

# BCA Building Energy Benchmarking Report

(Statistics and Figures) 2019

Snapshot of BEBR  
2019

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Singapore Building  
Energy Benchmarking

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Statistics and Figures  
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## Acknowledgement

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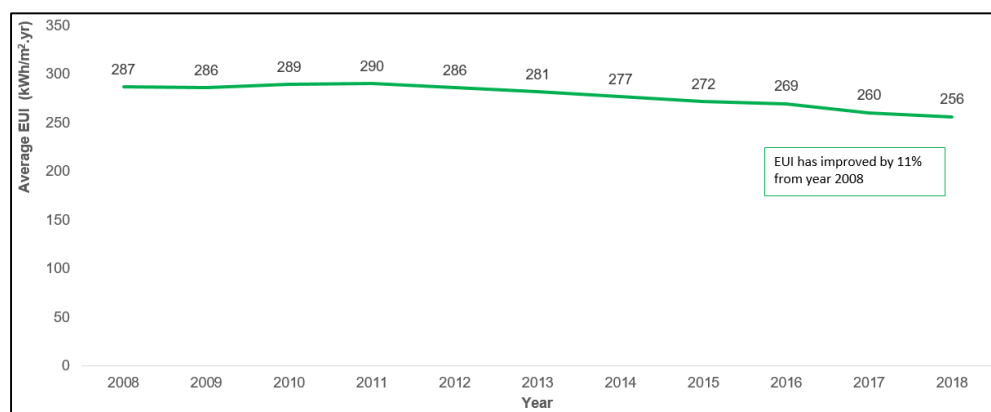
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# Snapshot of BEBR (Statistics & Figures) 2019



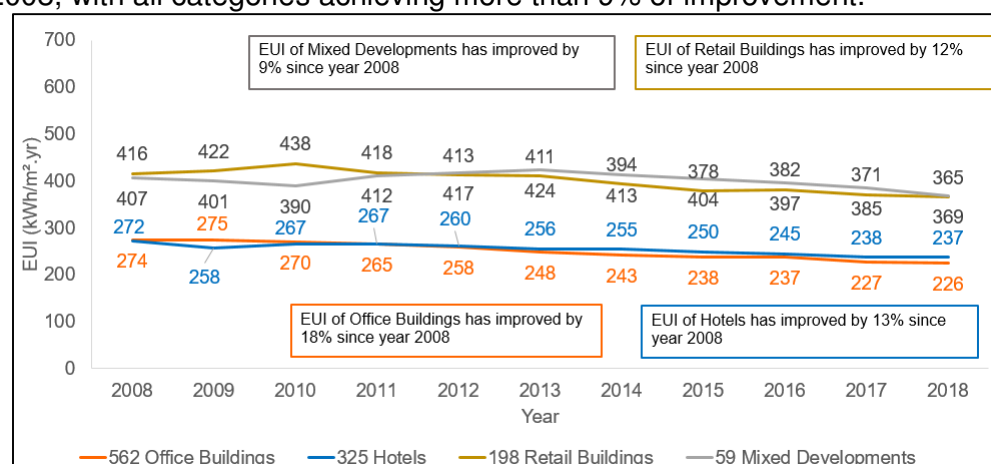
## Overall Performance of Submitted Buildings in 2018

- Based on the submitted data from 1,654 buildings, BCA observed that the overall energy use intensity (EUI) has improved by 11%, with steady improvement over a ten-year period. Electricity consumption stabilised in recent years even with GFA continued to increase by 47%.



Average EUI Trend of Submitted Buildings

- Commercial buildings showed commendable improvement at 14% in EUI since 2008, with all categories achieving more than 9% of improvement.



Average EUI Trend by Commercial Building Types

Voluntary Disclosed Building Energy Performance Data for Commercial Buildings (based on 2018's submission cycle) are publicly available at [www.bca.gov.sg/bess](http://www.bca.gov.sg/bess) and [www.data.gov.sg](http://www.data.gov.sg)

<b>Section 1</b>	<h1>Singapore's Building Energy Benchmarking</h1>
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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 6<sup>th</sup> year, BEBR 2019 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<br>(2013/ 2014)                     | ➤ Commercial buildings comprising office buildings, hotels, retail buildings and mixed developments                      |
| Stage 2<br>(2015/ 2016)                     | ➤ Healthcare facilities and educational institutions   |
| Stage 3<br>(2017/ 2018/ 2019 <sup>1</sup> ) | ➤ Large buildings of civic, community and cultural institutions, sports and recreation centres, and transport facilities |

<sup>1</sup> In 2019, the large-size (GFA ≥5,000 m<sup>2</sup>) commercial buildings, healthcare facilities, educational institutions, civic, community and cultural institutions, sports and recreation centres are targeted for submission.

<b>Section 2</b>	<b>Overview of 2018's Statistics and Figures</b>
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In 2018, commercial buildings, healthcare facilities, and educational institutions were targeted for the annual mandatory submission, together with 3 other building types, namely: large-sized buildings of civic, community and cultural institutions, and sports and recreation centres, and transport facilities.

In total, 1,654 buildings, with a combined Gross Floor Area (GFA) of 33 million m<sup>2</sup> and total annual electricity consumption at 8,478 GWh were analysed for this benchmarking exercise, recording 96% compliance for 2018.

Chart 1: Total GFA (million m<sup>2</sup>) by Building Types

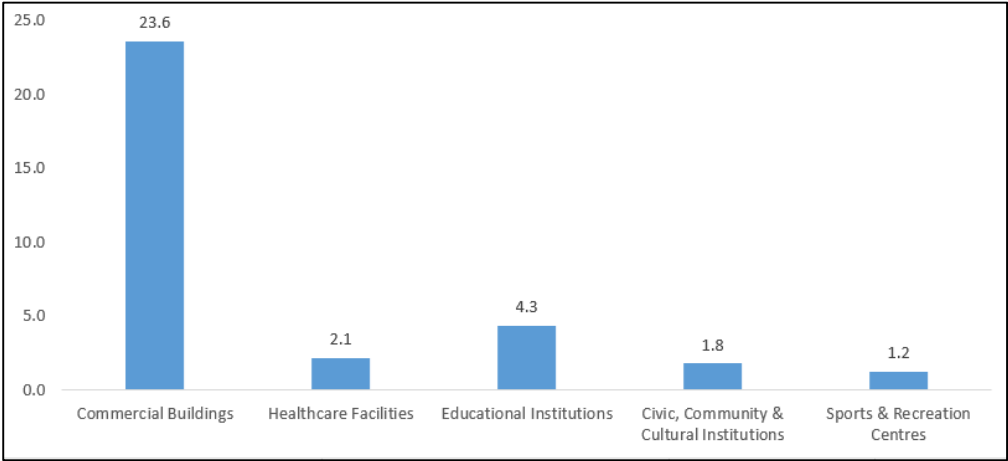
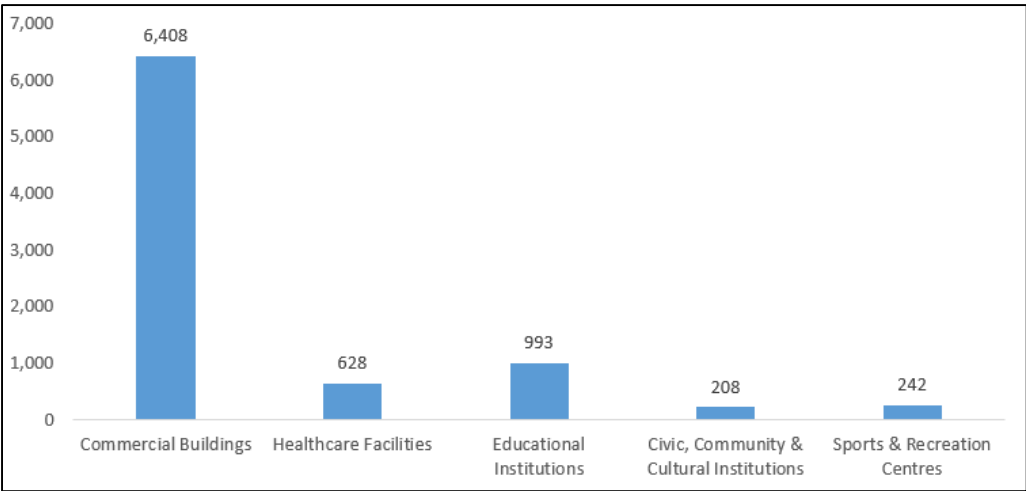


Chart 2: Total Electricity Consumption (GWh) by Building Types

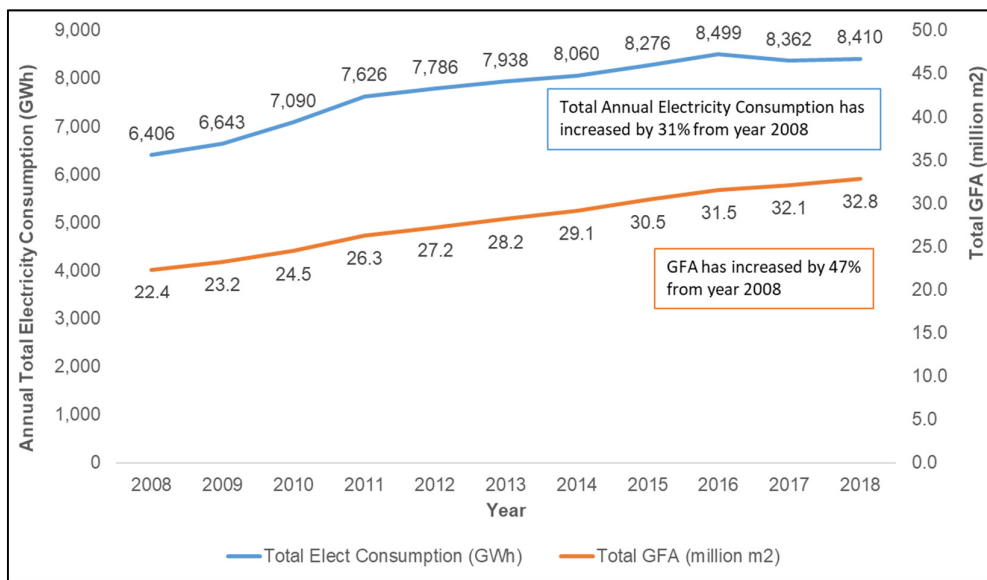


## EUI Trend

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 (m<sup>2</sup>). 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.

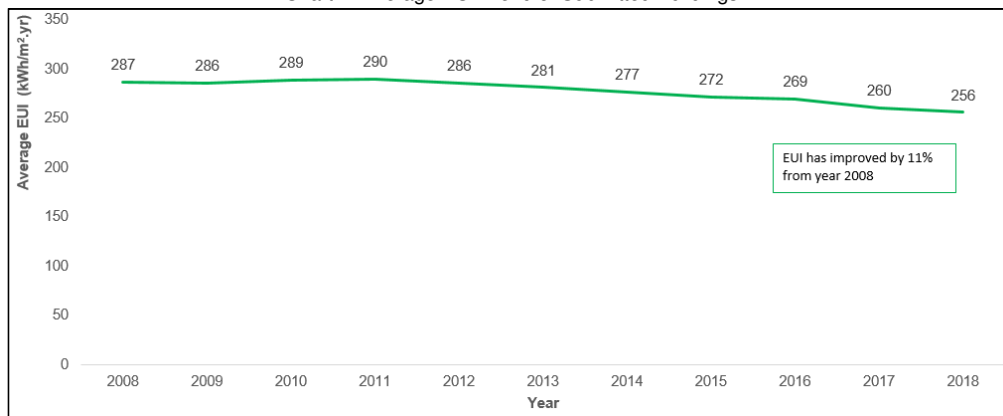
Over the period from 2008 to 2018, the annual electricity consumption of these 5 building types has increased at a slower rate by 31%, compared with the growth of the GFA at 47%.

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



The overall EUI for the submitted buildings has therefore improved by 11%, 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 2018, the annual electricity consumption of 1,144 commercial buildings has increased at a slower rate of 27%, compared to the growth of the corresponding GFA at 49%. The average EUI has improved by 14% since 2008.

**National Building Energy Benchmarks [EUI (kWh/m<sup>2</sup>.yr)]**

In 2018, a total of 1,011 commercial buildings were included for benchmarking. We omitted 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. To facilitate the benchmarking exercise, the buildings are 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: Average EUI Trending for Commercial Buildings

Building Type	Size*	No. of Buildings (in 2018)	Average EUI (kWh/m <sup>2</sup> .yr)		
			2013	2017	2018
Office Buildings	Large	194	236	217	219
	Small	284	273	247	237
Hotels	Large	86	279	261	260
	Small	217	300	281	279
Retail Buildings	Large	78	397	356	350
	Small	99	431	384	375
Mixed Developments	All	53	312	290	273

Table 2: National Building Energy Benchmarks for Commercial Buildings (2018)

Building Type	Size*	No. of Buildings (in 2018)	EUI of the Top 10%		EUI Ranges (kWh/m <sup>2</sup> .yr)			
			2017	2018	Top Quartile (1% - 25%)	2nd Quartile (26% - 50%)	3rd Quartile (51% - 75%)	Bottom Quartile (76% - 100%)
Office Buildings	Large	194	≤121	≤113	≤138	138 - 185	185 - 246	≥246
	Small	284	≤86	≤79	≤131	131 - 180	180 - 250	≥250
Hotels	Large	86	≤187	≤187	≤223	223 - 263	263 - 326	≥326
	Small	217	≤140	≤129	≤187	187 - 257	257 - 345	≥345
Retail Buildings	Large	78	≤163	≤161	≤239	239 - 411	411 - 513	≥513
	Small	99	≤147	≤145	≤234	234 - 349	349 - 481	≥481
Mixed Developments	All	53	≤167	≤156	≤209	209 - 259	259 - 335	≥335

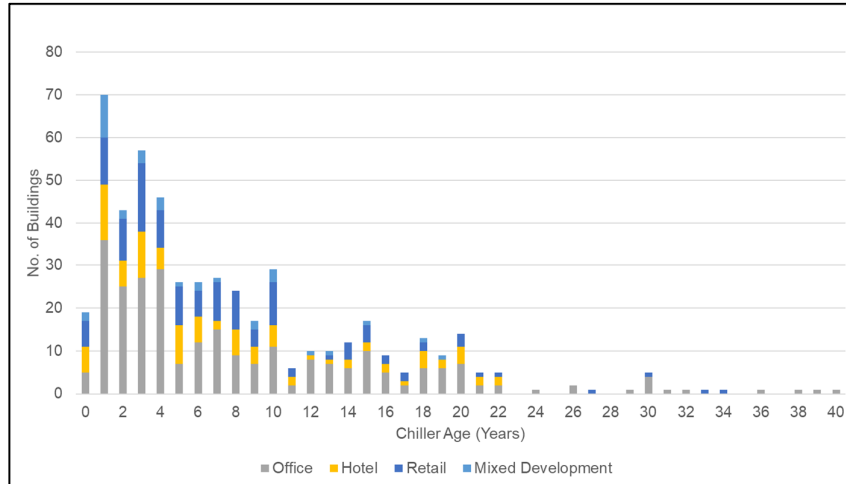
\*Large: Office, Retail, Mixed Developments of GFA ≥15,000 m<sup>2</sup>; Hotels of GFA ≥7,000 m<sup>2</sup>

\*Small: Office, Retail, Mixed Developments of GFA <15,000 m<sup>2</sup>; Hotels of GFA <7,000 m<sup>2</sup>

## Profile of Central Chilled Water Air-conditioning Systems

In total, 517 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 318 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

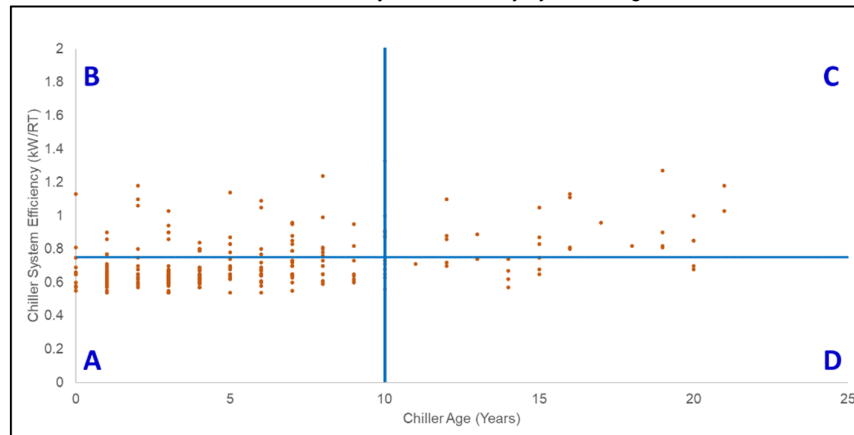


Table 3: Chiller System Efficiency and Chiller Age

Quadrant	Chiller Plant Efficiency (kW/RT)	Age of Newest Chiller	2017	2018
A	≤0.75	≤10	62% (191 buildings)	68% (216 buildings)
B	>0.75	≤10	20% (61 buildings)	17% (55 buildings)
C	>0.75	>10	13% (40 buildings)	10% (33 buildings)
D	≤0.75	>10	5% (16 buildings)	4% (14 buildings)
		Total	100% (308 buildings)	100% (318 buildings)



<b>Section 4</b>	<b>Healthcare Facilities</b>
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### EUI Trend of Healthcare Facilities

Over the period from 2008 to 2018, the annual electricity consumption of 82 healthcare facilities has increased at a faster rate of 58%, compared to the growth of the corresponding GFA at 55%. It was observed that the average EUI for healthcare facilities has increased by 2% over the period from 2008 - 2018.

Table 4: Average EUI Trending for Healthcare Facilities

Healthcare Type	No. of Buildings (in 2018)	Average EUI (kWh/m <sup>2</sup> .yr)		
		2015	2017	2018
General Hospital/ Specialist Centre (Public)	12	393	377	376
Private Hospital (Private)	8	369	369	369
Community Hospital	4	198	201	200
Polyclinics	13	159	161	144
Nursing Homes	35	88	93	89

Table 5: Energy Benchmarks of Healthcare Facilities with Bed Spaces

Healthcare Type	No. of Buildings (in 2018)	Average Elect Consumption per Bed Space (kWh/Bed Space)		
		2015	2017	2018
General Hospital (Public)	11	42,928	49,308	47,454
Private Hospital (Private)	8	60,803	58,983	58,899
Community Hospital	4	10,452	11,310	11,292
Nursing Homes	35	3,844	4,356	3,550

<b>Section</b> <b>5</b>	<b>Educational Institutions</b>
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### EUI Trend of Educational Institutions

The annual electricity consumption of 53 educational institutions had increased at a lower rate of 37%, compared to the growth of the corresponding GFA at 39% over the period 2008 – 2018. It was observed that the EUI has improved by 2% during this period.

Table 6: Average EUI Trending for Educational Institutions

Educational Institution Type	No. of Institutions (in 2018)	Average EUI (kWh/m <sup>2</sup> .yr)		
		2015	2017	2018
Universities	5	396	367	364
Polytechnics/ ITE Campus	8	128	124	120
Private Colleges/ Private Schools	40	187	172	170

<b>Section 6</b>	<b>Other Targeted Building Types</b>
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### EUI Trend of Civic, Community and Cultural Institutions

The annual electricity consumption of 157 civic, community and cultural institutions had increased at a faster rate of 37%, compared to the growth of the corresponding GFA at 26% over the period 2008 – 2018. It was observed that the EUI has increased by 9% during this period.

Table 7: Energy Benchmarks of Civic and Community Institutions

Building Type	Sub-categorisation	No. of Buildings (in 2018)	Average EUI (kWh/m <sup>2</sup> .yr)	
			2017	2018
Civic and Community Institutions <sup>#</sup>	Civic Institutions	21	113	110
	Community Institutions	124	111	111

<sup>#</sup>GFA ≥5,000 m<sup>2</sup>

### EUI Trend of Sports and Recreation Centres

The annual electricity consumption of 66 sports and recreation centres had increased at a lower rate of 62%, compared to the growth of the corresponding GFA at 66% over the period 2008 – 2018. It was observed that the EUI has improved by 2% during this period.

Table 8: Energy Benchmarks of Sports and Recreation Centres

Building Type	Sub-categorisation	No. of Buildings (in 2018)	Average EUI (kWh/m <sup>2</sup> .yr)	
			2017	2018
Sports and Recreation Centres <sup>#</sup>	Sports Complexes	16	149	142
	Recreation Clubs	47	214	214

<sup>#</sup>GFA ≥5,000 m<sup>2</sup>

## Glossary

<b>Average Energy Use Intensity (EUI)</b>	Weighted average of the energy use intensities of buildings is calculated based on electricity consumed using gross floor area as the weightage factor.
<b>Energy Use Intensity (EUI)</b>	Measures the total energy consumed in a building in a year, expressed as kilowatt hour (kWh) per gross floor area (m <sup>2</sup> ).
<b>Gross Floor Area (GFA)</b>	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.
<b>Building Types</b>	<p><b>Office building</b> is a development with premises used as a place of business and for conducting administrative work.</p> <p><b>Hotel</b> is a development used for accommodation purposes on a commercial basis. The predominant use of this development shall be hotel rooms.</p> <p><b>Retail building</b> 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><b>Mixed development</b> is a combination of any of the above three commercial building types.</p> <p><b>Healthcare facility</b> 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><b>Educational institution</b> 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><b>Civic, community and cultural institution</b> 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. (With GFA more than 5,000 m<sup>2</sup>)</p> <p><b>Sports and recreation centre</b> is a development to be used mainly for sports and recreational purpose, such as sports complex, swimming complex and recreation club. (With GFA more than 5,000 m<sup>2</sup>)</p>

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