

BCA Building Energy Benchmarking Report

(Statistics and Figures) 2020

Snapshot of BEBR 2020	Singapore Building Energy Benchmarking	Statistics and Figures of Commercial Buildings	Statistics and Figures of Other Targeted Building Types
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Acknowledgement

Environmental Sustainability Group

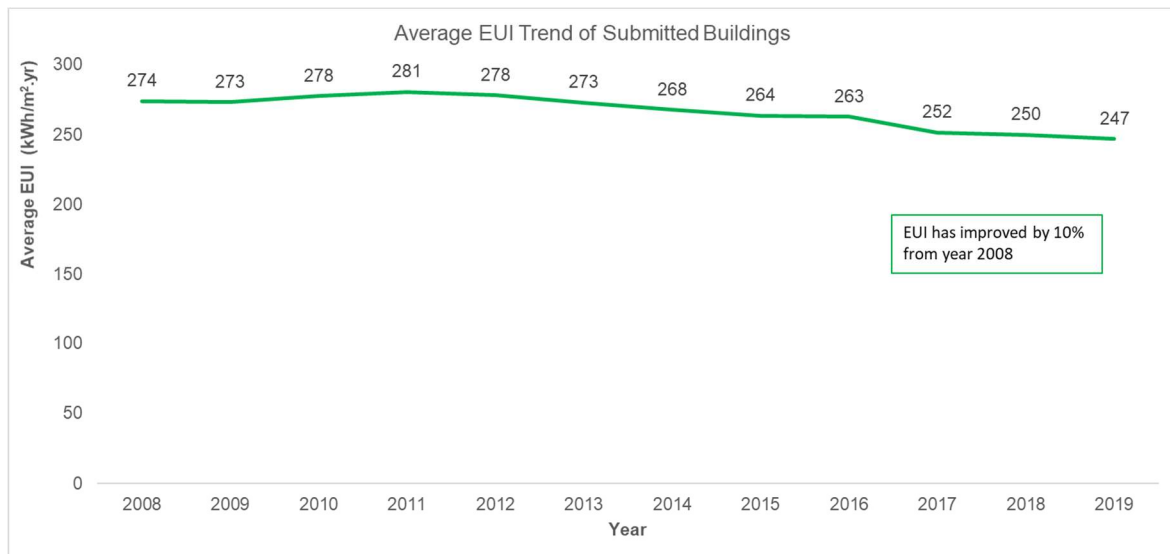
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Snapshot of BEBR (Statistics & Figures) 2020



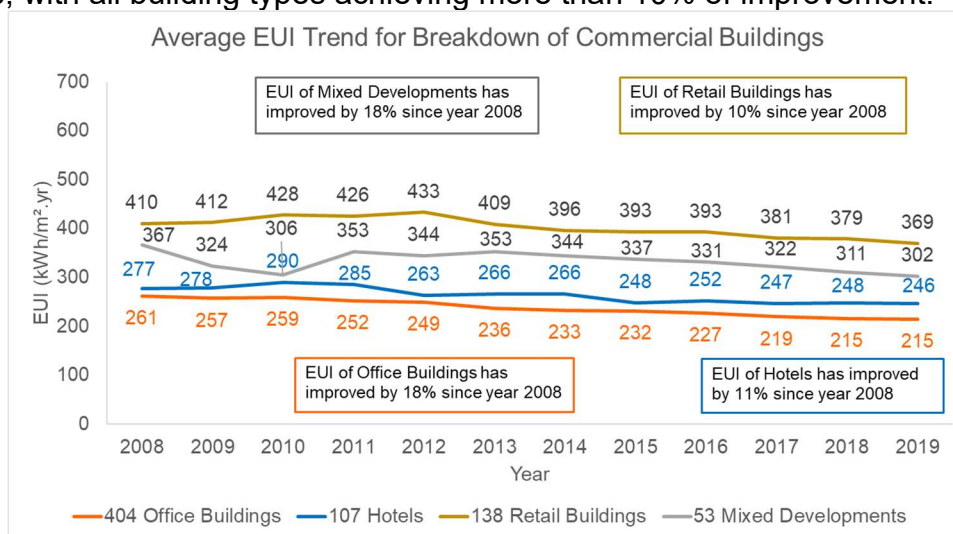
Overall Performance of Submitted Buildings in 2019

- Based on the submitted data from 1,101 buildings (GFA ≥5,000 m²), BCA observed that the overall energy use intensity (EUI) has improved by 10%, with steady improvement over a ten-year period. Electricity consumption stabilised in recent years even with GFA continued to increase by 46%.



Average EUI Trend of Submitted Buildings

- Commercial buildings showed commendable improvement at 14% in EUI since 2008, with all building types achieving more than 10% of improvement.



Average EUI Trend by Commercial Building Types

Voluntary Disclosed Building Energy Performance Data for Commercial Buildings (based on 2019's submission cycle) are publicly available at www.bca.gov.sg/bess and www.data.gov.sg

Section 1

Singapore's Building Energy Benchmarking

BCA publishes the Building Energy Benchmarking Report (BEBR) annually since 2014, to monitor the building energy performance of Singapore's building stock. This publication is an initiative under the BCA 3rd Green Building Masterplan, which aims to:

- Inform building owners and facilities managers on how well their buildings have performed;
- Spur them to initiate and implement improvements in building energy efficiency; and
- Shape the market through information transparency of buildings' energy performance.

For the 7th year, BEBR 2020 continues to be the key outreach medium for building energy performance for the sustainable built environment.



Under the Building Control Act, building owners have been required to submit building related information and energy consumption data to BCA on an annual basis since 2013. The information thus collected was analysed to establish the national building energy benchmarks for Singapore's built environment.

In this year's Annual Mandatory Submission exercise, BCA has covered the following types of buildings:

- | | |
|-------------------------------|--|
| Stage 1
(2013/ 2014) | ➤ Commercial buildings comprising office buildings, hotels, retail buildings and mixed developments |
| Stage 2
(2015/ 2016) | ➤ Healthcare facilities and educational institutions |
| Stage 3
(2017/ 2018/ 2019) | ➤ Large buildings of civic, community and cultural institutions, sports and recreation centres, and transport facilities |

**Section
2**

Overview of 2019's Statistics and Figures

In 2019¹, commercial buildings, healthcare facilities, educational institutions, civic, community and cultural institutions, and sports and recreation centres were targeted for the annual mandatory submission.

In total, 1,101 buildings, with a combined Gross Floor Area (GFA) of 31.0 million m² and total annual electricity consumption at 7,642 GWh were analysed for this benchmarking exercise, recording 96% compliance for 2019.

Chart 1: Total GFA (million m²) by Building Types

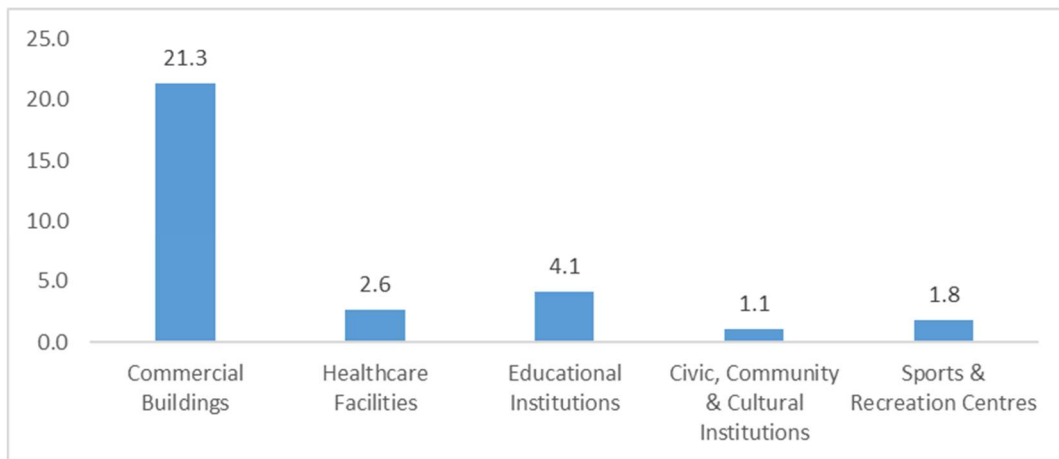
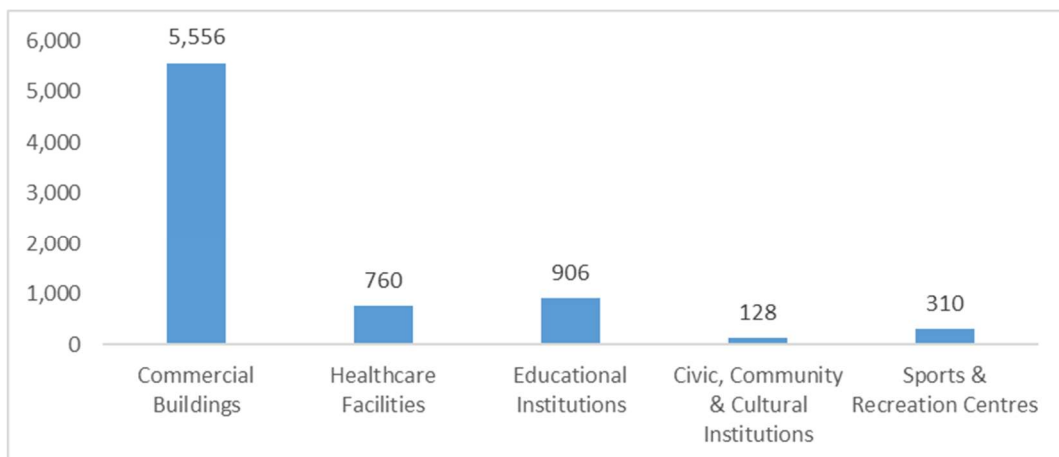


Chart 2: Total Electricity Consumption (GWh) by Building Types



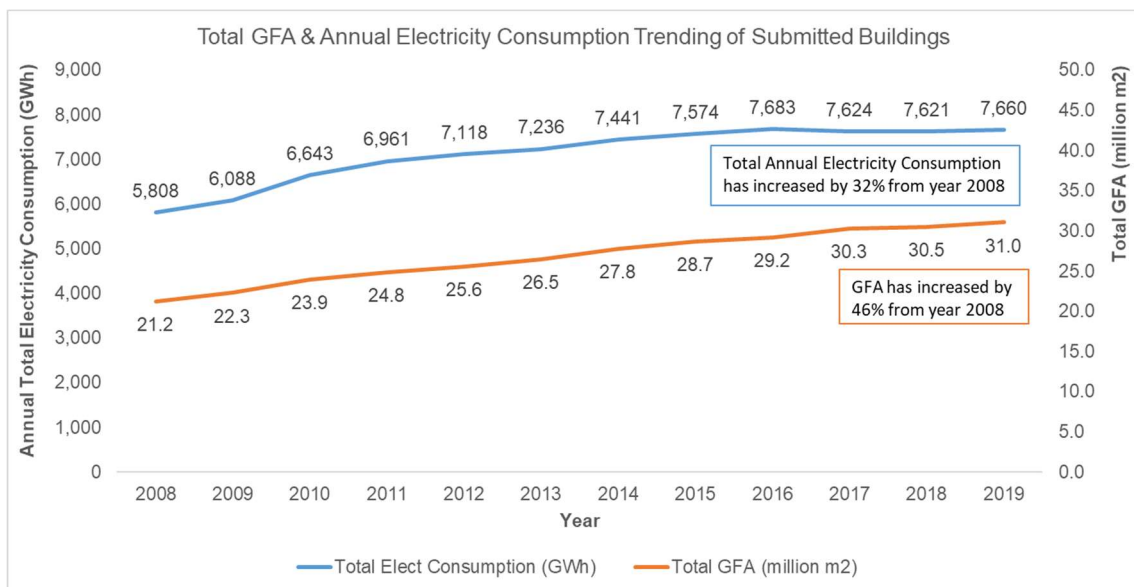
¹ In 2019, only buildings with GFA ≥5,000 m² were targeted for submission.

EUI Trend

As electricity is the main source of energy used in Singapore's buildings, other energy sources were excluded in the computation of energy use intensity (EUI). EUI is measured by the total electricity used within a building in a year, expressed as kilowatt hour (kWh), per gross floor area (m²). The total number of submitted buildings trended each year are updated to reflect newly added buildings and existing buildings that have completed major renovation or redevelopment.

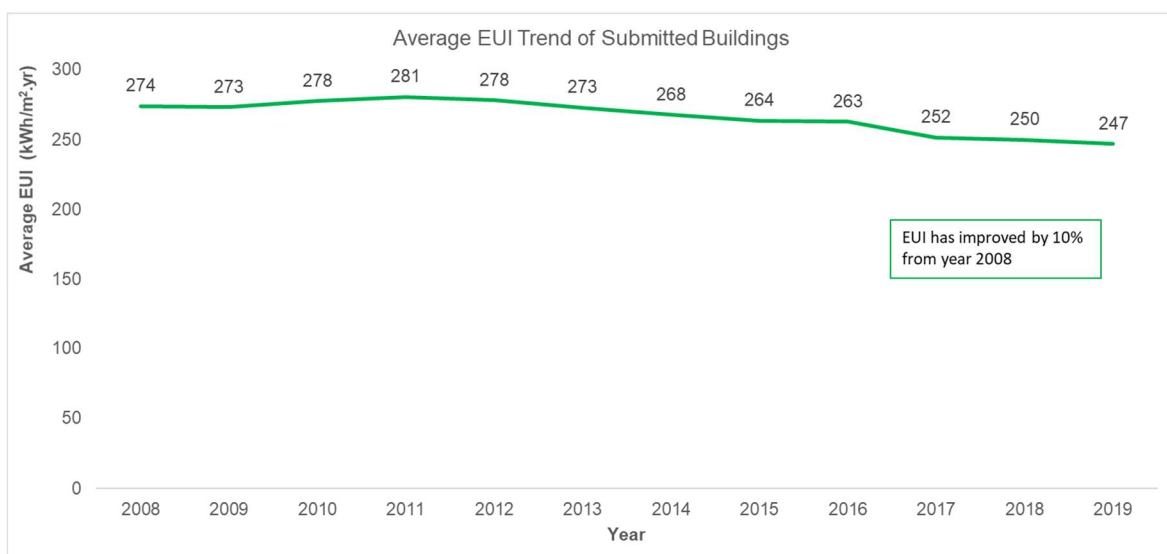
Over the period from 2008 to 2019, the annual electricity consumption of these 5 building types has increased at a slower rate by 32%, compared with the growth of the GFA at 46%.

Chart 3: Total GFA & Annual Electricity Trend of Submitted Buildings



The overall EUI for the submitted buildings has therefore improved by 10%, with steady improvement over this period.

Chart 4: Average EUI Trend of Submitted Buildings



**Section
3**

Commercial Buildings

EUI Trend of Commercial Buildings

Between 2008 to 2019, the annual electricity consumption of 702 commercial buildings (GFA $\geq 5,000 \text{ m}^2$) has increased at a slower rate of 25%, compared to the growth of the corresponding GFA at 46%. The average EUI has improved by 14% since 2008.

National Building Energy Benchmarks [EUI (kWh/m².yr)]

In 2019, a total of 555 medium and large size commercial buildings were benchmarked. Newly constructed or retrofitted buildings, buildings on district cooling systems (DCS), and aggregated mixed developments with electricity consumption or shared centralised air-conditioning systems that could not be segregated due to the lack of sub-metering were omitted from the benchmarks. To facilitate the benchmarking exercise, the buildings have been categorised by type and size.

For the purpose of benchmarking, EUI can be used as an index for building owners and facilities managers to compare their building's annual energy performance against similar building types. EUI is the combined result of energy efficiency and consumption behaviour/pattern of the building.

Table 1: National Building Energy Benchmarks for Commercial Buildings (2019)

Building Type	Size*	No. of Buildings (in 2019)	Average EUI (kWh/m ² .yr)	EUI of Top 10%	EUI Ranges (kWh/m ² .yr)			
					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 $\geq 15,000 \text{ m}^2$;

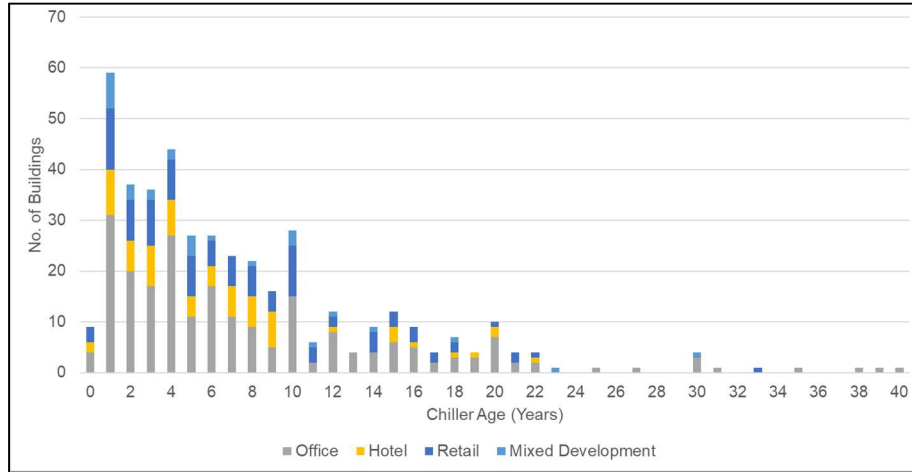
*Medium: Office Buildings and Retail Buildings of GFA $\geq 5,000 \text{ m}^2$ and $< 15,000 \text{ m}^2$

*Hotels & Mixed Developments: Buildings of GFA $\geq 5,000 \text{ m}^2$.

Profile of Central Chilled Water Air-conditioning Systems

In total, 426 commercial buildings are using central chilled water plants, the majority of which are less than 10 years old.

Chart 5: Frequency of Buildings by Chiller Age



A total of 281 buildings furnished the data from energy audits. The chart below showed the relationship between the centralised air-conditioning system efficiency and the chiller age. To better analyse the buildings, four quadrants have been defined, based on chiller plant efficiency and age of the system.

Chart 6: Chiller System Efficiency by Chiller Age

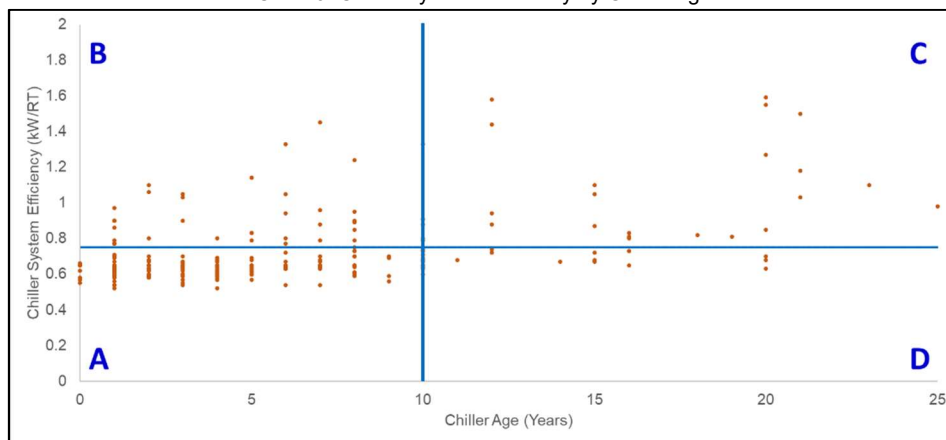


Table 2: Chiller System Efficiency and Chiller Age

Quadrant	Chiller Plant Efficiency (kW/RT)	Age of Newest Chiller	Distribution of Buildings in 2019
A	≤0.75	≤10	73% (204 buildings)
B	>0.75	≤10	15% (42 buildings)
C	>0.75	>10	5% (13 buildings)
D	≤0.75	>10	8% (22 buildings)
		Total	100% (281 buildings)

**Section
4**

Healthcare Facilities

EUI Trend of Healthcare Facilities

Over the period from 2008 to 2019, the annual electricity consumption of 62 healthcare facilities (GFA $\geq 5,000$ m²) has increased at a faster rate of 83%, compared to the growth of the corresponding GFA at 79%. It was observed that the average EUI for healthcare facilities has increased by 2% over the period from 2008 - 2019.

Table 3: Average EUI Trending for Healthcare Facilities

Healthcare Type	No. of Buildings (in 2019)	Average EUI (kWh/m ² .yr)		
		2015	2018	2019
General Hospital/ Specialist Centre (Public)	14	350	338	347
Private Hospital (Private)	7	367	367	342
Community Hospital	4	198	200	209
Polyclinics	7	142	149	152
Private Clinics	4	229	215	219
Nursing Homes	26	83	82	88

Table 4: Energy Benchmarks of Healthcare Facilities with Bed Spaces

Healthcare Type	No. of Buildings (in 2019)	Average Elect Consumption per Bed Space (kWh/Bed Space)		
		2015	2018	2019
General Hospital (Public)	9	53,894	52,067	53,611
Private Hospital (Private)	7	56,855	56,800	57,081
Community Hospital	4	10,263	11,088	11,563
Nursing Homes	25	3,923	3,635	3,844

Section
5

Educational Institutions

EUI Trend of Educational Institutions

The annual electricity consumption of 42 educational institutions (GFA \geq 5,000 m²) had increased at a lower rate of 32%, compared to the growth of the corresponding GFA at 35% over the period 2008 – 2019. It was observed that the EUI has improved by 3% during this period.

Table 5: Average EUI Trending for Educational Institutions

Educational Institution Type	No. of Institutions (in 2019)	Average EUI (kWh/m ² .yr)		
		2015	2018	2019
Universities	6	383	388	367
Polytechnics/ ITE Campus	15	124	120	121
Private Colleges/ Private Schools	21	108	103	106

**Section
6**

Other Targeted Building Types

EUI Trend of Civic, Community and Cultural Institutions

The annual electricity consumption of 63 civic, community and cultural institutions (GFA $\geq 5,000$ m²) had increased at a faster rate of 38%, compared to the growth of the corresponding GFA at 27% over the period 2008 – 2019. It was observed that the EUI has increased by 8% during this period.

Table 6: Energy Benchmarks of Civic and Community Institutions

Building Type	Sub-categorisation	No. of Buildings (in 2019)	Average EUI (kWh/m ² .yr)		
			2017	2018	2019
Civic and Community Institutions	Civic Institutions	13	117	129	112
	Community Institutions	43	90	101	101

EUI Trend of Sports and Recreation Centres

The annual electricity consumption of 56 sports and recreation centres (GFA $\geq 5,000$ m²) had increased at a lower rate of 80%, compared to the growth of the corresponding GFA at 59% over the period 2008 – 2018. It was observed that the EUI has increased by 13% during this period.

Table 7: Energy Benchmarks of Sports and Recreation Centres

Building Type	Sub-categorisation	No. of Buildings (in 2019)	Average EUI (kWh/m ² .yr)		
			2017	2018	2019
Sports and Recreation Centres	Sports Complexes	13	171	165	166
	Recreation Clubs	44	241	243	227

Glossary

Average Energy Use Intensity (EUI)	Weighted average of the energy use intensities of buildings is calculated based on electricity consumed using gross floor area as the weightage factor.
Energy Use Intensity (EUI)	Measures the total energy consumed in a building in a year, expressed as kilowatt hour (kWh) per gross floor area (m ²).
Gross Floor Area (GFA)	All covered floor areas of a building, except otherwise exempted, and uncovered areas for commercial uses, are deemed the gross floor area of the building. Generally, car parks are excluded from gross floor area computation.
Building Types	<p>Office building is a development with premises used as a place of business and for conducting administrative work.</p> <p>Hotel is a development used for accommodation purposes on a commercial basis. The predominant use of this development shall be hotel rooms.</p> <p>Retail building is a development with premises primarily used for any trade or business where its primary purpose is the sale of goods or foodstuff by retail or provision of services.</p> <p>Mixed development is a combination of any of the above three commercial building types.</p> <p>Healthcare facility is a development used mainly for medical services, such as hospitals, medical centres, community health centres, nursing homes, clinics (including dental clinics), and clinical laboratories (including x-ray laboratories).</p> <p>Educational institution comprises tertiary and private institutions. Tertiary institution is a facility space used for post-secondary education, such as Institute of Technical Education (ITE), Polytechnic and University. Private institution is a privately owned and funded facility/space used for education.</p> <p>Civic, community and cultural institution consists of civic, community or cultural facilities. Civic facilities include police station, fire station and prison. Community facilities are mainly community centre/club, and places of worship. Cultural facilities comprise performing arts centre, library, museum and concert halls.</p> <p>Sports and recreation centre is a development to be used mainly for sports and recreational purpose, such as sports complex, swimming complex and recreation club.</p>

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