CONTENTS

GREEN HIGHLIGHTS

02 The Green Building Policy Agenda
04 CDL: Building Eco-Leadership
06 Jem™ scores GM Platinum V4.0
09 Green Lease – The Way Ahead

BUILDING INDUSTRY CAPABILITIES THROUGH TRAINING

17 Requirement for Permanent Measurement and Verification

SPURRING THE PRIVATE SECTOR

PROMOTING R&D IN ENVIRONMENTAL SUSTAINABILITY

11 Green Mark GFA Incentive Scheme - Gaining Popularity Among Developers
12 Greater Incentive to Retrofit Buildings

14 Blueprint for Sustainable Construction
16 Case Study: More Upcycling - Precast Concrete Plank (PCP) for Site Construction Access

18 How far are we from our national target of 80%?
As a small city-state with an open economy, Singapore is particularly vulnerable to the consequences of climate change. Hence, greening the built environment is part of our nation’s commitment to build a sustainable environment for our people. In addition, as a responsible member of the global community, we are also playing our part to reduce the global carbon footprint.

Globally, buildings consume about 40% of the world’s energy, and emit approximately one-third of greenhouse gas (GHG) emissions. As such, green buildings are key to Asia’s future because they offer the greatest potential to reduce the amount of GHG emissions, and also promote sustainable developments in the long run.

It was with these in mind that we started the magazine, “Build Green”, that you are reading now. Build Green is dedicated to sharing knowledge on Asia’s green building movement, green building policy agenda, outstanding green building design and operation practices, green innovations, as well as updates on environmental sustainability in Singapore and the region. Through this publication, you will be able to gain insights into the green building movement in Asia, and we hope that they will inspire or take you further on your own green building journey.

Indeed, when BCA started our green building movement in 2005, the industry was curious if the movement could really take off in Singapore. It is a reality that Singapore is a small country in the tropics with heavy reliance on energy intensive air conditioning, and there are not many professionals with in-depth ‘green’ building knowledge. Singapore is also a ‘late comer’ in green buildings compared to countries such as UK, US and Australia.

Well, seven years on, our achievements and progress show “We Can Do” it. With BCA’s comprehensive Green Building Masterplan and the Green Building R&D Roadmap, we have achieved several significant milestones internationally. The BCA Green Mark Scheme is recognised as one of the twenty-one green building rating systems in the world. We received the Aspen Institute Energy and Environment Award in 2010 as well as the World Green Building Council (WGBC) Government Leadership Award – Regional Leadership Award in 2011. Singapore and BCA have also achieved many firsts; we were ranked first in Asia Pacific for Green Building Policy and first in Asian Green City Index. The Zero Energy Building@BCA Academy is also the first zero energy building in South East Asia retrofitted from an existing building.

I am pleased to present to you the premiere issue of Build Green magazine. This issue brings you interesting and useful articles on the Green Building Policy Agenda, System Measurement and Verification, Green Lease and details on enhancements to the Green Mark Gross Floor Area (GM GFA) scheme and the Green Mark Incentive Scheme for Existing Buildings (GMIS-EB).

Lastly, the International Green Building Conference (IGBC) and BEX Asia Exhibition 2012 will be held from 10th – 12th October in Singapore. Participants will gain valuable knowledge and learning points from international top green building professionals and advocates. The IGBC itself is a very good international networking platform for like-minded people. BCA will also be sharing details on the new legislation on Existing Building and updates on the Green Mark criteria for new buildings at IGBC.

So, see you there!

Dr John Keung
Chief Executive Officer
GREEN BUILDINGS IN SINGAPORE

Green Mark Building Projects in Singapore (Cumulative)

The green building movement in Singapore gained momentum here after the launch of the BCA Green Mark scheme in 2005.

Singapore is one of the greenest cities in the world in terms of certified green building floor area per capita.

With an ambitious target set by the government in 2009 to ‘green’ at least 80 percent of all buildings in Singapore by 2030, the Building and Construction Authority (BCA) has led this island-wide green transformation through its Green Building Masterplan.

Public sector buildings have taken the lead to go green to get higher ratings under the Green Mark certification scheme. Attractive incentive and training programmes were launched to encourage the greening of buildings and building the industry’s capabilities. Legislations were put in place in 2008 for new buildings to meet the minimum environmental sustainability standard.

Greening Existing Buildings

After the greening of new buildings took off, BCA started focusing its efforts on greening existing buildings which make up the bulk of the building stock. BCA introduced a $100 million Green Mark Incentive Scheme and the Building Retrofit Energy Efficiency Financing (BREEF) Scheme to encourage building owners to upgrade their existing buildings to be more energy efficient.

Recently, the drive to green existing buildings received a further boost when legislation was passed to get existing buildings to meet minimum Green Mark standards when they retrofit their cooling systems. Correspondingly, BCA will require a three-year energy audit on building cooling systems and an annual submission of building information and energy consumption data by building owners.

“The Singapore is among the first few countries to legislate the greening of new buildings nationwide. With further legislations just announced to green existing buildings, Singapore has become first in the world to mandate minimum environmental sustainability standards for existing buildings.”

– Dr John Keung, CEO BCA.
Over the years, BCA has been widely recognised as a green building leader in the region. BCA has also been working with countries like China and Bahrain to develop local green building capabilities. BCA has also helped to develop the local green building standards in other cities and countries, including the Tianjin Eco-City Green Building Evaluation Standard in China.

In 2011, the United Nations Environment Programme (UNEP) was so impressed with Singapore’s efforts in green buildings that it signed an MOU with BCA to set up a collaborating centre to drive greater adoption of sustainable buildings within the region.

The BCA’s Green Mark scheme has now been adapted for use in more than 10 countries.


On the R&D front, BCA’s Zero Energy Building (ZEB), which is Southeast Asia’s first ZEB retrofitted from an existing building, also shown impressive results, achieving a net zero energy consumption for three years of operation since its opening in October 2009.

Beyond Buildings
The BCA Green Mark scheme has come a long way in helping Singapore achieve environmental sustainability since 2005. The Scheme has extended beyond buildings to include more aspects of the built environment, e.g. districts, parks, infrastructure, rapid transit systems.

In addition, more emphasis is now placed on engaging the community such as tenants and homeowners to change their energy use behaviour so that they can play an integral part in keeping buildings green. For example, the Green Mark for Office Interior launched in 2009, and the Green Mark for Restaurants introduced in 2011 further inculcate a user-centric green building movement. Three other user or occupant-centric Green Mark schemes will be launched in October. They are Green Mark Scheme for Data Centres, Retail and Supermarkets.

International Recognition
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“\nThe WorldGBC’s ‘Regional Leadership Award’ recognises the outstanding vision and commitment of Singapore’s Building and Construction Authority. We congratulate the Singapore Government for developing a Masterplan that sets minimum environmental standards for building codes, provides incentives for the private sector and promotes research, development and capacity building. Singapore’s achievements clearly demonstrate that green building is not only achievable, but also affordable and practical.\n
– Jane Henley, CEO of World GBC”
MR KWEK LENG JOO, MANAGING DIRECTOR OF CITY DEVELOPMENTS LIMITED (CDL), SHares with BUILD GREEN ON HIS COMPANY’S ENVIRONMENTAL SUSTAINABILITY JOURNEY.

How has the industry evolved following the introduction of the BCA Green Mark Scheme in 2005?

Mr Kwek: In the early years, when it was a voluntary scheme, CDL faced challenges with green expertise and also buy-in from industry stakeholders. But today, I am glad that we persevered and continued to encourage and lead fellow players in the built industry to embrace sustainability.

Since the BCA Green Mark Scheme (minimum certification standard) was made mandatory in 2008, there is certainly a heightened awareness within the industry on the importance of environmental conservation and sustainability. Now, there are more than 1,000 Green Mark building projects in Singapore, and that number continues to grow every year. This can only be a good thing – in the end, the real winner is our built environment.

How has CDL benefitted from this industry transformation?

Mr Kwek: As the industry in Singapore begins to transform with growing awareness of the importance of sustainability, CDL as an early adopter, has enjoyed both intangible and tangible benefits.

In terms of intangible benefits, CDL’s brand and reputation as a leading green developer has been enhanced both globally and locally. On the other hand, tangible benefits are seen when the returns on investment from our green buildings are reflected in the reduced use of natural resources (both during construction and the life-cycle of the building), financial savings from reduced water and energy usage and even the possible increased capital value of the developments.

Would you like to share CDL’s journey in adopting BCA Green Mark Schemes?

Mr Kwek: As early as the late-1990s, CDL has been leading the industry by introducing eco-features in its developments. We were convinced that green properties should not only be eco-friendly to build but should incorporate green features to mitigate the environmental impact of the building’s lifespan.

With this goal in mind, we launched our first Eco-Condo, Savannah CondoPark in November 2002, which embraces several technological firsts, including the first photovoltaic panels in a condominium in Singapore to power the lights and water-heater in the clubhouse. Since then, CDL’s properties have incorporated many features including the dual chute pneumatic waste collection system, pre-fab toilets and dry walls.

In 2005, when the Scheme was introduced, we were committed to attaining the Green Mark Award for all new CDL developments. Since 2011, CDL has also raised our target of attaining at least a Green Mark Gold rating to a minimum Green Mark GoldPlus rating for all new developments.

A special edition Nature Calendar for 2012 paid tribute to CDL’s corporate green philosophy by featuring a collection of its BCA Green Mark properties.
MAKING THE RIGHT GREEN MOVES

How have your Green Mark-certified projects performed financially?

Mr Kwek: Beyond a reduction in our carbon footprint, CDL approximates that some $19.7 million cost savings from electricity alone annually will be saved from our 37 Green Mark awarded buildings between 2008 and 2011. Efficiency gains in buildings are likely to provide the greatest energy reductions and in many cases will be the most economical option.

Although the green economy is still in its infancy and demand for green buildings is only just starting to grow, we hope that our position as a pioneering green developer will give us a first-mover advantage when the age of socially responsible consumerism dawns. Besides being selected as an index component in the Dow Jones Sustainability Indexes both worldwide and in Asia Pacific in 2011, CDL has also been listed on the FTSE4Good Index Series since 2002, a global benchmark for socially responsible investments. This makes CDL the only Singapore developer to be listed on both indices.

What new green innovations can we expect in your future projects?

Mr Kwek: One of our recently launched innovative projects is an exclusive 96-unit terrace housing development called HAUS@SERANGOON GARDEN. Approximately 4% of the total construction cost was invested into the development of the estate’s green innovations which is expected to result in up to 40% energy savings for each house.

Going forward, how would CDL continue to differentiate itself as a green developer against its competitors?

In 2003, we articulated CDL’s firm commitment to being a green and responsible developer with the establishment of the Environmental, Health and Safety policy to create a ‘Safe and Green’ culture. The policy sets the strategic direction for all departments, and all CDL employees are committed to improving the company’s environmental performance.

Innovation is a key driver in all of CDL’s operations as we seek to differentiate our products and services. New technology is constantly explored and reviewed for adoption into our products whenever possible. Apart from engaging in collaborative initiatives with our builders and consultants, we also leverage on collaborative partnerships with educational institutions, government agencies, technology providers and manufacturers for R&D.
The Jem™ by Lend Lease became the first mixed-use development in Singapore to achieve BCA Green Mark Platinum Version 4.0. The project, located at Jurong Lakeside, comprises a retail mall to be completed in the second quarter of 2013, and an office tower to be completed in fourth quarter 2013.

The award recognizes the project’s outstanding green design features as well as its ability to influence sustainable outcomes through its integrated property value chain, from the design and development stage right through to the construction and property management stages.

"Achieving the BCA Green Mark Platinum Award based on the version 4 criteria is a significant milestone in making Jem™ one of the most sustainable mixed-use assets in Singapore," said Mr Rod Leaver, CEO Asia of Lend Lease. "We are honoured to add these latest awards to the other BCA Green Mark Platinum Awards we previously received for 313@somerset and Parkway Parade in the new buildings category and existing building category respectively. More importantly, it is fulfilling for us to contribute directly to Singapore’s green-building targets."
The other awards that Lend Lease received include the BCA Green Mark Platinum (office fitout) for Lend Lease’s Asia regional headquarters at 60 Anson Road, and the BCA Green & Gracious Builder award in the ‘Star’ category, which is the highest tier in this scheme.

The new office space at Jem™ consists of a large floor plate design, and makes extensive use of ‘sky-rise’ greenery to reduce heat loads on the building facade. At the same time, the office design incorporates a dramatic side atrium to deliver natural light into the office space, reducing the need for artificial lighting near the perimeter areas of the floor plate. The atrium will be activated by a suspended interconnecting stair, minimizing the need for staff to rely on lifts to travel between adjacent floors, further improving energy savings for the new office.

Other key green features of Jem™ include the following:

A) Energy Savings
Jem™ is expected to cut down on energy consumption by 13 GWh, or 31.8% annually. This overall energy saving, equivalent to that generated by about 2,400 HDB apartments annually is achieved through special features. One of these is a highly efficient multi-tier chilled water plant system achieving a state-of-the-art system efficiency at 0.55 kW/RT. Other features include a highly demand-responsive air-side system, regenerative lifts and the extensive use of LED lighting.

B) Water Savings
The project will see a reduction in water consumption of about 250,000 cubic metres annually, equivalent to the volume of about 100 Olympic-sized swimming pools.

C) Significant Green Features
Some of the green features that can be expected at Jem™

- High-performance building envelope by adopting highly insulated, low-E double glazing spandrel back panels
- External shading provided by the Cascading Sky Park and Sky Terraces
- Deep dehumidification PAHUs with double-stage cooling
- Innovative two-stage fresh air treatment
- Carbon dioxide sensors to optimise the supply of fresh air in the development
- Transitional zones at the entrances to the development
- Harvesting of rainwater for reuse in landscape irrigation and sanitary purposes
- Water usage monitoring
- High-efficiency water fittings
- Condensate water recovery
- Cool air heat recovery
D) Cascading Sky Park
Spread across three floors of the Jem™ building is the Cascading Sky Park located from the fifth to the seventh levels. It will serve as the building’s ecological and communal heart, providing a variety of passive and active recreational spaces that the community can enjoy. This includes children’s play spaces, meeting areas, quiet reflection zones, a cafe and an area focusing on bio-diversity and education.

In creating the Cascading Sky Park, Lend Lease collaborated with a number of government organizations and retail tenants to create a space that the community can enjoy for years to come.

“We support the URA’s green replacement strategy. When completed, Jem™ will achieve 124 per cent green replacement back into the building, far exceeding the 100 per cent green replacement requirements mandated by the URA. These green spaces are designed into meaningful recreational spaces which the community can enjoy” said Lend Lease Project Development Director, Mr Chris Brown, who oversees the Jem™ mixed-use project.

E) Green Lease
Besides designing and constructing a sustainable building, Lend Lease encourages occupiers to operate in a sustainable manner for a truly sustainable outcome. All retailers at Jem™ will be required to operate under Lend Lease’s Green Lease model, which encourages retailers to make use of highly efficient lighting systems, adopt recycling strategies and reduce overall tenancy waste.
A GREEN LEASE FORMS PART OF A BUILDING’S SOFTWARE TO ENGAGE TENANTS TO SHARE THE SUSTAINABILITY RESPONSIBILITY WITH THE BUILDING OWNER.

Today, there are over a thousand buildings that are Green Mark certified in Singapore. A green building would not be operating optimally just by relying on its ‘hardware’, or green features. It also needs the ‘software’, such as green leases, to influence tenants to join in the sustainable operation and maintenance of the building, thus maximising the green performance of the building.

The concept of a green lease is fairly new in Singapore although it has been established in Australia, Canada, South Africa, United Kingdom and United States of America. The green lease toolkits from various countries can be found in the web links below.

<table>
<thead>
<tr>
<th>COUNTRIES</th>
<th>WEB LINKS</th>
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</thead>
<tbody>
<tr>
<td>Canada</td>
<td><a href="http://www.realpac.ca/?page=GreenLeaseGuidefo">http://www.realpac.ca/?page=GreenLeaseGuidefo</a></td>
</tr>
<tr>
<td>United Kingdom</td>
<td><a href="http://www.betterbuildingspartnership.co.uk/media/toolkits/">http://www.betterbuildingspartnership.co.uk/media/toolkits/</a></td>
</tr>
<tr>
<td>United States of America</td>
<td><a href="http://sustainca.org/green_leases_toolkit">http://sustainca.org/green_leases_toolkit</a></td>
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</table>

The mechanism of green lease, as recommended by various green lease toolkits, can be in the form of a Memorandum of Understanding (MoU), or a Green Lease Schedule to specify the provisions in operating and maintaining the leased premises. The MoU should include clauses for sharing of data and other relevant information between building owners and tenants. The MoU should also include the formation of a Building Management Committee, which comprises representatives of the building owner, tenants and any other persons involved in operating and maintaining the building, as a forum for reviewing and revising any environmental management plan for the building.

With desired green practices widely adopted by the tenants, the building owner will be able to better monitor the performance and maintain the building. Ideally in such arrangement, the building owner can share the utilities savings with the tenants directly through lower rental rates or rebates. Other intangible benefits include gaining or upholding a reputation for their contribution towards environmental sustainability.

Case Study on Australia’s Green Lease Schedule
The 50 Marcus Clarke Street building, owned by Walker Corporation, was leased to the Department of Education, Employment and Workplace Relations (DEEWR) on a gross lease basis. In this lease arrangement, the Walker Corporation is responsible for the day-to-day operation and cost of operating and maintaining the plant and equipment such as the heating, ventilation and air conditioning systems (HVAC) and electrical systems, while DEEWR pays for cleaning, its internal lighting and power use, light bulb replacement and waste removal. Apart from this energy cost division, the Australian Government Green Lease Schedule was included in the gross lease agreement to set out the objectives and means for the building owner and tenants to optimise the energy efficiency elements in the building.

Walker Corporation was involved since the start of the early design stages, by engaging an accredited energy assessor and forming a Building Management Committee to ensure that the design could meet the Green Lease Schedule standards. The Building Management Committee, which consists of representatives from DEEWR, Walker Corporation, energy assessors, the building contractors and the operator of the Building Management System (BMS), met monthly to review the BMS reports in relation to operation issues, with focus on energy consumption.

With the joint efforts, the average energy consumption of 50 Marcus Clarke Street building is well below the Energy Efficiency in Government Operation policy target rating for tenant, and the benefits of this low average energy consumption was shared between Walker Corporation and DEEWR through lower operational costs to both. Walker had noted that a A$10 less per square metre operational budget of the building as compared to the lowest operating cost expressed in the Property Council of Australia latest figures for buildings within Canberra, as shown in Figure 1.

Figure 1: Operation Cost Comparison
Source of Case Study and Graph: Department of Climate Change and Energy Efficiency
Singapore’s First Green Lease

The first green lease implemented in Singapore was at 313@somerset, owned by Lend Lease. Lend Lease wanted to encourage and enable its tenants to put in place green initiatives aligned with its own sustainability aspirations and values.

The green lease at 313@somerset included the Technical Design Guidelines to provide tenants with the sustainable fit-out elements and the Centre Management House Rules, which contained sustainability initiatives to govern the tenants’ daily operations, including monitoring of tenants’ energy use and incentives for tenants who maintained a set level of energy consumption.

Lend Lease would review its tenants’ actual fit-out plans and conduct on-site checks regularly. With the green lease in place, tenants have managed to save about 20% to 30% of energy usage.

What 313@somerset Tenants Say

"As part of our agreement in the “Green Lease”, we installed LED lightings for our outlet at 313@somerset. Although the lightings cost more at setup, but it is nearly maintenance-free and have helped save in long term operational costs as they use nearly 80% less energy than normal light bulbs. Witnessing the savings and benefits, we may adopt this practice in future in our other outlets."

Ms Evelyn Lam, Operations Manager, THEFACESHOP

"At Brotzeit®, we are committed to uphold sustainability standards, from the usage of materials in the construction of our store to the constant efforts taken by our staff to ensure that the green guidelines are met. Signing a Green Lease with 313@somerset is a reaffirmation of our efforts to help keep the earth green."

Mr Sean Flynn, CEO, Brotzeit®

Lend Lease’s Green Lease

• Provides Technical Design Guidelines for sustainable fit-out elements
• Provides Centre Management House Rules for sustainability initiatives to govern tenants’ daily operations
• Reviews tenants’ actual fit-out plans and conduct on-site checks

While other major building owners are still studying the feasibility of implementing green leases for their developments, Lend Lease, with the success of 313@somerset, has plans to adopt similar concept of green lease with tenants for their new retail mall Jem™ at the Jurong Gateway.

The Way Ahead

Moving forward, BCA is placing more emphasis on tenants’ involvement in the green movement by introducing Green Mark schemes to cater for different types of tenants. For a start, building owners and tenants can refer to the guidelines on Green Mark for Office Interior, Green Mark for Restaurant and the soon-to-be launched Green Mark for Retail, Green Mark for Supermarket and Green Mark for Data Centre, for tenants’ involvement in sustainable operation and maintenance of green building, to better appreciate the beauty of green lease.
Recent Enhancements

In consultation with the industry, BCA has introduced enhancements to the scheme on 2 July 2012.

1. Extending GM GFA scheme to existing buildings that undergo substantial upgrading to achieve higher GM ratings

   Existing buildings demonstrating substantial improvements in the environmental performance and achieving at least the same high GM standards under 'New Building' category will be considered under the GM GFA scheme. This is applicable to buildings 10 years and above and must not be previously incentivized under similar incentive schemes.

2. Streamlining GM GFA application process to shorten approval time

   To address industry’s feedback on shortening the processing time for GM GFA application, BCA will now require applicants to submit a letter of commitment to fulfil all necessary obligations for the GM certification. This letter will help to reduce clarifications arising from the GM GFA application. Full submission for subsequent GM assessment will still be required as part of the GM certification process.

For more information on the GM GFA incentive scheme, please visit


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GREEN MARK GFA INCENTIVE SCHEME HAS SEEN A GROWTH IN THE NUMBER OF APPLICATIONS.

On 29 April 2009, BCA introduced the Green Mark Gross Floor Area (GM GFA) incentive scheme to accelerate the progress of sustainable development in Singapore. Under the scheme, developers are granted additional GFA beyond the Master Plan Gross Plot Ratio when their buildings achieve higher-tier BCA Green Mark ratings of Platinum and GoldPlus.

Three years down the road, BCA has received a total of 92 applications, of which 57 projects have obtained URA’s planning approval of more than 35,000m² of bonus GFA.

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GRANTED BONUS GFA

GM GFA TRENDING

Trending of GM GFA Applications - Based on Development Type (As at Oct 2012)

- Commercial
- Hotel
- Industrial
- Institution
- Mixed Developments
- Condominiums/Apartments

GREEN MARK RATING
- Platinum - 36 projects
- GoldPlus - 35 projects

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Financial consideration appears to be one of the key barriers for existing building owners to upgrade energy performance of their buildings. That is why BCA has enhanced its Green Mark Incentive Scheme for Existing Buildings (GMIS-EB) to make it even more economically viable for existing building owners to bring forward their energy efficiency retrofits.

The scheme, first introduced in April 2009, co-funded up to 35% or $1.5 million of the approved energy efficient equipment cost, whichever was lower. It is applicable to existing private non-residential buildings with a central cooling system, and gross floor area of 2,000m² and above.

Since 26 July 2012, BCA has raised the co-funding rate to 50% and increased the cap amount to $3 million. The co-funding scope has also been expanded to include cost of installing the energy-efficient equipment and engaging professional services.

To spur building owners to achieve higher energy efficiency standards, BCA has modified the qualifying criteria to require buildings to attain higher Green Mark ratings beyond the basic certified level under the revised Green Mark for Existing Non-Residential Buildings (GM ENRB) Version 3; and achieve the specified cooling system efficiency.

To ensure existing applicants are not left out, BCA has extended the enhanced scheme to all existing applicants who have yet to receive any disbursement in the current scheme. These applicants can opt to attain the higher Green Mark ratings and be re-assessed under the new GM ENRB Version 3 or choose to remain in the current scheme.

An Overview of the GMIS-EB Enhancement

<table>
<thead>
<tr>
<th>Green Mark Requirement (Based on GM ENRB Version 3)</th>
<th>Co-funding Rate (Supply and installation cost of energy efficient equipment and professional services)</th>
<th>Cap on Total Incentive Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold or better GoldPlus or better Platinum</td>
<td>35%</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>0.70 or better</td>
<td>40%</td>
<td>$2,250,000</td>
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<tr>
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<td>50%</td>
<td>$3,000,000</td>
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</tbody>
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For more information on Green Mark Incentive Scheme for Existing Buildings, please visit http://www.bca.gov.sg/GreenMark/gmiseb.html or contact Ms Wendy Li at 6730 4422 (or email: wendy_li@bca.gov.sg), Mr Halim at 6325 5082 (or email: md_halim_anapi@bca.gov.sg) or Ms Archana at 6325 5095 (or email: archana_balasubramaniam@bca.gov.sg)
From 26 July 2012, existing non-residential buildings applying for Green Mark certification will be assessed under the new Green Mark for Non-residential Buildings (GM ENRB) Version 3. GM ENRB criteria have gone through two revisions; the last revision was in 2009 with Version 2.1. A grace period of about 2 months was given for buildings that opt to be assessed under Version 2.1 to submit their applications by 30 Sep 2012.

Version 3 places more emphasis on the building system energy efficiency. For example, more stringent requirement for chiller plant efficiency to encourage use of more efficient air-conditioning equipment and to minimize energy consumption. The pre-requisites to attain Gold, GoldPlus and Platinum ratings have also been revised. All buildings are now required to provide permanent measuring instruments to monitor the operating system efficiency of their central air-conditioning system.

Six Battery Road is one of the buildings that applied for GMIS-EB to retrofit its Chiller Plant and Lightings to high energy efficiency standards.

For more information on Green Mark for Existing Non-Residential Buildings, please visit http://www.bca.gov.sg/GreenMark/green_mark_criteria.html or contact Mr Thomas Pang at 63255025 (or email: Thomas_pang@bca.gov.sg) or Mr Kong Jia Hng at 63255174 (or email: Kong_Jia_Hng@bca.gov.sg)
THE SUSTAINABLE CONSTRUCTION MASTERPLAN WAS REVISED IN JUNE 2009 TO BE IN LINE WITH SINGAPORE’S SUSTAINABLE BLUEPRINT.

Through the Sustainable Construction Masterplan, BCA will lead and steer the industry towards easing the impact on the country’s limited landfill capacity and enhancing the supply resilience of our building and construction materials.

BCA aims to achieve reduction in the use of natural aggregates in concreting works through two initiatives, namely (1) encouraging the use of recycled materials such as Recycled Concrete Aggregates (RCA) and other alternative materials eg. Washed copper slag (WCS), as well as (2) looking into the optimal use of concrete for building works.
**Up-cycling Strategies**

Taking this further, BCA is promoting to up-cycle majority of the industry’s concrete waste for higher-value applications. This covers processing concrete waste into recycled concrete aggregates for structural building works.

In its current practice, the industry would typically use most of the crushed concrete from demolition works for lower-value applications such as backfilling or as hardcore material for construction of temporary site access roads. BCA aims to raise the awareness of the industry, of the potential to up-cycle the concrete waste for structural works.

At the same time, BCA is exploring the use of other waste materials as alternatives for lower-value and other civil engineering applications. Such waste includes treated incineration bottom ash and dredged materials.

**Capability Development Fund**

A key initiative to drive sustainable construction is the set up of a $15 million Sustainable Construction Capability Development Fund (SC Fund) to develop capabilities of the industry to adopt sustainable construction materials and methods.

The Fund will cover up to 50% of the total qualifying costs, depending on the type and merits of the project. The costs supported by the Fund include manpower-related costs, equipment and materials acquisition and professional services. Training providers can also make use of the Fund to develop and conduct courses related to sustainable construction. In these cases, the Fund could cover the costs of course development, trainers’ fees, training materials and venue rental.

For more information on the Sustainable Construction Capability Development Fund, please visit [www.bca.gov.sg/Professionals/GovAsst/govasst.html](http://www.bca.gov.sg/Professionals/GovAsst/govasst.html).
SC Fund Facts (As at 1st Oct 2012)
- **84** Projects Applied
- **53** Projects Approved
- **$4.5 million** Committed Amount

### Fund Beneficiaries

**DEMOLITION CONTRACTORS**
Neo & Goh Construction, Technocrete, Beng Siew Contractors, Asset Recovery, Beng Soon Machinery, Yong Sheng Engineering & Hak Kian Enterprise

**READY MIX CONCRETE SUPPLIERS**
Pan-United, Holcim, Samwoh, Tiong Seng Contractors, TopMix, Alliance Concrete, Island Concrete, Elite Concrete, EnGro, G&W Industries & Tong Seng Concrete Products

**C&D Waste Recyclers**
Hock Chuan Hong Waste Management & SamGreen

**PILOT STUDIES PROJECTS**
Woh Hup, Samwoh, SiMTech, Teambuild Construction, NewEarth, CH2M Hill, Tiong Seng, Admaterials, EnGro, Pan-United, Emerald Land, Soo Li Heng, Singapore Poly, Natsteel, Ngee Ann Poly, Qingjian Precast, Takenaka & Tuas Power

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**Case Study**

**MORE UPCYCLING - PRECAST CONCRETE PLANK (PCP) FOR SITE CONSTRUCTION ACCESS**

Teambuild Construction received partial funding from the SC Fund to develop an innovative solution to use precast concrete planks (PCP) for laying site access in their HDB lift-upgrading projects.

In current site practices, construction of site access typically involves using a thick layer of 300mm to 400mm hardcore for laying the road base. The precast concrete planks (PCP) are designed to the optimum capacity for lorry crane handling and can withstand the load of a 250 tonne crane for steel shaft launching. It is a robust and durable material that can be reused as many times as possible with little maintenance.

PCPs are made of eco-concrete, comprising recycled aggregates processed from demolition waste and washed copper slag, a by-product of ship-blasting activities. It reduces the demand for hardcore so that more recycled aggregates can be channelled to higher-value applications.

The planks are manufactured off-site, in a controlled environment. No skilled labour is required in the fabrication process. The installation of the planks is also very easy and fast. As compared to the conventional method of constructing site access, using precast concrete planks can reduce labour and machinery hours by about 30%.

Mr. Kenny Ho, Project Director of Teambuild construction quoted: “After adoption and implementation of the PCP for our HDB lift upgrading projects, it is proven that it requires 30% less labour and machinery hours compared to the conventional construction method. This is a successful pilot study funded by the SC Fund that has received positive feedback from HDB. Teambuild will implement this system for all future construction projects.”

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**Conventional Hardcore**
- Usually 300mm to 400mm thick
- Loosely compacted which results in soil erosion after downpour
- Uneven surfaces causes stagnation of water, creates potential mosquito breeding ground

**Precast Concrete Plank (PCP)**
- Made of 175mm thick prefabricated element using Grade 50 Eco-green concrete
- Modular size of 1.2m by 2.2m for easy handling
- Reinforced with welded mesh & edge protected with angle iron
- Robust, durable & reusable
- Easy, speedy, reduces labour & machinery hours by 30% compared to conventional method
- Releases recycled aggregates for more up-cycling
At present, over 90% of Singapore’s existing building stock was built prior to the Environmental Sustainability regulations. Energy efficiency in these existing buildings needs to be significantly improved to support the nation’s target to reduce greenhouse gas emission. In view of this, BCA will be amending the Building Control Act to introduce three legislative measures. These include mandatory submission of energy consumption and building data, requirement to meet minimum Green Mark standards, and mandatory three-yearly audit of Operational System Efficiency.

Delving into the second measure in greater detail, BCA’s Green Mark criteria for existing buildings has been revised to introduce new pre-requisite criteria to ensure an air-conditioning plant is functioning efficiently, as designed and commissioned, throughout its life cycle. These requirements cover minimum air-conditioning system efficiency standards and the installation of accurate permanent measurement and verification instrumentation for chilled water plants. The requirements will apply to new developments and existing buildings undergoing retrofitting.

The installed permanent instrumentation should have an accuracy to measure the plant efficiency within 5% of the true value, in accordance with ASHRAE Guide 22 and AHRI 550/590 standards. The measurements should be verified using a heat balance, where 80% of the sampled points during normal operational hours have to be within +/-5%.

**Training Course on the New Requirement**

To guide consultants, building owners and facilities managers through the new requirement, BCA Academy has started a new course on Chilled Water Plant Measurement and Verification. The lecturers are drawn from veterans in the measurement field as well as experts from A*Star National Metrology Centre. Many industry professionals have already benefited from the practical knowledge gained from the course.

"The course has equipped me with an insight about achieving end-to-end accuracy, how each sensor works, the importance of correct installation as well as the verification of the accuracy of the measurement," said Zaw Min, Executive Engineer from the National Institute of Education, who attended the course.

He added: "The accuracy of measurement is a fundamental requirement for successful energy management. When we embarked on our chiller plant upgrading project in 2011, a prerequisite was for an accurate measurement and verification system to be in place for effective energy management. The enhanced knowledge from the course was applied successfully in our chiller plant upgrading project that is now operating at 0.6 kW/RT efficiency and is being continuously monitored by a high accuracy permanent measurement and verification system."

For more information on the Chilled Water Plant Measurement & Verification course, please visit BCA Academy’s site at [http://tinyurl.com/MVatBCAA](http://tinyurl.com/MVatBCAA)
PERCENTAGE OF GREEN BUILDINGS IN SINGAPORE
AS AT OCTOBER 2012

2004 | 0%
2012 | 16.9%
2030 | 80% (Target)