ FVR)}\ x\ \frac{AWH}{WOH} \qquad \text{---------- (4)}$$

Where:

| | |
|---|---|
| *BEI* | = total energy consumed in a building in a year, expressed as kWh per gross floor area ($m^2$) |
| *TBEC* | = total yearly building energy consumption (kWh/y) |
| *CPEC* | = yearly car park energy consumption (kWh/y) |
| *DCEC* | = data centre energy consumption (kWh/y) |
| *GFA* | = gross floor area ($m^2$) |
| *CPA* | = car park area ($m^2$) |
| *DCA* | = data centre area ($m^2$) |
| *GLA* | = gross lettable area ($m^2$) |
| *FVR* | = floor vacancy rate (%) |
| *AWH* | = average weekly operating hours (hours/week) |
| *WHO* | = weighted weekly operating hours (hours/week) |

[1] Green Building Index Malaysia, www.greenbuildingindex.org (accessed 3 October 2021).

## 5.4 BEI Labelling

For this report, the establishment of EEIs for commercial buildings is suggested to be named BEI labelling. Singapore's Building and Construction Authority (BCA) named the EEI energy use intensity (EUI). BEI labelling can be a tool to drive the agenda of energy efficiency in commercial buildings. As discussed previously, EEC building design would involve deploying a combination of passive and active design measures. BEI labelling would guide the design with targets and indications of the extent of energy efficiency that could be achieved in commercial buildings. The benefits of BEI labelling are summarised as follows:

1) If made mandatory for designated buildings, BEI labelling would allow the DOE to collect building information and energy consumption data annually to develop and monitor in-depth indicators for supporting and evaluating the development of various energy efficiency policies and measures. Upon the disclosure of sufficient data for various categories of commercial buildings by the respective subsectors, the DOE can establish and formulate benchmarking values for each category of commercial buildings. EEC implementation concerning the issuance of building permits for new and existing commercial buildings is the jurisdiction of the local government units.

2) The BEI is a key performance metric for commercial buildings. It provides a means of measurement and indication of the energy performance of buildings of the same category or subsector for design and building operation purposes. It is a key driver of design parameters throughout the project delivery and operational targets during building occupancy. The BEI value derived from a functional building is the combined result of energy efficiency and consumption behaviour or pattern of the building.

3) BEI labelling can set minimum building energy performance requirements for compliance by building owners, developers, and designers to ensure that the designated buildings attain the required benchmarking value, which confirms the achievement of minimum energy performance. BEI establishment would allow the DOE and the building industry to propagate and understand building energy performance. Building owners can proactively improve their building's energy performance by monitoring and comparing its annual energy performance against similar building types.

4) The publication of BEI trending can be a means of feedback to building owners to monitor and confirm how well their respective buildings have performed.

5) BEI labelling can be used as a guide and basis for assessing building energy performance by the building approving authority.

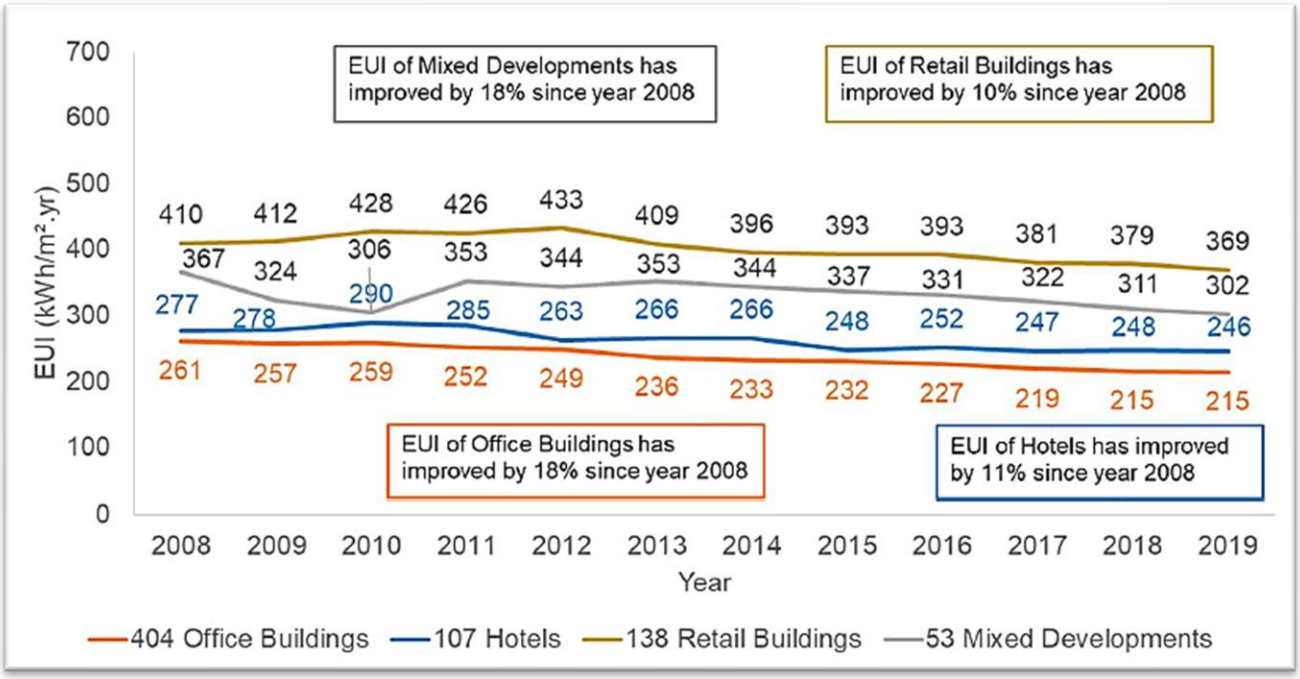
6) BEI labelling can be used to recognise energy-efficient buildings in the national energy efficiency award scheme as part of national EEC campaigns. Such campaigns can spur building owners to initiate and implement improvements in energy efficiency and generate greater awareness amongst the public and building occupants.

7) BEI labelling can help shape the property market through information transparency of buildings' energy performance compared to benchmarking values of the respective building categories or subsectors.

Figure 5.2 shows the average EUI trend by commercial building types in Singapore based on BCA's data collection since 2008. The collection of data has enabled the BCA to establish EUI trending and building energy benchmarking in Singapore. Based on the EUIs, an overall reduction in energy consumption can be derived. Figure 5.2 shows that the BCA could quantify overall energy efficiency achievements (in terms of average EUI) in Singapore as of 2019 compared to 2008. The achievements are summarised as follows:

1) Office buildings improved by 18%.
2) Hotels improved by 11%.
3) Mixed developments improved by 18%.
4) Retail buildings improved by 10%.

**Figure 5.2: Illustration of the Application of EUI Monitoring in Singapore**




EUI = energy use intensity.
Source: BCA (2020).

**Table 5.1: Singapore's National Building Energy Benchmarks for Commercial Buildings, 2019**

| Building Type | Size | No. of Buildings (in 2019) | Average EUI (kWh/m²y) | EUI of Top 10% | EUI Ranges (kWh/m²y) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Top Quartile (1%–25%) | 2nd Quartile (26%–50%) | 3rd Quartile (51%–75%) | Bottom Quartile (76%–100%) |
| Office buildings | Large | 173 | ≤212 | ≤115 | ≤147 | 147–196 | 196–270 | >270 |
| | Medium | 133 | ≤222 | ≤90 | ≤125 | 125–175 | 175–245 | >245 |
| Hotels | All | 90 | ≤272 | ≤199 | ≤226 | 226–268 | 268–352 | >352 |
| Retail buildings | Large | 74 | ≤331 | ≤156 | ≤254 | 254–446 | 446–568 | >568 |
| | Medium | 48 | ≤372 | ≤179 | ≤255 | 255–376 | 376–468 | >468 |
| Mixed developments | All | 37 | ≤280 | ≤152 | ≤202 | 202–246 | 246–370 | >370 |

*Large: Office buildings and retail buildings of GFA ≥15,000 $m^2$
*Medium: Office buildings and retail buildings of GFA ≥5,000 $m^2$ and <15,000 $m^2$
*Hotels and mixed developments: Buildings of GFA ≥5,000 $m^2$
Source: BCA (2020).

Table 5.1 illustrates how BCA Singapore analysed and computed national building energy benchmarks based on 555 medium and large-sized commercial buildings. The buildings were categorised by type and size to facilitate the benchmarking exercise. It is interesting to note that Table 5.1 provides an overall value of EUI for different building types. In general, the average EUI for large-sized commercial buildings is lower than that of medium-sized commercial buildings. Table 5.1 also shows that the top 10% of commercial buildings in Singapore have achieved impressive EUIs, i.e. these buildings are very energy efficient. For example, the top 10% of large office buildings in Singapore achieved 115 kWh/$m^2$.y, compared to the average EUI of 212 kWh/$m^2$.y.

## 5.5 Annual Mandatory Submission of Data

The implementation of BEI labelling requires the mandatory submission of building information and annual energy consumption data. The requirement for the mandatory submission may be based on the designated establishments defined in the Philippine EEC Act, i.e. Type 1 Designated Establishments (yearly energy consumption of 500,000 kWh to 4,000,000 kWh), and Type 2 Designated Establishments (yearly energy consumption of more than 4,000,000 kWh). However, for commercial buildings, it is more appropriate to set the criterion for mandatory submission of data to be based on the GFA of a building due to the following reasons:

1) It provides a means of predefining an appropriate level of minimum GFA (e.g. ≥4,000 $m^2$) for a building because it is not practical and viable for a small building to take up EEC measures.
2) Basing on the GFA is more definitive and relatively straightforward to implement for new building development projects. Unlike existing buildings, the annual energy consumption for a new building development project is only an estimation.

For BEI computation, the following building information should be submitted by owners of existing buildings or by the principal submitting persons (e.g. architects or consulting engineers) for new building development projects:

1) ownership and building functions (activity type, occupancy type, etc.);
2) building data (GFA, air-conditioning floor area, retrofitting works if renovation);
3) monthly and total annual energy consumption (electricity, diesel, natural gas, liquefied petroleum gas, etc.);
4) energy-use breakdowns (ACMV, lighting, lifts and escalators, hot water systems, etc.).