

MEDIA RELEASE

HEALTHIER AND GREENER BUILDINGS IN NEXT LAP OF SINGAPORE'S GREEN BUILDING JOURNEY

- *New research study by BCA and NUS show that BCA Green Mark buildings have better Indoor Environment Quality*
- *Market opportunities for firms with expertise in designing and delivering green buildings*
- *International Panel of Experts endorses strategies towards super low energy, zero and positive energy buildings in Singapore*

12 September 2017, Singapore – The Building and Construction Authority (BCA) has reviewed its 3rd Green Building Masterplan. New initiatives arising from this review will be rolled out in phases, to enhance the indoor environment quality for occupants, encourage high energy efficient buildings as well as greening existing buildings and spaces. These were announced by Guest-of-Honour, Mr Desmond Lee, Minister for Social and Family Development, and Second Minister for National Development, at the opening of the Singapore Green Building Week (SGBW) 2017.

BCA Green Mark buildings provide healthier indoor environment

2 A research study conducted by BCA and the National University of Singapore (NUS) on **Indoor Environmental Quality (IEQ)** found that, besides being more energy efficient, BCA Green Mark buildings also provide a healthier indoor environment for its occupants. The study observed that occupants in Green Mark buildings were more satisfied with their indoor environment and were less likely to experience sick building syndrome symptoms. The results of the study will help BCA refine its criteria for future BCA Green Mark schemes. For a start, BCA will pilot a new set of criteria for the **Green Mark for Existing Non-Residential Buildings GM ENRB: 2017** scheme for one year, which include enhanced requirements for building owners to improve the IEQ for its occupants as well as adopt smart control systems to operate the buildings. For example, the building owner could make use of ventilation strategies that regulate the amount of fresh air intake into a building. *(Refer to Annexes A & B for details)*

3 In addition, BCA is exploring with the Health Promotion Board (HPB) to develop a new Green Mark scheme to encourage good designs such as the provision of energy efficient lighting and office equipment (the “hardware”) as well as the development of workplace health-related programmes (the “software”) to encourage healthy practices

amongst office occupants. The new scheme aims to get companies to consider the health and well-being of their occupants when designing both interior fit-outs and provisions of the offices, as well as the workplace health programmes and policies for the workers. *(Refer to Annex C for details)*

4 BCA Chief Executive Officer, Mr Hugh Lim said, “BCA continues to work with stakeholders to green our built environment. In addition to our focus on energy and resource efficiency, it is timely for us to consider how good design in green buildings can impact occupants’ health and sense of well-being. Making such benefits clear to building users will better engage them as champions of change in promoting green practices at homes, offices and schools. This will strengthen the impetus for developers and building owners to create greener and healthier spaces for the end-user.”

Greater transparency of building energy performance data can create demand for green building services

5 Since 2013, BCA has progressively required commercial buildings, healthcare facilities and educational institutions to submit building information and energy consumption data annually. The latest findings show a **9% improvement in the overall Energy Use Intensity (EUI) of these buildings in 2016** compared to 2008, with more significant improvement over the last five years. *(Refer to Annex D for details)*

6 To allow building owners to be aware of their building’s energy performance vis-à-vis other buildings of similar types, this year BCA will **disclose the energy performance data of commercial buildings** whose owners have voluntarily agreed to publicly disclose their buildings’ data. This will cover about three-quarters of all commercial buildings in Singapore and is a follow on from last year’s round of anonymised disclosure. Such data disclosure aims to encourage building owners and facilities managers to consciously adopt cost-effective measures for their buildings and also with their tenants, to reduce the energy footprint of their buildings. The energy data is made available on [BCA’s website](https://www.bca.gov.sg) and [Singapore’s open data portal](http://www.data.gov.sg/)¹. BCA will next be approaching healthcare facilities and educational institutions to voluntarily disclose their energy performance data from 2018. *(Refer to Annex E for details)*

7 Greater transparency of building energy data will increase demand for green buildings and its related services. With this, green building firms can expect more market opportunities both locally and regionally in areas such as energy audits and environmentally sustainable design. The availability of building energy performance data could also spur the research community and companies to study ways to advance green building solutions in Singapore and the region.

8 The continued growth in demand for green building design and technologies has been identified as a key trend in the Construction Industry Transformation Map (ITM)

¹ BCA’s website: <https://www.bca.gov.sg/BESS/BenchmarkingReport/BenchmarkingReport.aspx>
Singapore’s open data portal: <http://www.data.gov.sg/>

which is currently being developed. To meet the increasing demand for green buildings, BCA has revised its target **to train 25,000 green building professionals by 2025** (from the previous target of 20,000 by 2020). To date, about 16,000 professionals, managers, executives and technicians (PMETs) have been trained by the Institutes of Higher Learning, BCA Academy and the industry associations.

International experts endorse strategies to further push green building boundaries

9 In the lead up to SGBW 2017, BCA convened an International Panel of Experts meeting on Sustainability in the Built Environment (IPE-SBE) from 6 – 8 September to seek experts' views and review Singapore's green building initiatives. The panel included high performance green buildings expert Mr Stephen Selkowitz from the Lawrence Berkeley National Laboratory, behavioural change expert Ms Sonja Graham from Global Action Plan, and IEQ expert Prof. Shinichi Tanabe from Waseda University, Japan, as well as other prominent overseas and local experts. *(Refer to Annex F for list of experts)*

10 The IPE agreed that Singapore has made significant progress in its green building movement since the BCA Green Mark was launched in 2005. They also endorsed Singapore's efforts to further engage building occupants to enhance health and well-being, and push boundaries to spur the development of positive-energy low-rise, zero-energy medium-rise, and super low-energy high-rise buildings (PE-ZE-SLEB) in the tropics, including BCA's ongoing efforts with the industry and research institutions to develop a technology roadmap to support this long term aspiration. *(Refer to Annex G for details)* Mr Selkowitz said, "Singapore's significant progress in the green building arena over the past 12 years is commendable. I am confident that with the strategies in place and its plans for the future, BCA and its partners will be able to overcome challenges to achieve zero and positive energy buildings that are greener and healthier".

11 The week-long SGBW, which starts from 11 Sept will see a range of events targeted at industry professionals, academics, students, and end-users. The IGBC, themed "Build Green: Be the Change" is the anchor event of the week, and will be held from 12 – 14 September in conjunction with the Bex Asia and MCE Asia exhibitions, organised by Reed Exhibitions.

Issued by the Building and Construction Authority on 12 September 2017

Enclosed:

Annex A: Factsheet on BCA-NUS Research Study on Indoor Environmental Quality
Annex B: Factsheet on GM ENRB: 2017
Annex C: Factsheet on BCA-HPB Green Mark Scheme
Annex D: Factsheet on Building Energy Benchmarking Report 2017
Annex E: Factsheet on Voluntary Disclosure of Building Energy Performance Data
Annex F: Factsheet on PE-ZE-SLEB Technology Roadmap
Annex G: International Panel of Experts on Sustainability in the Built Environment

About BCA

The Building and Construction Authority (BCA) of Singapore champions the development of an excellent built environment for Singapore. BCA's mission is to shape a safe, high quality, sustainable and friendly built environment, as these are four key elements where BCA has significant influence. In doing so, it aims to differentiate Singapore's built environment from those of other cities and contribute to a better quality of life for everyone in Singapore. Hence, its vision is to have "a future-ready built environment for Singapore". Together with its education arm, the BCA Academy, BCA works closely with its industry partners to develop skills and expertise that help shape a future-ready built environment for Singapore. For more information, visit www.bca.gov.sg.

ANNEX A: FACTSHEET ON BCA-NUS RESEARCH STUDY ON INDOOR ENVIRONMENTAL QUALITY

Background

With the 3rd Green Building Masterplan placing greater emphasis on user engagement and well-being, BCA has collaborated with NUS (Prof Tham Kwok Wai as principal investigator) on a research study on Indoor Environmental Quality (IEQ*) since 2014.

*IEQ refers to the quality of a building's environment in relation to the health and well-being of those who occupy space within it.

Objective

The BCA-NUS research study investigates IEQ performance in BCA Green Mark buildings in comparison with buildings without Green Mark certification. The findings of the study will be used to enhance IEQ criteria in future versions of the BCA Green Mark scheme.

Key Findings

8 Green Mark and 6 Non-Green Mark office buildings located in different part of Singapore, were analysed on the outcomes of objective measurement (using various IEQ instruments) and subjective measurement (occupant survey) data collected over one week per building.

The key findings are as follows:

- BCA Green Mark buildings achieve energy savings by regulating ventilation rate (CO2 level) in addition to the use of energy efficient systems and design
- With higher performance filters, Green Mark buildings can filter out fine particulates such as PM2.5 and bacteria more effectively than Non-Green Mark buildings.
- In the survey carried out with the occupants, those in Green Mark buildings were more satisfied with the temperature, humidity, lighting, air quality and indoor environment, compared to occupants in Non-Green Mark buildings
- When benchmarked against Non-Green Mark buildings, the occupants in Green Mark buildings are less likely to experience sick building syndrome symptoms such as unusual fatigue, headache and irritated skin.

Conclusion:

- BCA Green Mark buildings are more energy efficient and provide healthier indoor environment than non-Green Mark buildings.
- Occupants in Green Mark buildings are more satisfied with their indoor environment and have less risk of experiencing sick building syndrome symptoms.

ANNEX B: FACTSHEET ON THE BCA GREEN MARK FOR EXISTING NON-RESIDENTIAL BUILDINGS GM ENRB: 2017

Background

The BCA Green Mark Scheme was launched in January 2005 as a yardstick to rate the environmental sustainability of buildings in the tropics and to stimulate the growth of green buildings in Singapore. It aims to set parameters and establish indicators to guide the design, construction and operation of buildings towards higher energy efficiency and enhanced environmental performance.

The scheme started as a green building rating tool for new and existing residential and non-residential buildings. It has since been extended to a total of 18 schemes (see Table A) to also promote environmental sustainability beyond buildings, as well as green occupant-centric spaces within buildings.

Since the first version of the Green Mark for Existing Non-Residential Buildings scheme in 2005, the scheme has undergone continued enhancements to keep pace with improvements in technology, building standards and industry best practices. The industry has also shown marked transformation over the years both in driving sustainable operations and practices, as well as achieving higher energy efficiency standards in the retrofit of existing buildings.

As the standards in the BCA Green Mark mature, and with the last iteration, Version 3 implemented since 2012, it is timely for BCA to review and enhance the scheme to stay relevant and to push the boundaries for better energy and environmental performance standards.

Objectives

BCA hopes to establish GM ENRB: 2017 as the leading green building rating tool in the tropics and sub-tropics for existing buildings. It will also accelerate Singapore towards the national target of 'greening' 80% of buildings in Singapore by 2030.

Extensive Industry and Stakeholder Engagement

BCA has worked closely with the industry to review the scheme and developed the **Green Mark for Existing Non-Residential Buildings (GM ENRB: 2017), which will be launched at the International Green Building Conference in September 2017 for one year of piloting.**

A total of **14 industry taskforces and workgroups** were formed. These were co-chaired by BCA and leading industry experts and **comprised over 70 industry members**. A **series of 8 industry consultations and dialogues** on the draft criteria were also held since February 2017 and **attended by more than 430 industry stakeholders, from public agencies, building owners, facility managers, consultants and industry associations** such as the Singapore Green Building Council (SGBC), The Institution of Engineers, Singapore (IES), Association of Consulting Engineers Singapore (ACES), Real Estate Developers' Association of Singapore (REDAS), International Facility Management Association (IFMA) Singapore Chapter, Singapore Institute of Architects (SIA), Singapore Institute of Surveyors and Valuers (SISV) and the Singapore Hotel Association (SHA).

Strong industry participation and involvement provided a practical dimension to the scheme and empowered industry professionals with the ownership to strive for better building performance.

Enhancements and Key Highlights of GM ENRB: 2017

To align with the latest Green Mark Schemes for New Non-Residential and Residential Buildings (GM NRB: 2015 and GM RB: 2016), the GM ENRB: 2017 criteria has been similarly re-structured into the following five sections for consistency and to facilitate easier understanding of the sustainability outcomes by stakeholders: ***(i) Sustainable Management, (ii) Building Energy Performance, (iii) Resource Stewardship, (iv) Smart and Healthy Building, and (v) Advanced Green Efforts.***



Key highlights of the criteria include:

- (a) Greater Tenant and Occupant Engagement.** Tenants and occupants play an important role in sustainable building operations. In line with the 3rd Green Building Masterplan, GM ENRB: 2017 encourages greater tenant and occupant engagement through green leases, green user and fit-out guides, as well as participation in Green Building Committees and green-related activities.
- (b) Performance-based Procurement for Retrofit and Maintenance.** GM ENRB: 2017 hopes to promote sustainable building management by awarding credit points to buildings for engaging SGBC-accredited Energy Performance Contracting (EPC) firms² to implement energy improvement works with an energy performance contract, as well as maintenance of the chilled water air-conditioning and air distribution systems' efficiencies through a performance-based maintenance contract.
- (c) Energy Efficiency of Air Distribution Systems.** Air distribution systems have been identified as an area with high potential energy savings. Hence, the GM ENRB: 2017 hopes to encourage building and facility managers to

² For more details, pls refer to www.sgbc.sg/sgbc-certifications/2-uncategorised/479-epc-certification.

measure and understand the performance of their air distribution systems and take actions to improve or maintain the system efficiency.

(d) Uptake of Renewable Energy. Solar energy remains the most promising renewable energy source for Singapore. To drive solar adoption, GM ENRB: 2017 encourages projects to conduct a feasibility study on the building’s solar energy generation potential. Credit points are also awarded to other PV-related features like roof leasing for solar PV installation and purchasing of energy from renewable sources.

(e) Enhanced Indoor Environment Quality (IEQ). The health and well-being of building occupants is a key area under the 3rd Green Building Masterplan. Based on findings and recommendations from the BCA-NUS research project on indoor environment quality, the GM ENRB: 2017 promotes good practices such as the use of high-efficiency filters in air distribution systems and permanent sensors to monitor indoor air pollutants such as formaldehyde and particulate matters. Higher-tier GM projects are also to conduct a post occupancy evaluation survey to provide insights to the building and facility managers on improving occupant comfort.

(f) Adoption of Smart Control Technologies. Last but not least, the next level of improvement in efficiency and productivity will come from operating a building ‘smartly’ through technology. Aligned with Singapore’s ambition to become a Smart City, smart building controls and strategies are introduced in GM ENRB: 2017 in areas of energy monitoring, demand control as well as integration and analytics.

The GM ENRB: 2017 scheme presents a more holistic and market-friendly approach to ‘greening’ existing buildings in Singapore. The scheme aims to future-proof existing buildings, drive incremental improvements in energy efficiency and other sustainable parameters, and guide building owners to take practical improvement measures towards achieving total building performance.

TABLE A - List of Green Mark Schemes

New Buildings
<ul style="list-style-type: none"> ➤ BCA Green Mark for New Non-Residential Buildings ➤ BCA Green Mark for New Residential Buildings ➤ BCA Green Mark for Landed Houses ➤ BCA Green Mark for Healthcare Facilities ➤ BCA-IMDA Green Mark for New Data Centres
Existing Buildings
<ul style="list-style-type: none"> ➤ BCA Green Mark for Existing Non-Residential Buildings ➤ BCA Green Mark for Existing Residential Buildings ➤ BCA Green Mark for Existing Schools ➤ BCA-IMDA Green Mark for Existing Data Centres
Beyond Buildings
<ul style="list-style-type: none"> ➤ BCA-NParks Green Mark for New Parks ➤ BCA-NParks Green Mark for Existing Parks ➤ BCA Green Mark for Infrastructures ➤ BCA-LTA Green Mark for Rapid Transit System (RTS) ➤ BCA Green Mark for District
Within Buildings
<ul style="list-style-type: none"> ➤ BCA Green Mark for Office Interior ➤ BCA Green Mark for Restaurants ➤ BCA Green Mark for Supermarkets ➤ BCA Green Mark for Retail

ANNEX C: FACTSHEET ON BCA-HPB GREEN MARK SCHEME

Background

In recent years, there is an **increasing focus on occupants' health and well-being as the value proposition for green buildings and interior spaces**. In line with global trend, the BCA Green Mark has been placing greater emphasis on quality of indoor environments as well as the health, comfort and well-being of the users and occupants in the newer GM versions for New Non-Residential Buildings (GM NRB: 2015), New Residential Buildings (GM RB: 2016) and Existing Non-Residential Buildings criteria (GM ENRB: 2017). Moreover, we observed greater demand on the ground for green and healthy buildings, both from the landlords and tenants alike.

To **strengthen the business case for energy-efficient, resource-efficient and healthier interior spaces**, we are exploring with the Health Promotion Board (HPB) to develop a new Green Mark scheme. This new joint scheme aims to encourage upstream infrastructural changes and provisions ("hardware") and softer workplace health-related programmes ("software").

Upstream infrastructural changes and provisions and workplace health-related programmes can include energy efficient lighting and office equipment, office fit-out design and layout, selection of internal finishing and furnishings, water efficient fittings, recycling facilities, greenery, exercise facilities and access to healthier food and drink options etc.

Target Audience

As Singaporeans are increasingly interested in taking charge of their own health, the new joint scheme will include additional **wellness features and will cater to tenants who wish to position themselves as the employer of choice in the office setting**. We expect the new joint scheme to appeal to companies that place emphasis on both health and well-being, in addition to environmental sustainability.

More details of the joint scheme will be made available in mid-2018.

ANNEX D: FACTSHEET ON BCA BUILDING ENERGY BENCHMARKING REPORT (BEBR) 2017

Background

BCA took a momentous first step towards greater transparency in building energy performance information through the release of the annual BCA Building Energy Benchmarking Report (BEBR) in 2014.

Objective

With the release of the BEBR annually, BCA hopes to raise awareness among stakeholders of the performance of our buildings, spur positive action at all levels to initiate and implement improvements in building energy efficiency, drive change to energy consumption behaviour and embrace sustainable best practices as we move forward. This will further encourage the growth of green economy through driving demand for green buildings, thereby opening up market opportunities for green solutions and services.

Other than bridging the information gap for the industry, the data are also used to review BCA's Green Mark scheme and green building policies. This year's report continues to share findings on the energy performance of **commercial buildings, healthcare facilities and educational institutions**.

Target Audience

The national building energy benchmarks are set yearly and the report benefits stakeholders at all levels:

- Building Owners, Facilities Managers, and Tenants. Raise awareness of energy performance of their buildings and drive action to improve performance standards
- Consultants and Designers. Generate or refine new ideas, designs and best practices in designing/ retrofitting a green building
- The Government. Monitor energy consumption and efficiency of buildings and provide insights to support formulation of appropriate measures
- Research and Education Communities. Spur further research and studies to advance green building technologies and solutions for the future

The BEBR is available at BCA's website or Singapore's open data portal from 12 September 2017 onwards:

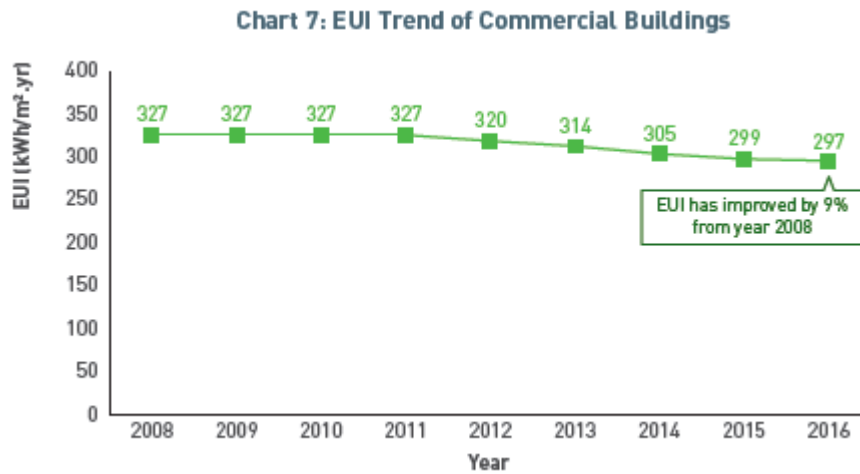
(<https://www.bca.gov.sg/BESS/BenchmarkingReport/BenchmarkingReport.aspx> or <http://www.data.gov.sg>).

Commercial Buildings

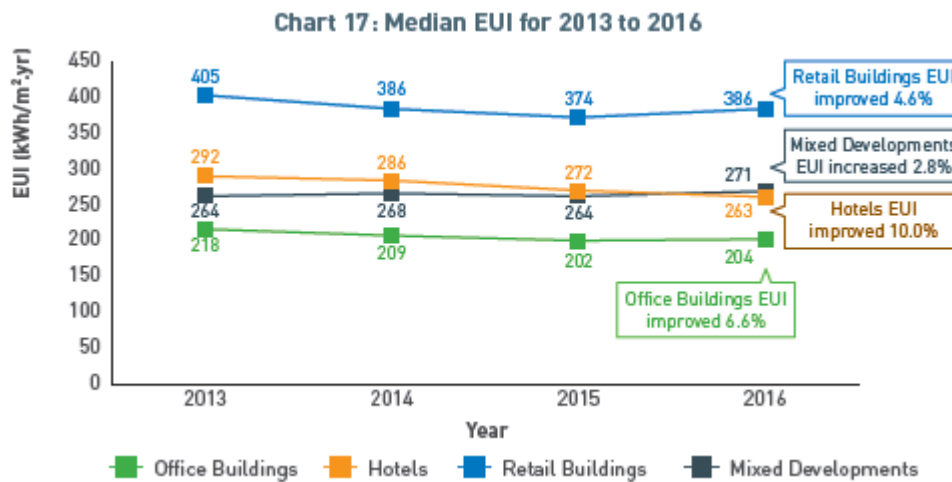
Building Energy Performance Trends

- Overall, the **commercial buildings continued to perform well with a 9% improvement in the energy use intensity (EUI) from 2008 to 2016**.
 - Hotels showed most significant improvement in energy performance.
 - It was observed that more commercial buildings are operating on newer and efficient building cooling systems.

EUI Trend of Commercial Buildings



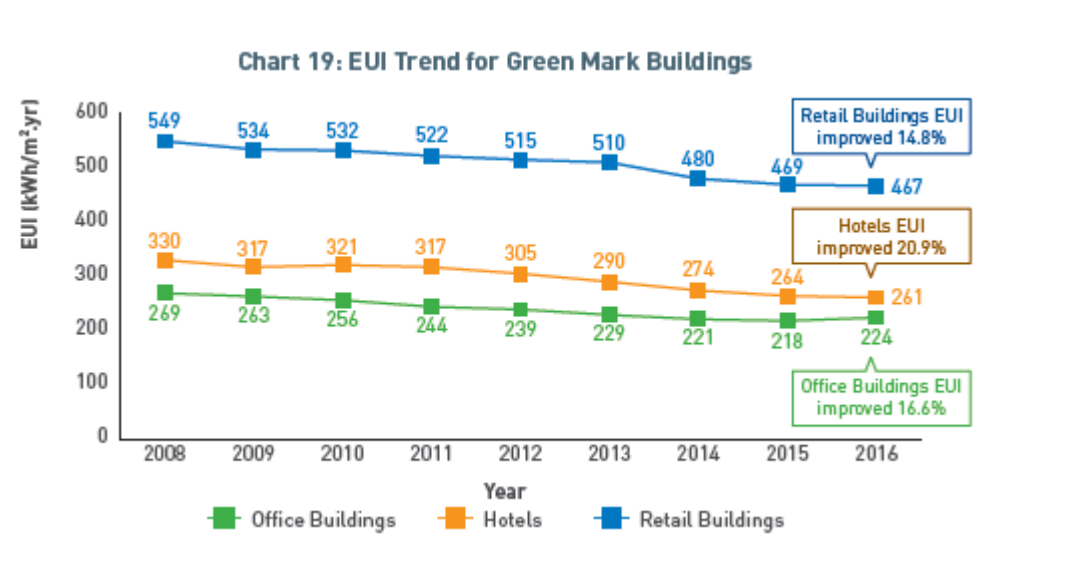
Median EUI Comparison Study for Commercial Buildings



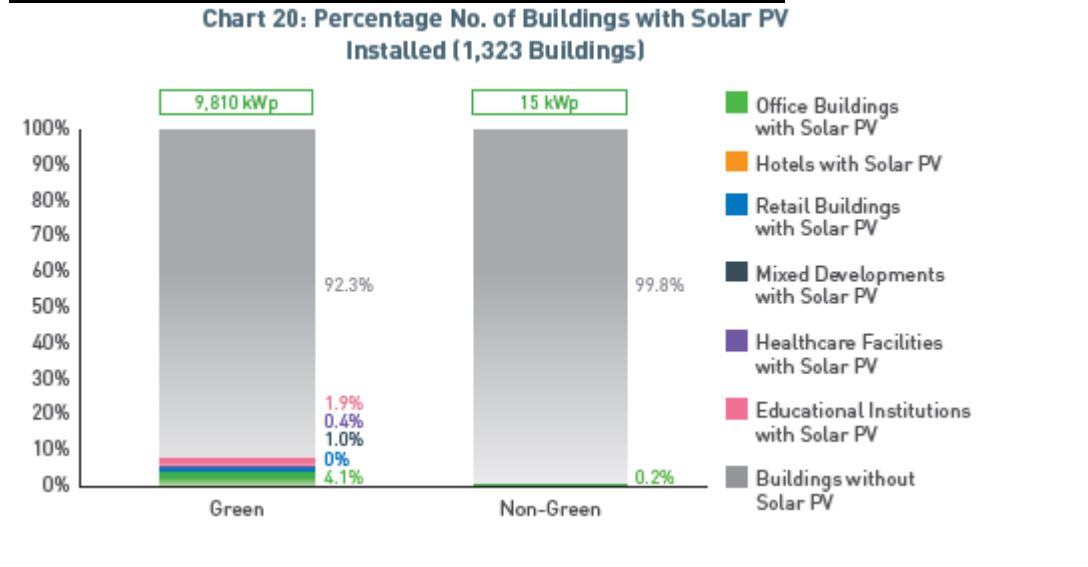
Energy Performance of Green Mark vs Non-Green Mark Commercial Buildings

- One notable finding is that **Green Mark commercial buildings continued to sustain better performance, ranging from 3% to 14% lower EUI, as compared to non-Green Mark commercial buildings of similar characteristics.**
- In addition, **the average EUI has improved substantially over the period 2008 to 2016, by up to 21% for the hotel category.** For hotels, it was observed that both the Green Mark and non-Green Mark hotels were performing almost equally well. This could be due to the long operating hours of the business where the operators will want the building to be run efficiently. Beyond energy savings, other aspects of environmental sustainability are also taken care of within a Green Mark hotel.
- **BCA Green Mark scheme also drives solar PV adoption.**

EUI Trend of Green Mark Commercial Buildings



Breakdown of Solar PV Installed by Building Types



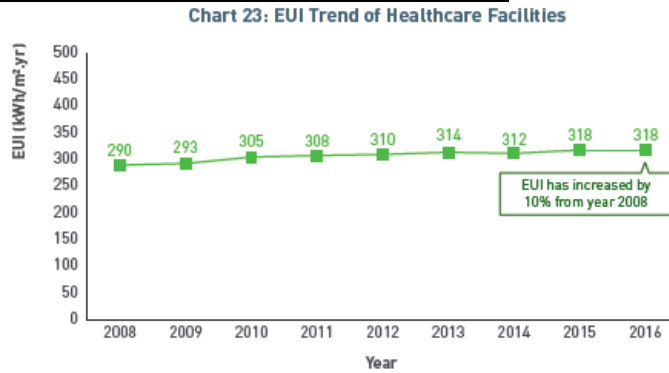
Building Owners and Tenants Energy Consumption Relationship in Commercial Buildings

For the fourth year, the breakdown of building owners' and tenants' electricity consumption showed an almost equal share of the total buildings' electricity consumption. Additionally, it was observed that the **proportion of the retail tenants' electricity consumption had increased as compared to that of 2015**. There is scope for building owners to work closer with their tenants to reduce their energy footprint.

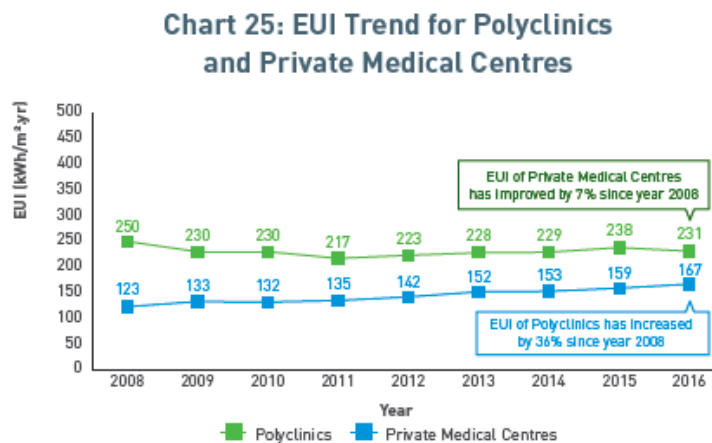
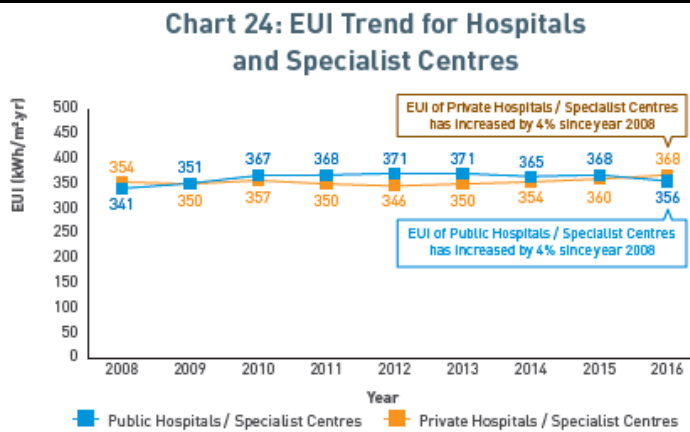
Healthcare Facilities

- The **EUI of healthcare facilities has increased by 10% from 2008**. With the growing demand for sophisticated healthcare services, there will be a need for hospitals, specialist centres and polyclinics to place greater emphasis on energy efficiency

EUI Trend of Healthcare Facilities



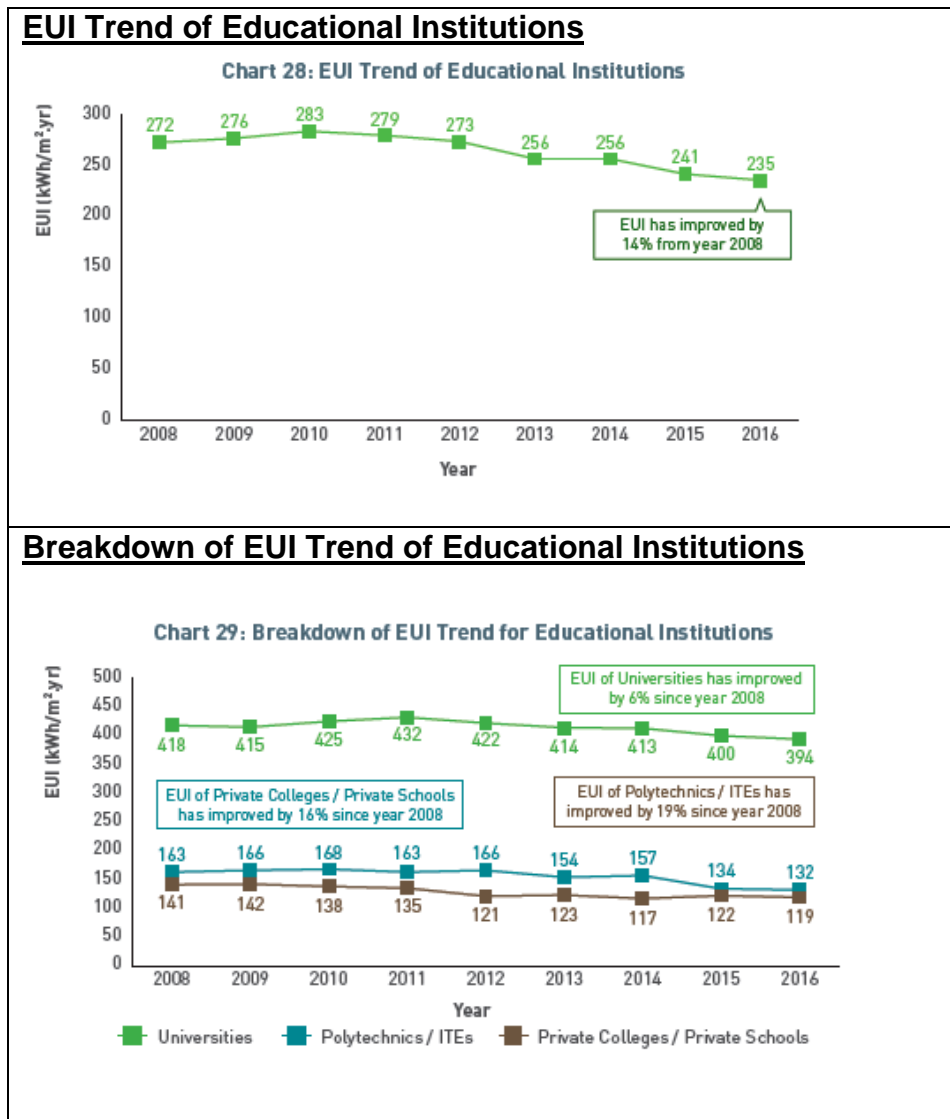
Breakdown of EUI Trend of Healthcare Facilities



Educational Institutions

- The **EUI of educational institutions has shown an improvement of 14% from 2008.**
- One reason could be that for public schools, which are covered under Government's Public Sector Taking the Lead in Environmental Sustainability (PSTLES) initiative, new and existing public buildings are required to attain higher Green Mark ratings.
- For private colleges and schools, it was observed that 70% of the GFA has been greened.

- In addition, some tertiary institutions have initiatives such as campus wide stakeholder engagement programmes that aim to reduce the overall energy use.



Next Steps

Continuous Outreach to Building Owners

With better understanding of building energy performance, **a more targeted approach could be deployed to engage owners and building users** so as to raise awareness about their building energy performance and encourage energy improvement actions. BCA will continue in this direction, with an added **focus on driving behavioural change**.

Disclosure of Building Energy Performance Data

In 2017, the first set of energy performance data for commercial buildings was released, on a voluntary basis, through BESS and Singapore's Open Data Portal, data.gov.sg. In addition, BCA is planning for the pipelined mandatory disclosure to allow more data to be shared in the public domain in the coming years.

ANNEX E: FACTSHEET ON VOLUNTARY DISCLOSURE OF BUILDING ENERGY PERFORMANCE DATA

Background

Last year, BCA released the energy performance data of commercial buildings in an anonymised manner. This year, owners of 76% of the commercial buildings have volunteered to name their buildings and indicate their energy performance.

Objective

The aim is to improve transparency and raise awareness of our buildings' energy performance, so as to present opportunities for building owners to reap potential saving from energy improvements. Companies could also ride on the chance to expand their reach in green solutions and services. Collectively, this would reduce the carbon footprint of the built environment.

Target Audience

With the voluntary disclosed data, owners, their facilities managers and users, and even members of the public can be more aware of the energy performance of individual buildings.

Phased Disclosure of Building Energy Performance

The three phases for public building energy performance disclosure are:

- (i) Phase 1 - Mandatory submission and small sample voluntary disclosure
BCA implemented the legislation on annual mandatory submission of building information and energy consumption data since 2013. Using the data collated, the top 10 commercial buildings for each building type have been named, with consent from the building owners, in the annual BCA Building Energy Benchmarking Report (BEBR) since 2014. The corresponding Energy Use Intensity (EUI) of these buildings were not released.
- (ii) Phase 2 - Anonymised disclosure and large sample voluntary disclosure
BCA has released anonymised building energy performance data of all commercial buildings publicly for the first time in 2016. The released data include the building type, size (large/small), Green Mark rating (yes/no) and the corresponding EUI.

The first set of commercial building data for voluntary disclosure will be released in September 2017. At this phase, the data released would cover the building name and address, type, size (Gross Floor Area), Green Mark (rating and year of award), and the corresponding EUI. For commercial building owners who did not volunteer, their building data would remain anonymised.

These data will be made available via BCA's Building Energy Submission System (BESS) website and Singapore's open data portal, data.gov.sg, from September 2017. The table below presents a sample of the data. The voluntary disclosed dataset will include the following parameters:

- Building Name
- Building Address
- Building Type

- Green Mark Status (Rating and Year of Award)
- Building Size (GFA)
- Energy Use Intensity (kWh/m².yr)

Additionally, BCA will work towards implementing voluntary disclosure for healthcare facilities and education institutions from 2018.

(iii) Phase 3 - Mandatory disclosure

BCA is planning for the pipelined mandatory disclosure to allow more data to be disclosed on public domain in the coming years.

The voluntary disclosed dataset is available on BCA's website or Singapore's open data portal from 12 September 2017 onwards:

(<https://www.bca.gov.sg/BESS/BenchmarkingReport/BenchmarkingReport.aspx> or <http://www.data.gov.sg>).

ANNEX F: FACTSHEET ON TECHNOLOGY ROADMAP FOR POSITIVE ENERGY, ZERO ENERGY AND SUPER LOW ENERGY BUILDINGS (PE-ZE-SLEB) IN SINGAPORE

Background

The Zero Energy Building at the BCA Academy (ZEB@BCAA) launched in 2009 was the first net zero energy office building in Singapore. Retrofitted from an existing building within the campus, the ZEB created a living demonstration for energy-efficient buildings and technologies. It has placed Singapore on the world map of net zero energy buildings, and it continues to operate at net zero energy as of today.

According to Navigant Research, the global ZEB market is projected to grow from less than USD 100 billion in 2016 to USD 1.4 trillion by 2035. The trend, notably, is led by rapid advancements of technologies and governments' sustainability agenda. This has led to a significant increase in demand and reduction of cost for renewable energy technologies, such as Photovoltaics (PV), and energy efficient equipment.

In 2016, BCA shared the aspiration of achieving Positive Energy, Zero Energy and Super Low Energy Buildings (PE-ZE-SLEB) in Singapore. In a survey conducted by BCA with the industry in Jul 2017, 124 respondents from the industry, academia and stakeholders gave positive responses to the aspiration, with 74% of the participants supporting or strongly supporting the development of a PE/ZE/SLEB policy in Singapore. This indicated the strong interest and willingness of participation by local stakeholders, as evidenced by several ZEB developments launched recently³.

Development of the PE-ZE-SLEB Technology Roadmap

To examine the opportunities and challenges of implementing PE/ZE/SLEB, BCA embarked on a study on the **PE-ZE-SLEB Technology Roadmap** since 2016. This study aims to map out pathways towards achieving PE-ZE-SLEB via development, demonstration and application of technologies, with a focus on cost-effective and implementable solutions. A consultative approach has been adopted with multiple industry consultation sessions, stakeholders' roundtable workshops and surveys. The study was conducted in collaboration with research institutes NTU-ERI@N and NUS-SERIS and industry partners, with funding support from the Green Buildings Innovation Cluster (GBIC) and National Research Foundation (NRF). BCA plans to seek further comments from the local and overseas experts at the IGBC-Roundtable Discussion Workshop.

Key Features of the PE-ZE-SLEB Roadmap

- Integration and updating of the Building Energy Efficiency R&D Roadmap (2014) and Solar PV Roadmap (2014);
- Developed a definition of PE-ZE-SLEB for the urban and tropical context of Singapore;
- Evaluated technological feasibility of achieving PE-ZE-SLEB in Singapore;
- Identifying 40 key technologies required in terms of technical performance and cost effectiveness;
- Recommending future R&D directions on technology development and translation into applications;
- Recommending strategies to drive adoption of PE-ZE-SLEB and capture potential values for the industry

³ Examples of net zero developments- NUS' School of Design and Environment (SDE 4) building, Singapore Sustainability Academy (SSA) at City Square Mall rooftop, CDL Gallery at Botanic Gardens.

ANNEX G: INTERNATIONAL PANEL OF EXPERTS FOR SUSTAINABILITY IN THE BUILT ENVIRONMENT

Co-Chairs:

- (1) **Mr. Hugh Lim**
Chief Executive Officer, Building and Construction Authority
- (2) **Mr. Tai Lee Siang**
Chairman, World Green Building Council
- (3) **Mr. Tan Swee Yiow**
President, Singapore Green Building Council

Immediate Past Chairs:

- (4) **Er. Lee Chuan Seng**
Emeritus Chairman, Beca Asia Singapore
Honorary Advisor & Founding President, Singapore Green Building Council

International Members:

- (5) **Mr. Stephen Selkowitz**
Senior Advisor, Lawrence Berkeley National Laboratory

Stephen Selkowitz is a Senior Advisor for building science, and the group leader of the windows and envelope materials group in the building technology and urban systems division at the Lawrence Berkeley National Laboratory. He is an internationally recognized expert on window technologies, façade systems, and daylighting, often collaborating with R&D teams worldwide. He has authored/co-authored over 170 publications, 3 books and holds 2 patents.

- (6) **Ms. Sonja Graham**
Managing Partner, Global Action Plan

Sonja Graham is a behavioural change expert, specialising in behavioural programmes that reduce environmental impact. As managing partner of global action plan, Sonja focuses on scaling GAP's profile and impact.

- (7) **Prof. Shinichi Tanabe**
Professor, Waseda University

Prof Shinichi Tanabe is professor under the department of Architecture, Waseda University, specializing in Architectural Environmental Engineering. He is a renowned international expert on indoor environmental quality and recipient of the 2016 Pettenkofer award which recognizes advance work on indoor environmental science.

- (8) **Dr Wolfgang Kessling**
Director, Transsolar Energietechnik GmbH

Dr Wolfgang Kessling is a climate engineer and expert for integral planning with special focus on low energy-high comfort concepts for buildings in hot and humid climates. He was involved in high profile sustainable projects throughout Europe, Middle East and Asia. In Singapore, he was involved in the climate and energy concept of the cooled conservatories in the Gardens by the Bay.

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- (10) **Prof. Lam Khee Poh**
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- (11) **Dr. Stephen Tay**
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- (12) **Mr. Etienne Drouet**
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- (13) **Mr. Jeffrey Chua**
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- (14) **Mr. Heah Soon Poh**
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- (15) **Dr. Johnny Wong**
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- (18) **Mr. Lim Fatt Seng**
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- (19) **Mr. Franklin Po**
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- (20) **Ms. Jennifer Yap**
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- (21) **Dr. Lena Chan**
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4th IPE-SBE Industry Representatives

- (1) **Mr. Chia Ngiang Hong**
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- (2) **Ms. Lynette Leong**
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- (3) **Mr. Allen Ang**
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- (4) **Mr. David Hutton**
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- (9) **Er. Edwin Khew**
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- (10) **Mr. Tan Szue Hann**
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