Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

BCA Building Energy

Benchmarking Report

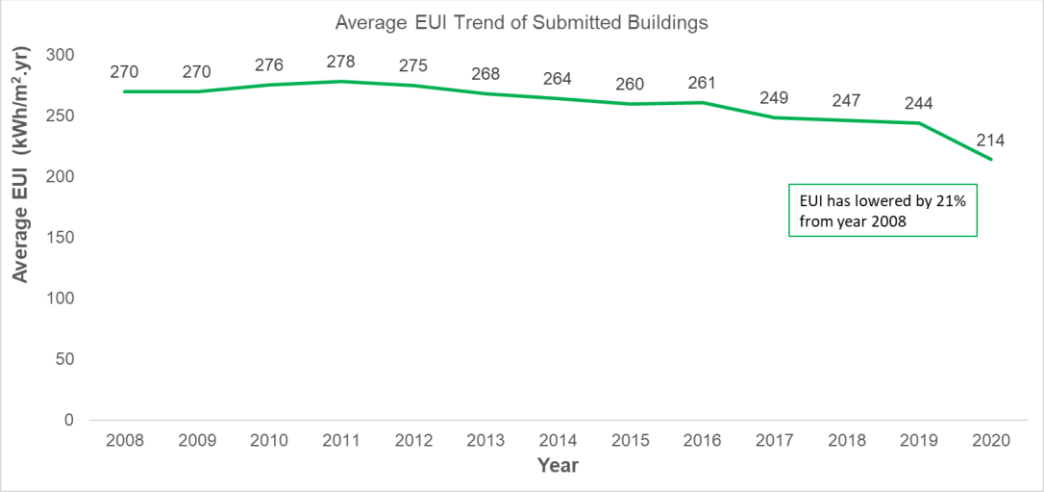
(Statistics and Figures) 2021

Contents

Snapshot of BEBR *(Statistics & Figures)* **2021**

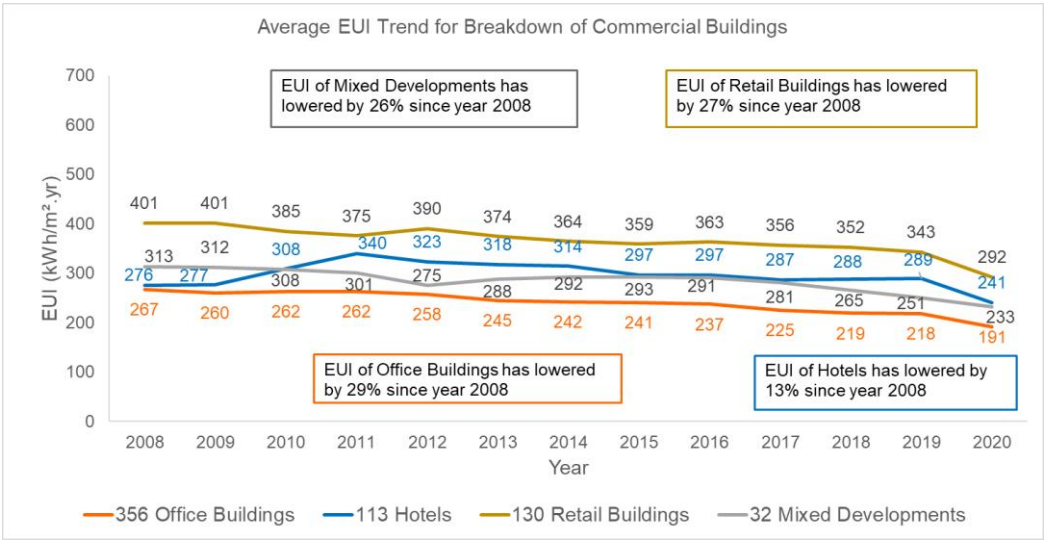
Overall Performance of Submitted Buildings in 2020

- Based on the submitted data from 925 buildings (GFA ≥5,000 m^2), BCA observed that the overall energy use intensity (EUI) has lowered by 21% over the period from 2008 to 2020. Building operations in the year 2020 was atypical due to the pandemic, whereby building occupancy was lower but with higher air ventilation requirements. Nonetheless, this report would still serve as a useful reference for building energy usage in 2020.



Average EUI Trend of Submitted Buildings

- Commercial buildings showed an overall 25% lower EUI in 2020 compared to 2008.



Average EUI Trend by Commercial Building Types

Building Energy Performance Data for Buildings (based on 2020's submission cycle) are publicly available. For more information, please visit https://go.gov.sg/energy-performance

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 and 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 8th year, BEBR 2021 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 2020, BCA has covered the following types of buildings[1] in the Annual Mandatory Submission exercise:

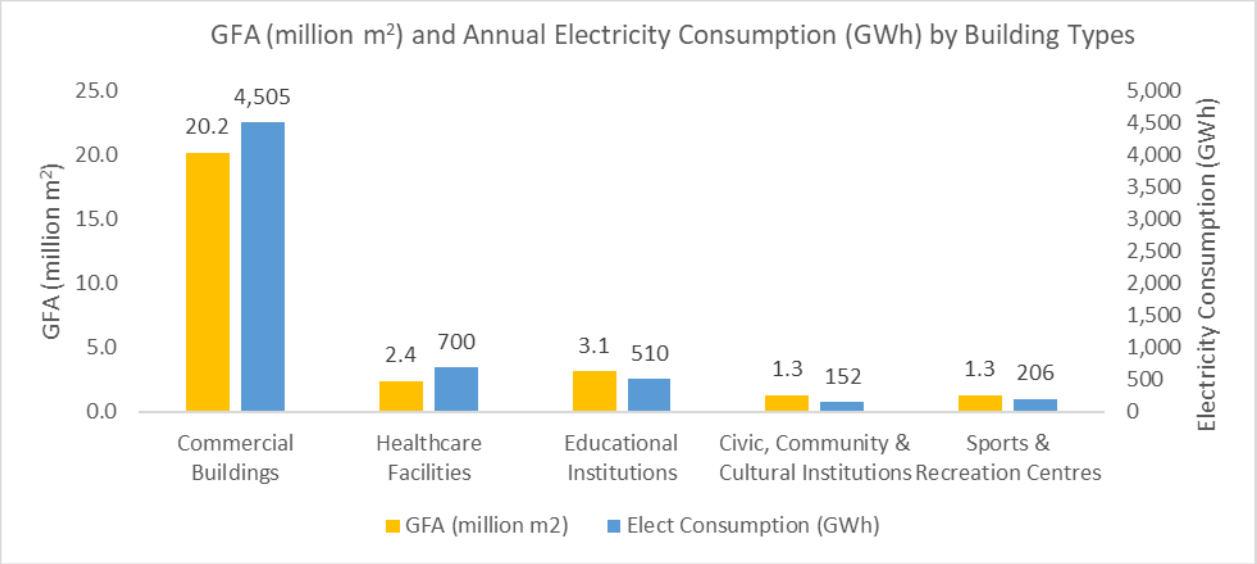
- Commercial buildings comprising office buildings, hotels, retail buildings and mixed developments
- Healthcare facilities
- Educational institutions
- Civic, community and cultural institutions
- Sports and recreation centres

[1] In 2020, only buildings with GFA ≥5,000 m² were targeted for submission.

Section 2	Overview of 2020's Statistics and Figures

In total, an 82%[2] compliance for 2020 was recorded, equivalent to 925 buildings, with a combined GFA of 28.4 million m² and total annual electricity consumption at 6,072 GWh were analysed for this benchmarking report.

Chart 1: GFA (million m²) and Annual Electricity Consumption (GWh) by Building Types



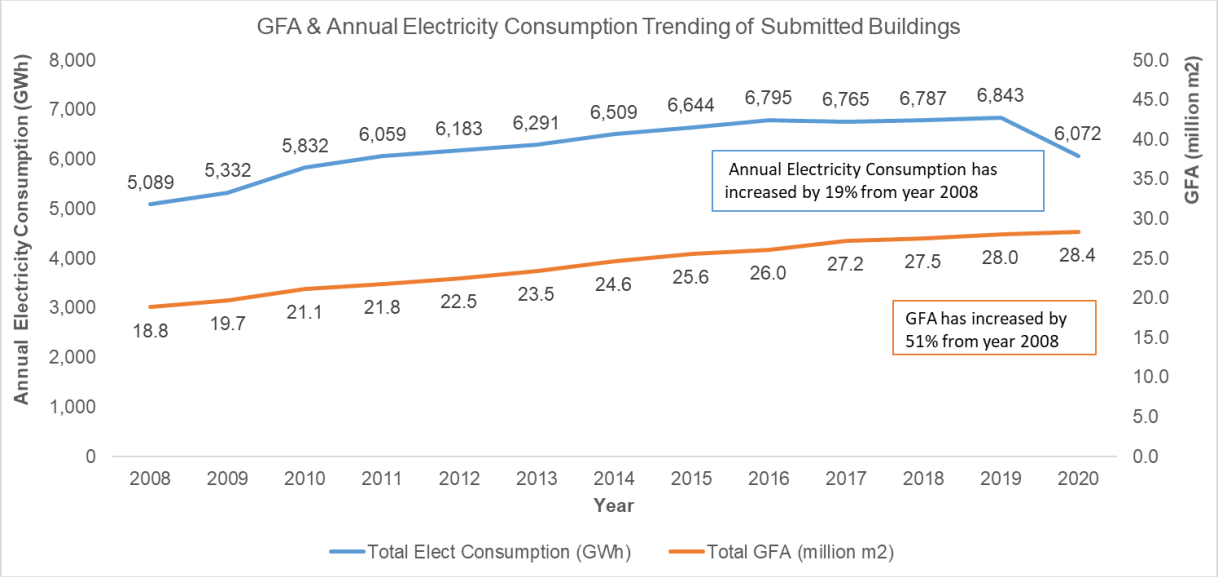
[2] At point of cut-off for data analysis

EUI Trend

As electricity is the main source of energy used in Singapore's buildings, other energy sources were excluded in the computation of 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^2). 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.

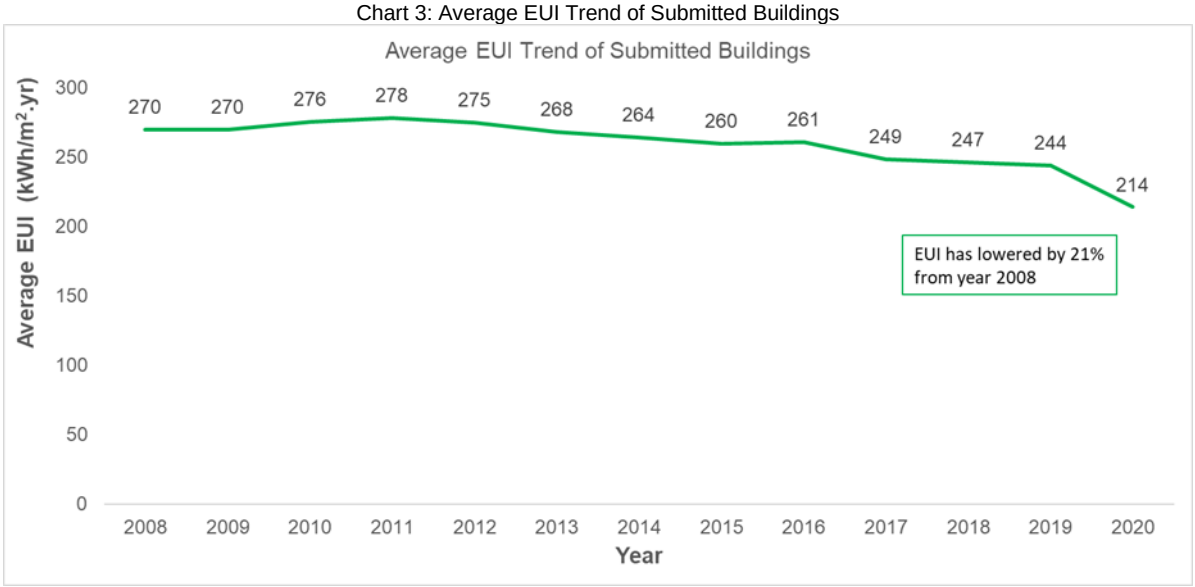
The annual electricity consumption of these 5 building types has increased by 19%, while the growth of the GFA was 51% over the period from 2008 to 2020.

Chart 2: GFA & Annual Electricity Trend of Submitted Buildings



The overall EUI for the submitted buildings in 2020 has therefore lowered by 21% compared to 2008.

Chart 3: Average EUI Trend of Submitted Buildings



Section 3

Commercial Buildings

EUI Trend of Commercial Buildings

Between 2008 to 2020, the annual electricity consumption of 631 commercial buildings (GFA ≥5,000 m^2) has increased by 12%, compared to the corresponding GFA growth at 50%. The average EUI in 2020 has lowered by 25% since 2008.

National Building Energy Benchmarks [EUI (kWh/m^2.yr)]

In 2020, a total of 498 commercial buildings (GFA ≥5,000 m^2) were benchmarked. Newly constructed or retrofitted buildings, buildings on district cooling systems (DCS) were omitted from the benchmarks, and developments with electricity consumption or shared centralised air-conditioning systems that could not be segregated due to the lack of sub-metering were aggregated. 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 to compare the 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 (2020)

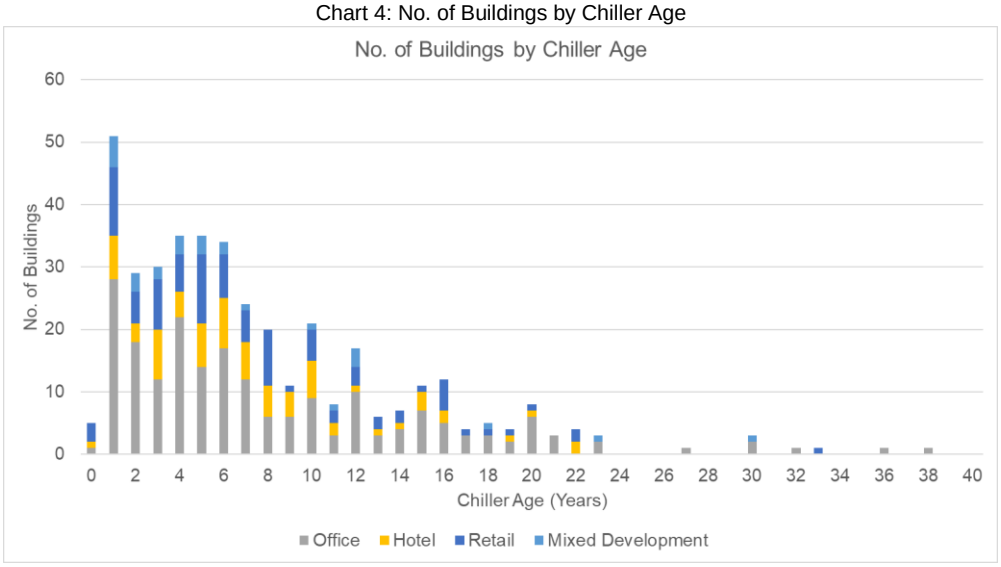
Building Type	Size*	No. of Buildings (in 2020)	Average EUI (kWh/m^2.yr)	EUI of Top 10%	EUI Ranges (kWh/m^2.yr)			
					Top Quartile (1% - 25%)	2nd Quartile (26% - 50%)	3rd Quartile (51% - 75%)	Bottom Quartile (76% - 100%)
Office Buildings	Large	151	≤185	≤90	≤124	124 - 163	163 - 211	>211
	Medium	121	≤217	≤75	≤110	110 - 142	142 - 225	>225
Hotels	All	89	≤218	≤160	≤187	187 - 219	219 - 270	>270
Retail Buildings	Large	63	≤312	≤124	≤190	190 - 390	390 - 460	>460
	Medium	43	≤326	≤136	≤216	216 - 294	294 - 434	>434
Mixed Developments	All	31	≤224	≤133	≤170	170 - 199	199 - 289	>289

**All: Hotels and Mixed Developments of GFA ≥5,000 m^2;*
**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.*

Profile of Central Chilled Water Air-conditioning Systems

In total, 395 commercial buildings are using central chilled water plants, the majority of which are less than 10 years old.

Chart 4: No. of Buildings by Chiller Age



A total of 271 buildings furnished the data from energy audits. The chart below showed the relationship between the centralised air-conditioning system efficiency and the chiller age.

Chart 5: Chiller System Efficiency by Chiller Age

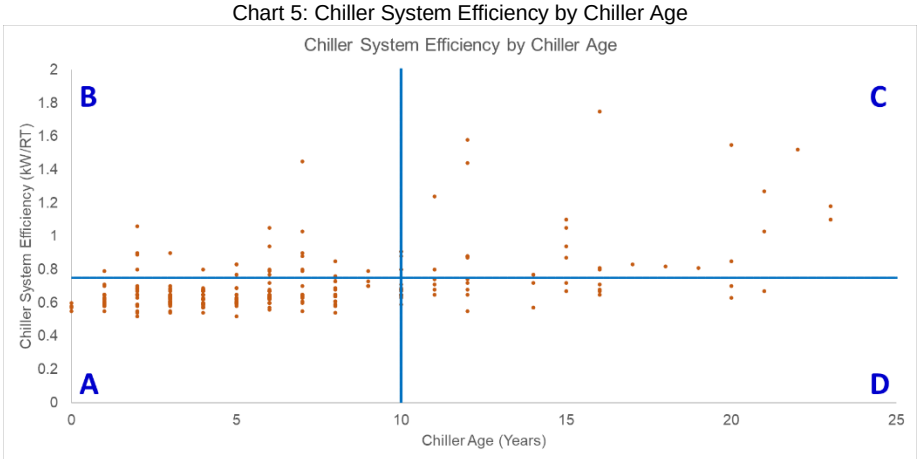


Table 2: Chiller System Efficiency and Chiller Age

Quadrant	Chiller Plant Efficiency (kW/RT)	Age of Newest Chiller	Distribution of Buildings in 2020
A	≤0.75	≤10	72% (196 buildings)
B	>0.75	≤10	11% (29 buildings)
C	>0.75	>10	10% (26 buildings)
D	≤0.75	>10	7% (20 buildings)
		Total	100% (271 buildings)

Section 4

Healthcare Facilities

EUI Trend of Healthcare Facilities

The annual electricity consumption of 67 healthcare facilities (GFA ≥5,000 m^2) has increased at a rate of 103%, compared to the growth of the corresponding GFA at 110% over the period from 2008 to 2020. It was observed that the average EUI for healthcare facilities in 2020 has increased by 3% since 2008.

Table 3: Average EUI Trending for Healthcare Facilities

Healthcare Type	No. of Buildings (in 2020)	Average EUI (kWh/m^2.yr)		
		2015	2019	2020
General Hospital/ Specialist Centre (Public)	12	390	364	365
Private Hospital (Private)	6	367	340	340
Community Hospital	5	116	185	174
Polyclinics	7	142	152	151
Private Clinics	4	229	219	205
Nursing Homes	31	83	91	91

Table 4: Energy Benchmarks of Healthcare Facilities with Bed Spaces

Healthcare Type	No. of Buildings (in 2020)	Average Elect Consumption per Bed Space (kWh/Bed Space)		
		2015	2019	2020
General Hospital (Public)	5	53,477	53,205	53,061
Private Hospital (Private)	6	58,382	58,559	58,438
Community Hospital	5	10,263	13,652	12,885
Nursing Homes	30	3,811	3,850	3,845

Section 5

Educational Institutions

EUI Trend of Educational Institutions

The annual electricity consumption of 41 educational institutions (GFA ≥5,000 m^2) had increased by 9%, compared to the growth of the corresponding GFA at 31% over the period from 2008 to 2020. It was observed that the EUI has lowered by 16% during this period.

Table 5: Average EUI Trending for Educational Institutions

Educational Institution Type	No. of Institutions (in 2020)	Average EUI (kWh/m^2.yr)		
		2015	2019	2020
Universities	10	361	349	324
Polytechnics/ ITE Campus	12	127	121	97
Private Colleges/ Private Schools	19	200	188	175

Section 6

Other Targeted Building Types

EUI Trend of Civic, Community and Cultural Institutions

The annual electricity consumption of 74 civic, community and cultural institutions (GFA ≥5,000 m^2) had increased at a rate of 29%, with the corresponding GFA growth at 29% over the period from 2008 to 2020. Despite the increasing EUI from 2008, the EUI for 2020 is currently the same as 2008.

Table 6: Energy Benchmarks of Civic and Community Institutions

Building Type	Sub-categorisation	No. of Buildings (in 2020)	Average EUI (kWh/m^2.yr)		
			2017	2019	2020
Civic and Community Institutions	Civic Institutions	16	102	106	95
	Community Institutions	51	116	124	109

EUI Trend of Sports and Recreation Centres

The annual electricity consumption of 58 sports and recreation centres (GFA ≥5,000 m^2) had increased at a rate of 56%, compared to the growth of the corresponding GFA at 74% over the period from 2008 to 2020. It was observed that the EUI has lowered by 10% during this period.

Table 7: Energy Benchmarks of Sports and Recreation Centres

Building Type	Sub-categorisation	No. of Buildings (in 2020)	Average EUI (kWh/m^2.yr)		
			2017	2019	2020
Sports and Recreation Centres	Sports Complexes	13	183	177	167
	Recreation Clubs	43	245	218	157

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	**Office building** is a development with premises used as a place of business and for conducting administrative work. **Hotel** is a development used for accommodation purposes on a commercial basis. The predominant use of this development shall be hotel rooms. **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. **Mixed development** is a combination of any of the above three commercial building types. **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). **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. **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. **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.

BCA Building Energy Benchmarking Report 2020