

Singapore's 3rd Green Building Master Plan Moving Forward with Green

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Images by Building and Construction Authority

This article provides an overview of the recently launched 3rd Green Building Master Plan and the key highlights of the inaugural Building and Construction Authority (BCA) Building Energy Benchmarking Report (BEBR) 2014. It will conclude with strategies for the future.

1. Overview of 3rd Green Building Master Plan

In 2005, the Singapore Government embarked on the green building movement by launching the BCA Green Mark scheme. This leading green building rating system in the tropics and sub-tropics serves as a benchmark for evaluating environmental sustainability in buildings. It also formed the backbone of Singapore's first Green Building Master Plan, developed in 2006, to encourage, enable, and engage industry stakeholders to adopt new green buildings.

The second Green Building Master Plan was launched in 2009 to tie in with the report on Sustainable Singapore by the Inter-Ministerial Committee on Sustainable Development (IMCSD). The master plan's focus then shifted to greening the large existing building stock in order to achieve the key target in the IMCSD report for "at least 80 percent of the buildings in Singapore to be green by 2030". With the first and second master plans in place, the green building momentum spearheaded by BCA took off in Singapore and achieved much international recognition.

Since the launch of the BCA Green Mark scheme in 2005, the number of green buildings in Singapore has grown exponentially, from 17 in 2005 to more than 2,100 in 2014. This translates to about 62 million square metres of gross floor area, equivalent to 25 percent

of the total built-up area in Singapore. In 2013, the US-based energy efficiency coalition, Alliance to Save Energy, conferred the International Star award on BCA in recognition of its outstanding achievement in leading the movement to green buildings and improve energy efficiency in Singapore. Singapore is the first country outside of America and Europe to receive this award.

With more than 25 percent of buildings already "greened", BCA began an ambitious plan to accelerate the green building agenda. Launched in 2014, the 3rd Green Building Master Plan was developed to engage building tenants and occupants more actively to drive behavioural changes to lower energy consumption and address their well-being. To formulate the new master plan, BCA held a series of consultations as well as feedback and discussion sessions with key industry players and stakeholders. This included a 3rd International Panel of Experts on Sustainability of the Built Environment (IPE-SBE) in June 2013.

1.1 Three Strategic Goals

The three strategic goals of Singapore's 3rd Green Building Master Plan are: first, **Continued Leadership**; second, **Wider Collaboration & Engagement**; and third, **Proven Sustainability Performance**. The initiatives under the three strategic goals will accelerate the proliferation of green buildings and contribute towards Singapore's overall efforts to provide a quality living environment for its people. In so doing, Singapore also hopes to become a climate-resilient global city that is well positioned for green growth.



1. Three Strategic Goals of Singapore's 3rd Green Building Master Plan

2. BCA Building Energy Benchmarking Report 2014

Singapore's building sector consumes up to 38 percent of the nation's electricity. With a focus on addressing the environmental impact caused by buildings, BCA formulates green building policies to track and improve the energy efficiency of Singapore's built environment under its Green Building Master Plans. These policies have triggered a growing green movement in the built environment, not only in Singapore, but also in the Asian region.

To contribute to enhancing Singapore's energy resilience and reducing emissions from the built environment, BCA released an inaugural building energy benchmarking report in 2014 to spur improvements in building energy efficiency and encourage change in the behaviours and practices of energy consumption in the long term.

2.1 Legislation on existing buildings

BCA effected the landmark legislation for existing buildings and implemented the *Annual Submission of Building Information and Energy Consumption Data* under Section 22FJ of the

Building Control (Amendment) Act 2012 in July 2013. This was carried out in stages starting with offices, hotels, retail buildings, and mixed developments.¹ The data collected and analysed in the inaugural report forms the basis for energy monitoring and national benchmarking. The findings have been shared with building owners to enable them to make more informed decisions and proactively monitor and improve their buildings' energy performance.

To initialise the data collection cycle, the Building Energy Submission System (BESS) platform was created. It provides a seamless online submission process for building owners to submit their building information conveniently. In the first year, building owners are required to provide all necessary information. The submission was streamlined to ease the difficulties of gathering energy consumption data from monthly electricity bills, with BESS extracting this data directly from utilities suppliers. In subsequent years, building owners will only need to update their building information online annually if there are changes.



2. The BESS Landing Page where building owners log in to submit their building information.

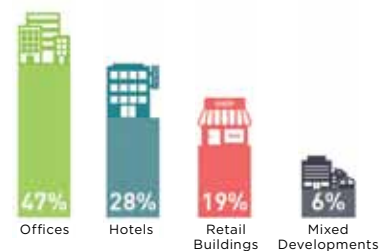
2.2 Overview of Singapore's commercial building stock

In the first year after the introduction of mandatory submission of building data, BCA recorded a total of 954 successful submissions, out of about 1,000 commercial buildings targeted, which was equivalent to an overall compliance rate of 99 percent. Of the 954 submissions, the complete information of 884 buildings, submitted by 31 December 2014, formed the basis of the analysis and benchmarking. By numbers, office buildings made up the majority of submissions at 47 percent, followed by hotels at 28 percent. Retail buildings and mixed developments formed the remaining portions at 19 percent and 6 percent respectively. The total gross floor area of the commercial buildings used for benchmarking purposes was 18.6 million square metres.

An analysis was conducted on the Energy Utilisation Index (EUI) of the commercial buildings.² A five-percent improvement in EUI was observed over the five-year period from 2008. This was attributed to the energy efficiency improvements in the buildings. BCA has been engaging building owners to improve the energy efficiency of their buildings and reduce carbon emissions to the environment. In typical commercial buildings, building owners own and operate the centralised air-conditioning system, common facilities such as lifts and escalators, as well as mechanical ventilation fans, lighting, and plug loads in the common areas.

Riding on the successful adoption of green practices by building owners, the new master plan has shifted its focus to include tenants and occupants. The electricity consumption breakdown of office and retail buildings show

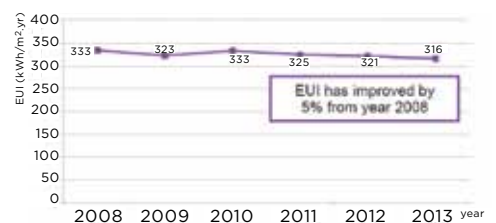
that building owners and tenants account for approximately equal shares of the buildings' total electricity consumption. Hence, tenants can take a more active role in improving the energy efficiency performance within their premises.



3. Percentage breakdown of 884 commercial buildings that submitted their data by building types



4. Percentage breakdown of the total gross floor area (18.6 million m²) of commercial buildings that submitted their data by building types



5. Trend of EUI (2008-2013) of 884 commercial buildings that submitted their building data

≈ 1,000
Offices, Hotels, Retail
Buildings and Mixed
Developments

99%*
Overall Compliance

92% = 884
Building
Analysed

*The full list of submitted commercial buildings can be found at <https://www.bca.gov.sg/BESS/UsefulLinks/UsefulLinks.aspx>



2.3 Data Analysis and Energy Benchmarking
Benchmarking is vital for BCA to monitor the overall progress of energy efficiency upgrades, measure performance, and effectively allocate its resources to attain the national target of greening 80 percent of the built environment. The data collected facilitates analysis of building energy performance, provides unprecedented insight into demand-side trends in energy usage of the entire commercial building stock, and enables an understanding of the operational use behaviour of different building types. The in-depth analytics will also allow BCA to quantitatively compare the energy usage in Green Mark buildings that have incorporated energy efficiency measures with buildings that have not undergone energy efficiency improvements.

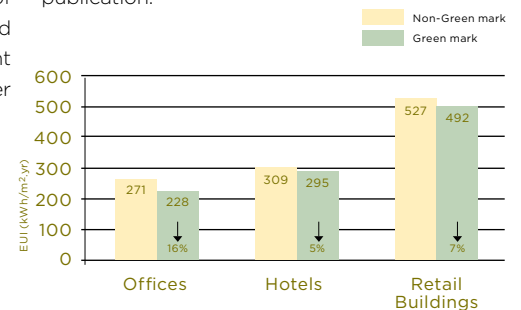
The building energy benchmarking results are shared with building owners via two platforms, through BESS and the BCA Building Energy Benchmarking Report 2014. This will raise the building owners' awareness and spur action

in reducing consumption through low- or no-cost energy-use behavioural changes and/or improve the buildings' energy performances in the long term with green retrofits. By sharing this information with tenants or occupants, building owners can reap cost and energy savings as well as environmental benefits collectively with the occupants.

The energy benchmarking of commercial buildings enables building owners to see how the energy performance of their buildings compares with other similar building types. The four quartiles of the range of EUIs obtained for the four commercial building types are shown. Through the energy benchmarking, it was verified that Green Mark commercial buildings perform better than non-Green Mark commercial buildings.³ The average EUI of Green Mark commercial buildings ranged from 16 percent lower for offices to 7 percent lower for retail buildings and 5 percent lower for hotels.

2.4 Green Buildings: Making Business Sense
BCA carried out a study on 54 retrofitted commercial buildings to quantify the business case for green buildings. The study highlights the benefits of a retrofitted green building, which include a reduction in energy consumption and operating expenses for building owners.

Following a previous study published in 2013 on 40 retrofitted commercial buildings, for the recent study, BCA enlarged the pool of retrofitted buildings studied to 54 to include commercial buildings that have completed the Green Mark assessment in 2013. It was found that an average of 16 percent of savings in total building electricity consumption was achieved, amounting to electricity savings of 120 gigawatt-hours per year, equivalent to about S\$30 million. Information on the 2013 study can be found in the *Build Green* publication.⁴



6. Comparison of average EUI of Green Mark and non-Green Mark certified buildings

EUI by Building Type [kWh/m ² yr]	Top Quartile [1%-25%]	2nd Quartile [26%-50%]	3rd Quartile [51%-75%]	Bottom Quartile [76%-100%]
Offices	164	164-218	218-280	> 280
Hotels	232	232-92	292-359	> 359
Retail Buildings	259	259-405	405-554	> 554
Mixed Developments	212	212-264	264-357	> 357

7. EUI of office, hotel, retail, and mixed buildings at 1st to 4th quartile marks

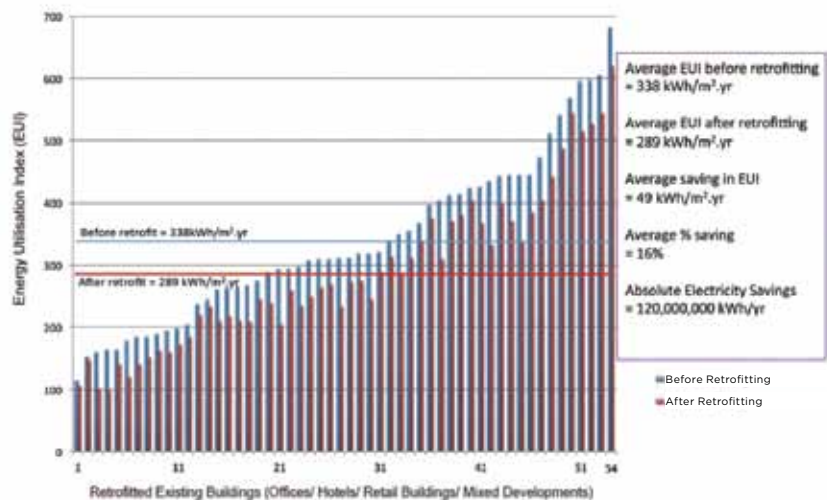
Further insights into the EUI and electricity savings were uncovered by breaking the data down into the various categories of commercial buildings. Retail, office, and mixed developments were shown to achieve a 9 to 13 percent reduction in their annual total building electricity consumption on average after retrofitting. For hotels, the electricity savings were even higher, at 21 percent on average as hotels typically operate 24 hours daily and do not have many tenants within the premises.

In Singapore's tropical climate, air-conditioning typically accounts for about 50 percent of a commercial building's electricity consumption. Thus, there is a strong business case to retrofit an air-conditioning plant if it is no longer energy-efficient. A large portion of electricity savings can be reaped by upgrading to a more efficient central air-conditioning system.

Before retrofitting, the average chiller plant system efficiency of the existing buildings under study stood at an average of 1.05 kW/RT, which was very inefficient. After the retrofit, the chiller plant system efficiency improved tremendously in the range of 7 to 62 percent with an average of 38 percent improvement. The new chiller plant efficiency for most of the 54 buildings was in the range of 0.6 to 0.7 kW/RT. Such performance is comparable to a new building with a chiller plant that has achieved either the Green Mark GoldPLUS or Platinum rating.

3. Strategies Moving Forward

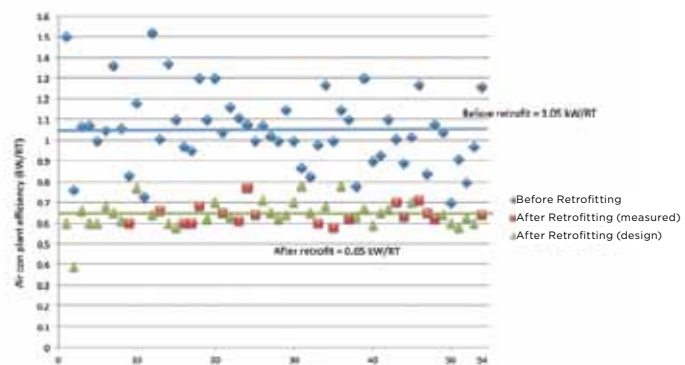
To achieve the target of greening 80 percent of Singapore's building stock by 2030, BCA will continue to engage and assist building owners and occupants to lower their energy consumption and reduce the carbon footprint.



8. EUI of retrofitted existing buildings in 2014 study before and after retrofitting

Building Type	No. of Buildings	EUI Before Retrofit (kWh/m ² .yr)	EUI After Retrofit (kWh/m ² .yr)	Percentage Improvement	Average percentage Improvement
Retail Buildings	10	411-680	369-619	5-17 %	9 %
Offices	25	114-366	106-339	3-37 %	13 %
Hotels	10	163-444	98-403	14-40 %	21 %
Mixed Developments	9	195-511	160-440	6-23 %	13 %

9. Percentage improvement of EUI of retrofitted existing buildings in 2014 study after retrofitting



10. Plant efficiency of retrofitted existing buildings in 2014 study before and after retrofitting

3.1 Voluntary and mandatory energy disclosure

A wider and more comprehensive pool of building energy data will be collected and shared. BCA will phase the inclusion of other building types, such as institutions and healthcare facilities, for the annual mandatory submission. This is to provide a more comprehensive and holistic overview of the building energy performance of Singapore's built environment.

In line with the 3rd Green Building Master Plan's strategic goal of proven sustainability performance, BCA will leverage the continual benchmarking efforts and encourage better energy-performing building owners to display their building's energy certificate at prominent public locations. With greater awareness of the benefits of good building energy performance, potential buyers and tenants are able to compare the operational costs of buildings with a view to lowering their future operating expenditure.

Through extensive information sharing, BCA hopes to drive the demand for green buildings among potential buyers and tenants. The growing demand for green buildings is prevalent in European Union cities, where the disclosure of a building's energy certificate is mandated at the transactional stage and potential buyers and tenants are generally more willing to buy or lease more energy-efficient buildings.

3.2 Incentivising building owners and tenants

A new S\$50 million Green Mark Incentive Scheme for Existing Buildings and Premises (GMIS-EBP) has been introduced to

encourage building owners and tenants to undertake and adopt energy efficiency improvements within their buildings and premises.


3.3 Financial assistance schemes

The Building Retrofit Energy Efficiency Financing (BREEF) scheme is a financing programme, introduced by BCA in collaboration with participating financial institutions, to assist building owners in overcoming the high cost of carrying out energy efficiency retrofits upfront. BREEF was piloted in a two-year trial for non-residential buildings with centralised air-conditioning plants. This financing scheme has since been extended for another two years and enhanced to include residential building owners and a loan default risk share of 60 percent, up from 50 percent previously, for BCA.

3.4 Promoting occupant-centric initiatives

To encourage the sustainability efforts of tenants, BCA has streamlined the application of Green Mark occupant-centric schemes through the Green Mark Portfolio Programme, which lets tenants certify similar spaces across a portfolio of buildings that share uniform standards in interior design and construction, as well as operations and management.

The programme targets: organisations that have multiple units or outlets in different locations; or multiple tenants within a single building using shared and common building systems and facilities, such as the air-conditioning system, lighting design and fittings, or other applicable common facilities. Additionally, to complement the above

occupant-centric schemes, BCA recently rolled out a Green Lease Toolkit to guide building owners and tenants in their collaborative efforts to maintain the environmental sustainability standards of their premises. With this guide, BCA aims to raise awareness of practices to improve or maintain a building's energy efficiency. This would drive the appreciation of valuation and demand for green buildings among building owners and tenants. 

- 1 The four building types are defined. An office building is a development with premises used as a place of business and for conducting administrative work. A hotel is a development used for accommodation purposes on a commercial basis whose predominant use shall be hotel rooms. A 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. A mixed development is a combination of any of the above three commercial building types.
- 2 Energy Utilisation Index (EUI) measures the total energy consumed in a building in a year expressed as kilowatt-hours (kWh) per square metre (m²) of gross floor area.
- 3 Average Energy Utilisation Index (EUI) is the weighted average of the energy utilisation indices of buildings, calculated based on electricity consumed, using gross floor area as the weightage factor.
- 4 Building and Construction Authority, "Dollars and Sense of Retrofitting", *Build Green 4* (2013): 12-14, www.bca.gov.sg/GreenMark/others/BGreen_4_2013.pdf.

Top Buildings by EUI by Building Type

Using the first year's benchmarking results, the top 10 buildings for each building type were identified based on a comparison of their EUI. These top performers have successfully sustained the energy performance of their buildings and serve as exemplars for the building sector.

Top 10 government offices

- 1 Connection One
- 2 Environment Building
- 3 Health Promotion Board
- 4 JTC Summit
- 5 Ministry of Manpower HQ
- 6 Ministry of Manpower Services Centre
- 7 Monetary Authority of Singapore
- 8 Supreme Court
- 9 Tourism Court
- 10 Treasury

Top 10 private offices

- 1 AXA Tower
- 2 City House
- 3 Concourse
- 4 Equity Plaza
- 5 Icon @ IBP
- 6 Keck Seng Tower
- 7 Keppel Tower & GE Tower
- 8 Mapletree Business City
- 9 Tampines Grande
- 10 Tong Eng Building

Top 10 hotel developments

- 1 Copthorne King's Hotel
- 2 Crowne Plaza Changi Airport Hotel
- 3 Furama Riverfront
- 4 Grand Hyatt Singapore
- 5 Holiday Inn Singapore Orchard City Centre
- 6 M Hotel Singapore
- 7 Novotel Singapore Clarke Quay
- 8 Park Avenue, One Rochester
- 9 Regent Singapore
- 10 Swissotel Merchant Court

Top 10 retail developments

- 1 Bukit Timah Plaza
- 2 City Square Mall
- 3 Ngee Ann City
- 4 OG Orchard Point
- 5 Parklane Shopping Mall
- 6 Parkway Parade
- 7 Plaza Singapura
- 8 The Star
- 9 Wisma Atria Shopping Centre
- 10 Building A*

Top 10 mixed developments

- 1 Adelphi
- 2 Atrium @ Orchard
- 3 Concorde Hotel & Shopping Mall
- 4 Harbourfront Centre
- 5 International Plaza
- 6 Mitsubishi Electric Building
- 7 Palais Renaissance
- 8 Tang Plaza
- 9 United Square
- 10 Wheelock Place



City Square Mall, retail development, Green Mark Platinum award.



Swissotel Merchant Court, hotel development, Green Mark Platinum award.



Mapletree Business City, private office building, Green Mark Platinum award.



Ministry of Manpower Bendemeer Services Centre, government office building, Green Mark Platinum award.



Connection One, government office building, Green Mark Platinum award.



Palais Renaissance, mixed development, Green Mark Platinum award.