CoreNet Global

INTERNATIONAL SUSTAINABILITY SYSTEMS COMPARISON

Key International Sustainability Systems: Energy and Water Conservation Requirements

Prepared for CoreNet Global by Ove Arup & Partners Ltd. | March 2014

CoreNet Global

Brookfield

ARUP

Primary Authors:

Jenn McArthur, Arup Toronto
Nubia Herrera, Arup New York
Pallavi Mantha, Arup New York

Contributing Authors and Reviewers:

Liz Meddings, Arup London
Dr. Gerard Healey, Arup Sydney
Jimmy Yam, Arup Hong Kong
Filique Nijenmanting, Arup Amsterdam
Jaroslaw Witek, Arup Warsaw
Dion Anandityo, Arup Singapore
Russell Cole, Arup London
Rebecca Hatchadorian, Arup Boston
Frederick Wong, Arup Shanghai
Alexander Kobler, Arup Sydney
Oliver Schwabe, Arup Berlin
Marcelo Nudel, Arup Brazil
Cameron Thomson, Arup New York
Jamie Loader, Brookfield Office Properties, Sydney

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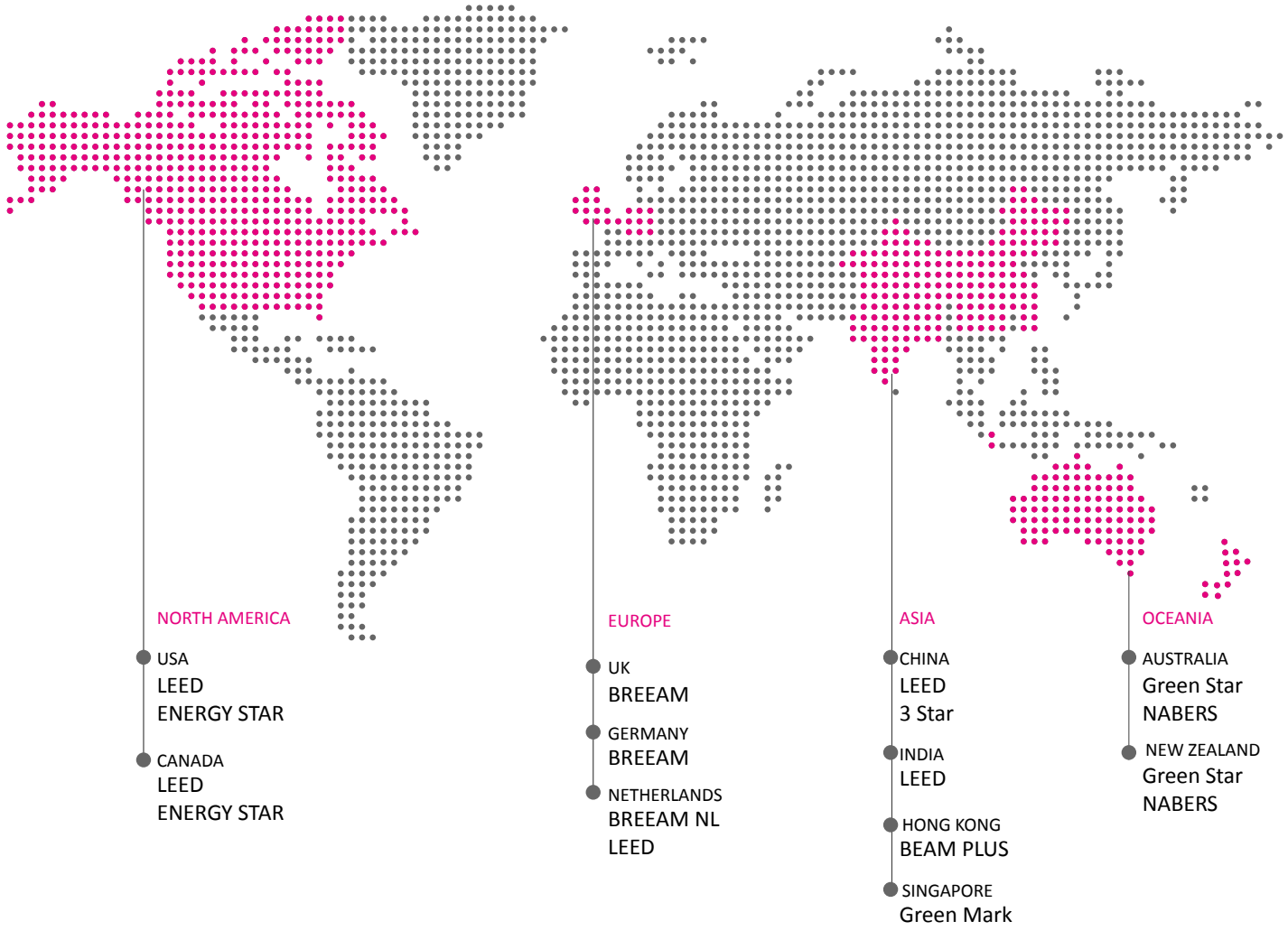
Disclaimer:

Contents

COUNTRIES AND APPLICABLE SYSTEMS DISCUSSED IN THIS REPORT



1.0 Introduction

Arup was engaged to provide a report comparing the individual Energy- and Water-related credit requirements for major sustainability systems globally, as well as a framework to guide the decision-making process to select the most appropriate sustainability rating system(s) and target rating for a given project.

The scope of this report is limited to major sustainability systems applicable to new commercial office building construction. Fit-out/interiors-only systems have not been included in this version of the report. "Major" certification systems for the purpose of this report have been defined as systems that are:

- Used widely outside the country of development, and/or
- The most commonly-used system in the countries where more than 1% of CoreNet Global Members as of January 2014, and
- Are current: where multiple versions of the same system are widely used between countries, those considered as current by the local Green Building Council (e.g. LEED® 2009 in Brazil vs. LEED v.4 in the USA and Canada (in-transition).

This report is laid out as follows:

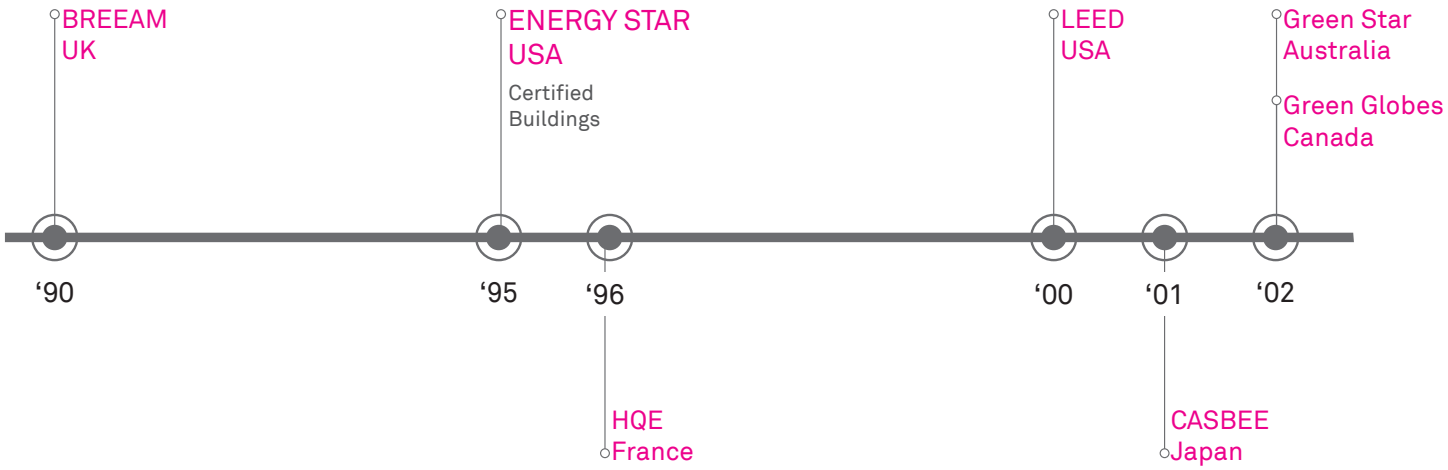
- Section 2 provides a brief overview of each of the major systems considered,
- Section 3 provides a decision-making framework,
- Section 4 compares the types of energy credits included in each system and compares each credit type across systems,
- Section 5 includes the same comparison for water-related credits, and
- Section 6 includes case studies highlighting global projects achieving certification in each system

The Appendix includes country-specific information to support the decision-making process and includes a summary of trends noted by Arup in the selection of sustainability rating systems and targeted certifications in each market. In several countries, there are additional sustainability rating systems that are also widely used and this has also been included in the Appendix. Note that region/country-specific water and energy Codes, standards and related laws and incentive schemes have not been included in this report except as examples.

2.0 Overview of Sustainability Systems

TIME LINE OF THE DEVELOPMENT OF RATING TOOLS

DATES AND COUNTRIES INDICATE FOUNDATION OF ORGANIZATION/LAUNCH OF THE SYSTEM
SOURCE: REED, 2011; UP TO 2010



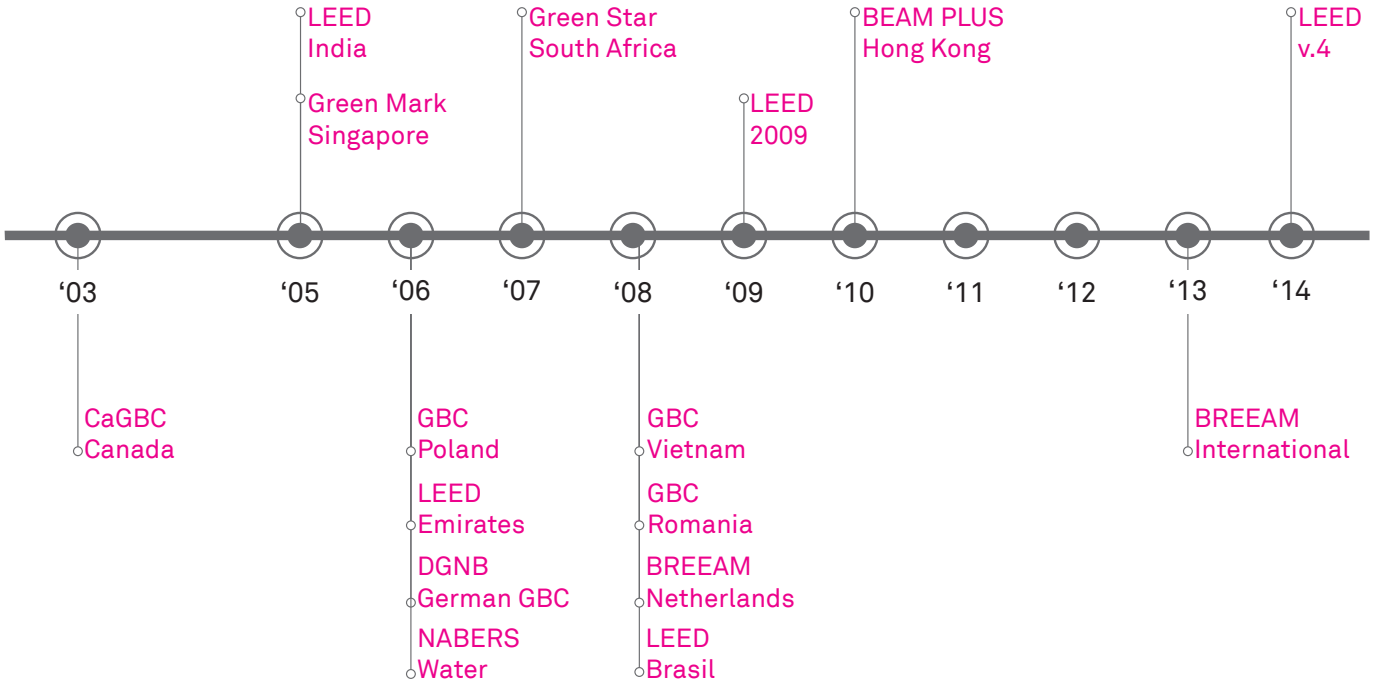
This report includes eight sustainability systems, five of which are comprehensive in scope, two are energy-only and one is water only:

- BREEAM International 2013
- LEED (2009 and v4)
- Green Mark (version 3)
- BEAM Plus
- Green Star
- NABERS Energy
- ENERGY STAR
- NABERS Water

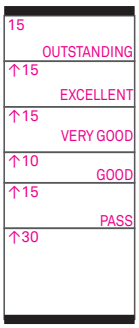
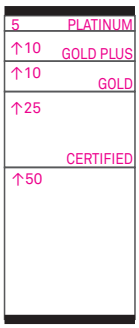
The timeline below indicates the relative development of each of these systems, along with several other early sustainability systems beyond the scope of this report.

These systems are compared in terms of level of achievable certification, incremental credit requirements to achieve this certification level and the relative emphasis for each of energy-related, water-related and other types of credits.

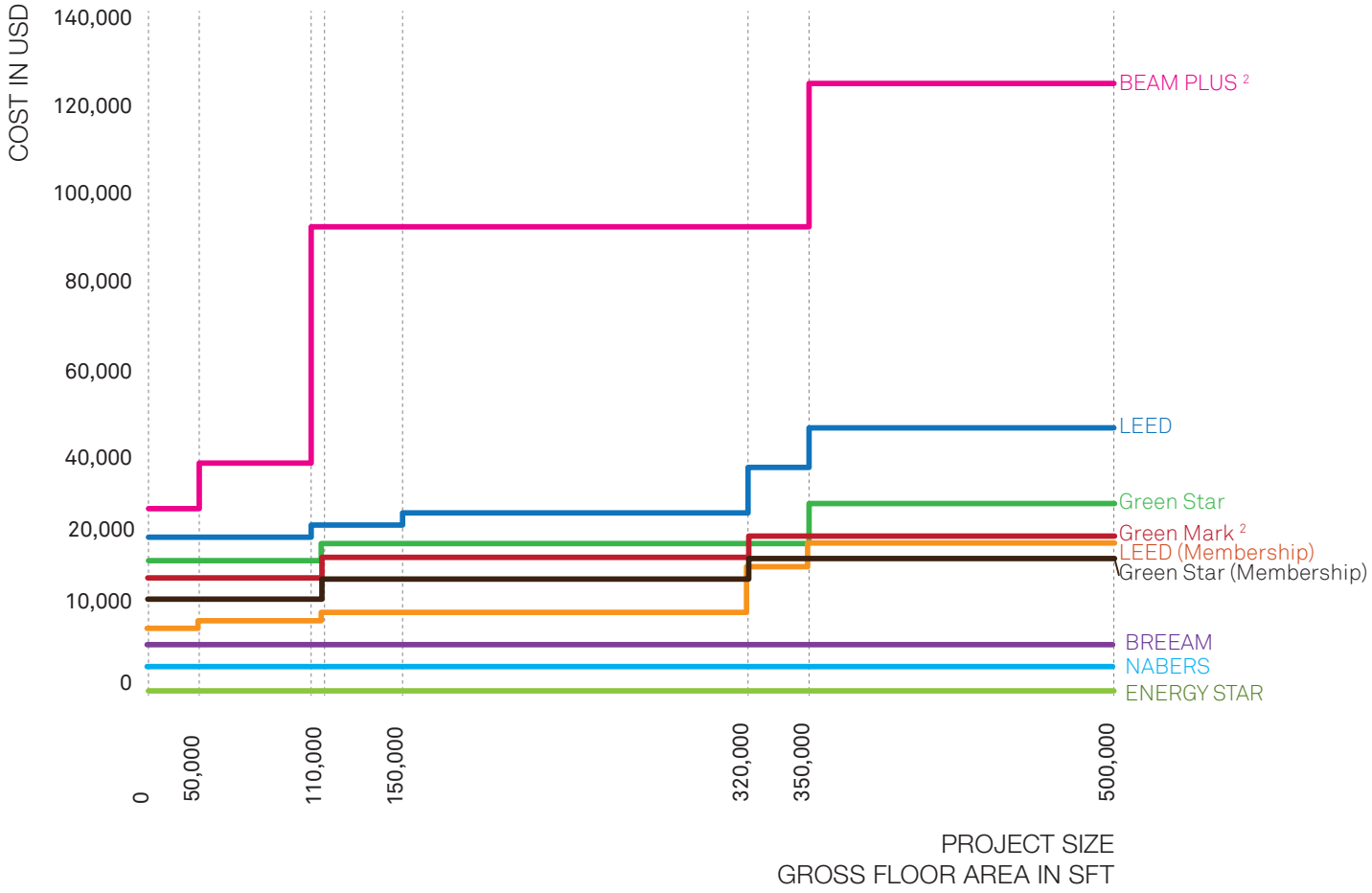
The following pages provide a brief overview of each of these systems as well as an at-a-glance look at the system and its geographic prominence. The Appendix contains more detail on the relative popularity of each system in various countries.



COMPARATIVE OVERVIEW OF RATING SYSTEMS

	BREEAM UK	LEED USA	GREENMARK Singapore	BEAM PLUS Hong Kong	GREEN STAR Australia	NABERS ENERGY Australia	NABERS WATER	ENERGY STAR USA
RATINGS AWARDED	OUTSTANDING EXCELLENT VERY GOOD GOOD PASS UNCLASSIFIED	PLATINUM GOLD SILVER CERTIFIED	PLATINUM GOLD PLUS GOLD CERTIFIED	PLATINUM GOLD SILVER CERTIFIED	6 STAR 5 STAR 4 STAR 3 STAR 2 STAR 1 STAR	6 STAR - MARKET LEAD 5 STAR - EXCELLENT 4 STAR - GOOD 2.5 - 3 STAR - AVERAGE 2 STAR - BELOW AVERAGE 1 STAR - POOR 0 STAR - VERY POOR		ENERGY STAR LABEL INDICATING PERCENTILE
CREDIT ALLOCATION Energy and Water								
INCREMENTAL CREDITS REQUIRED FOR EACH LEVEL OF CERTIFICATION						N/A	N/A	N/A

COMPARISON OF ADMINISTRATIVE FEES BY PROJECT SIZE



Notes:

1 Note that administrative fee includes the registration, accreditation/assessment and certification fee but excludes the design fee associated with the project as well as any costs incurred by the design team to document compliance. This suggests a reduced relative cost for LEED and Green Star ratings systems.

For projects exceeding 400,000 sft under BEAM PLUS or 1,000,000 and up in Green Mark, the fees are determined on a project-by-project basis.

2.1 BREEAM

BREEAM is the Building Research Establishment's (BRE) Environmental Assessment Method. It was first launched in the UK in 1990 by the BRE, an independent and impartial, research-based consultancy. The organisation was originally a government department but was privatised in 1997. BRE is also a founding member of the UK Green Building Council.

BREEAM sets the standard for best practice in sustainable building design and construction. Its main aims are:

- To mitigate the life cycle impacts of buildings on the environment.
- To enable buildings to be recognised according to their environmental benefits.
- To provide a credible, environmental label for buildings.
- To stimulate demand for sustainable buildings.

The ratings aim to demonstrate how environmentally sustainable a building is. The **Outstanding** rating is intended to be achieved by innovators making up less than top 1% of UK new non-residential buildings. The **Excellent** rating is aligned with best practice buildings making up the top 10% of new non-residential buildings. **Very Good** reflects "advanced good practice" (top 25%), while **Good** could be achieved by the top 50% of UK non-residential buildings. Finally, the **Pass** rating applies to the top 75% and is considered standard good practice.

Assessments are carried out by licenced BREEAM Assessors who are members of the project team. New assessors undergo a four day training course which includes an examination. Once the course has been passed, assessors submit their assessment reports. These undergo a quality assurance (QA) process by BRE. The first few assessments undergo a full QA where every credit and all the evidence is checked. Following that, only a number of credits are checked for each assessment, to ensure that the Assessor still meets quality standards.

BREEAM is used as the main rating system in the UK. It is a global scheme and there are a number of countries where country-specific schemes have been developed in Austria, Germany, Netherlands, Norway, Spain, and Sweden. It has been used widely in Europe and is gaining ground in other regions too.

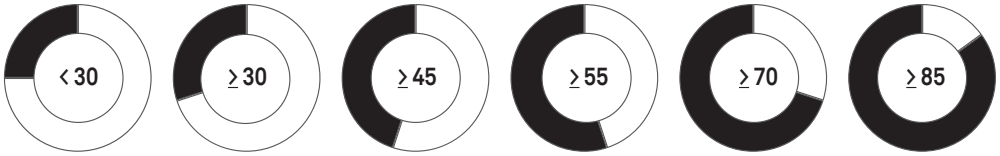
BREEAM: AT A GLANCE

BREEAM®

Countries with certified or registered projects

Building Research Establishment Environmental Assessment Methodology

BENCHMARKS



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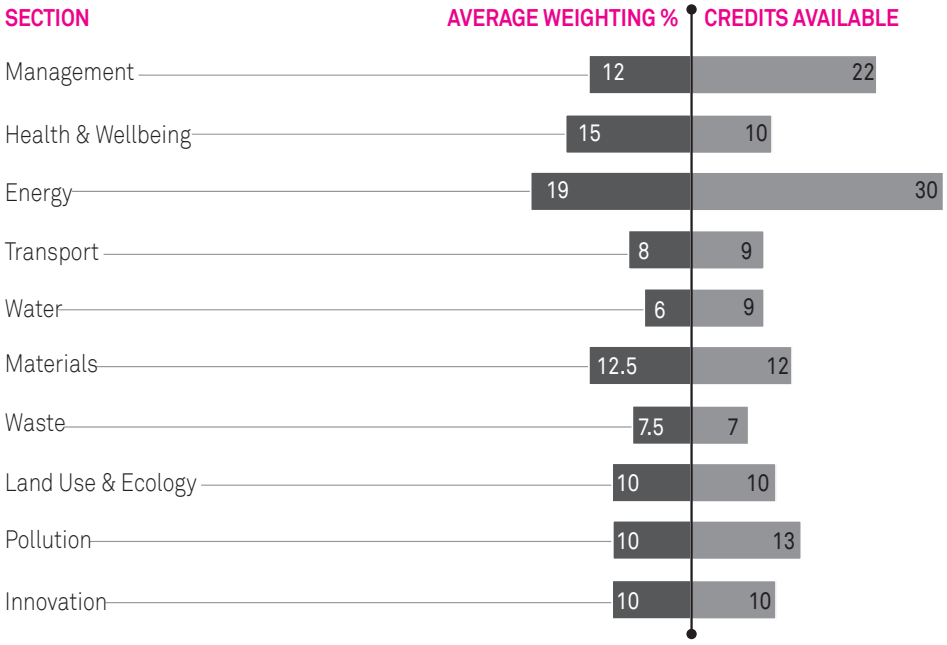


2.2 LEED

Leadership in Energy & Environmental Design, LEED©, is the sustainability rating system created by the US Green Building Council (USGBC) 2000 in the United States of America. It is a voluntary point-based sustainability assessment program for building projects. Each project is awarded scores against a standard set of credits and the sum of the points awarded determines the level of certification (Certification, Silver, Gold, or Platinum) achieved.

LEED is based on a set of performance-based criteria and therefore there is a wide range of paths to achieve the level of certification desired by incorporating strategies that meet specific criteria.All LEED projects are evaluated per each criterion which is either a 'Prerequisite' or 'Credit' which results in a point score for certification:

Prerequisites: This category is based on minimum requirements and must be met. No further points will be awarded unless the minimum is achieved. There are a total of seven prerequisites.

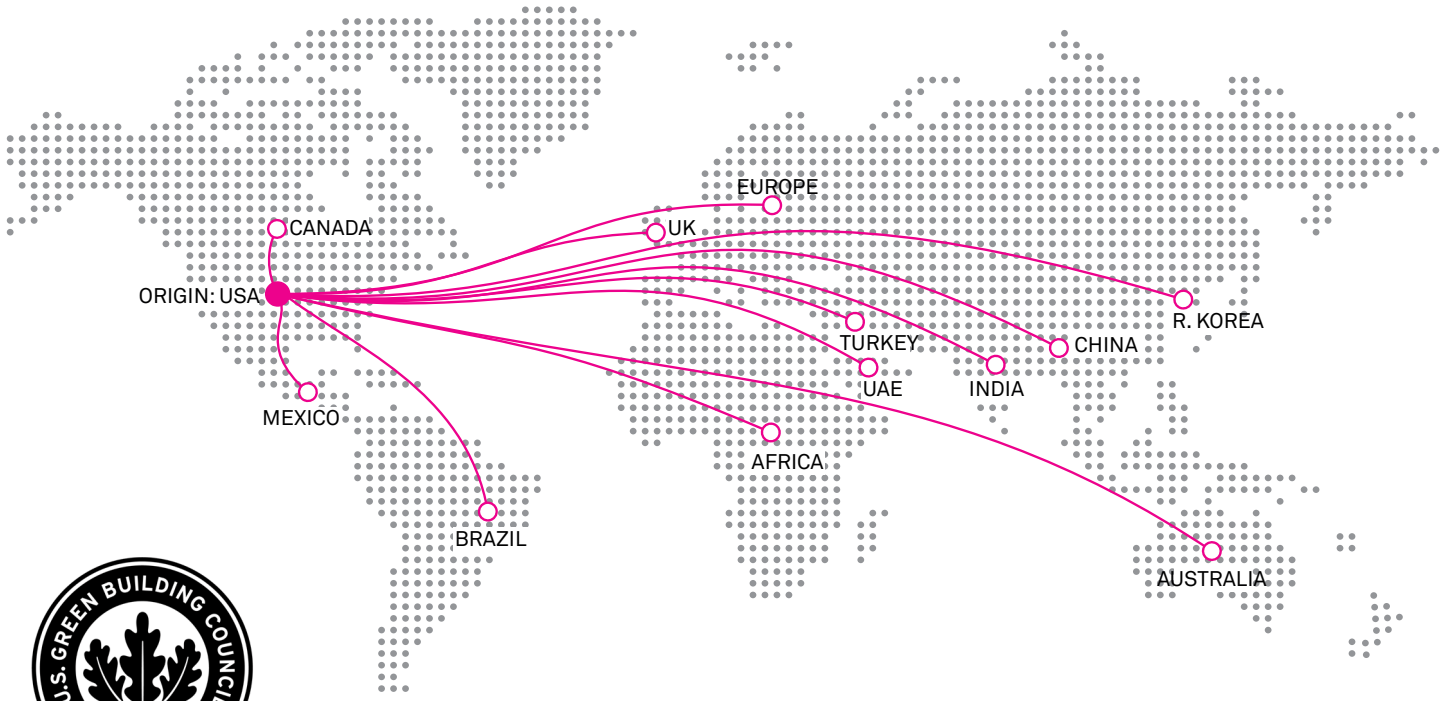
Credits: Credits are evaluated and result in a point score. The total points possible are 110 points.

LEED 2009 Rating System addresses the design features of the project across a range of criteria in five credit categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality. In addition to existing categories, recently released LEED v4 brought together existing and new credits and created two additional categories: Integrative Process and Location and Transportation.

Once the pre-requisites have been satisfied for a project, the choice of credits to pursue is at the discretion of the project team. Typically, the team will have a LEED® Coordinator who runs a charette with the various team members to identify which credits to pursue. This individual will work with the team to complete the credit templates which are submitted to the Green Building Certification Institute (GBCI), who grants building certification. There is an optional Design Application phase where individual credits will receive feedback from the GBCI on whether the credit is "Anticipated" or "Denied". The team is permitted to appeal the ruling on denied credits for a $500 fee, or accept all rulings and continue to the Construction Application Phase.

While a formal accreditation for the LEED® coordinator is not mandatory, it is strongly encouraged (and allocated one credit) for this person to be a LEED® Accredited Professional (LEED® AP). Up until June 30, 2009, there existed a LEED® AP credential that had no recertification or continuing education requirements; it is no longer offered but individuals with this credential have been grandfathered under these rules. Since 2009, two new credentials exist. The first is the LEED® Green Associate (LEED® GA), which requires a general exam to be written and 15 continuing education credits earned in every two year renewal period., and the LEED® Accredited Professional with speciality (e.g. LEED® AP (BD+C for Building Design and Construction), which requires a rating system-specific exam to be written and 30 continuing education credits related to their specialty in every two year period.

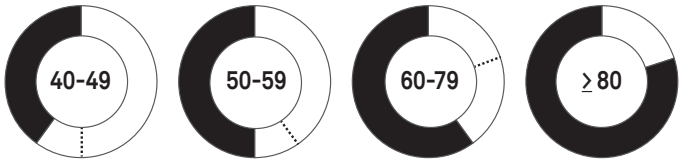
LEED® has become the dominant sustainability ratings system globally and is the most commonly-used system in the USA, Canada, Mexico, Central and South America and India. It is widely used in China and the Gulf region as well as most of Europe (particularly Western Europe).



Countries with certified or registered projects

Leadership in Energy and Environmental Design

BENCHMARKS



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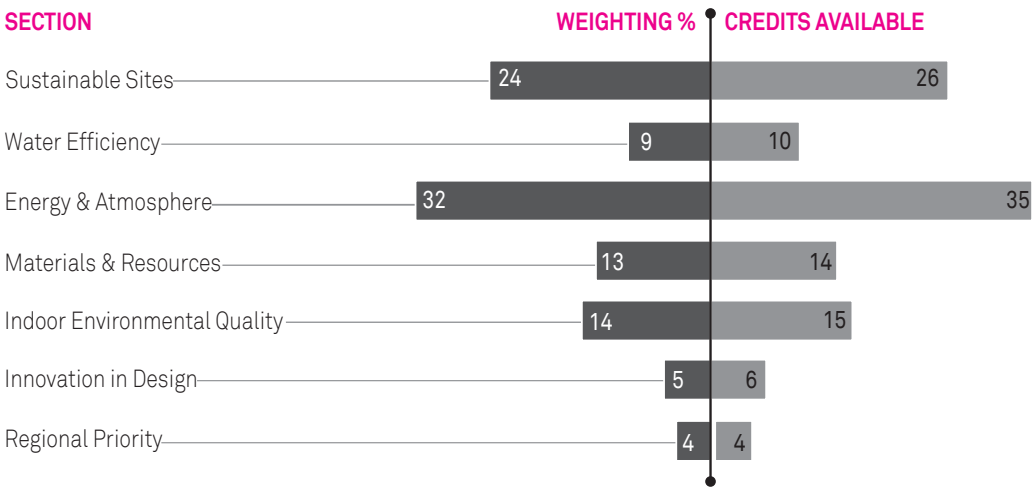


2.3 Green Mark

The Green Mark Scheme was launched in January 2005 as an initiative of Singapore's Building Construction Authority (BCA) with the goal to promote "sustainability in the built environment and raise environmental awareness among developers, designers and builders" (BCA website). While certification is voluntary, the scheme is heavily based on the Code for Environmental Sustainability of Buildings and results in all new buildings being constructed in this city-state to the minimum certification level. To achieve higher levels of certification (Gold, GoldPLUS or Platinum) an increasing number of credits must be achieved, along with specific additional pre-requisite requirements for GoldPLUS or Platinum ratings.

The four goals identified by the BCA for the Green Mark scheme are as follows:

- Facilitate reduction in water and energy bills,
- Reduce potential environmental impact,
- Improve indoor environmental quality for a healthy and productive workplace,
- Provide clear direction for continual improvement.

Certification of the building is a cooperative process involving interaction between the BCA and the development team (developer, building owner or government agency) from pre-design through construction.

The application process requires submission of an application by the developer, building owner or government agency pursuing the certification to the BCA as an expression of interest. Next, there is a preliminary meeting for the BCA assessment team to brief the project team on the Green Mark criteria and the requirement for documentary proofs and reports for subsequent submissions.

The actual assessment is performed by an independent assessor within the BCA and includes design and documentary reviews and, once the project is complete, site verification. Evidence of compliance with credit requirements is submitted by the project team at the end of the assessment and a letter of award is consequently provided to the team indicating the certification level achieved. (Source: BCA website).

This scheme has been adopted outside of Singapore with certified projects in Indonesia, Malaysia, Thailand and China.

Green Mark: AT A GLANCE

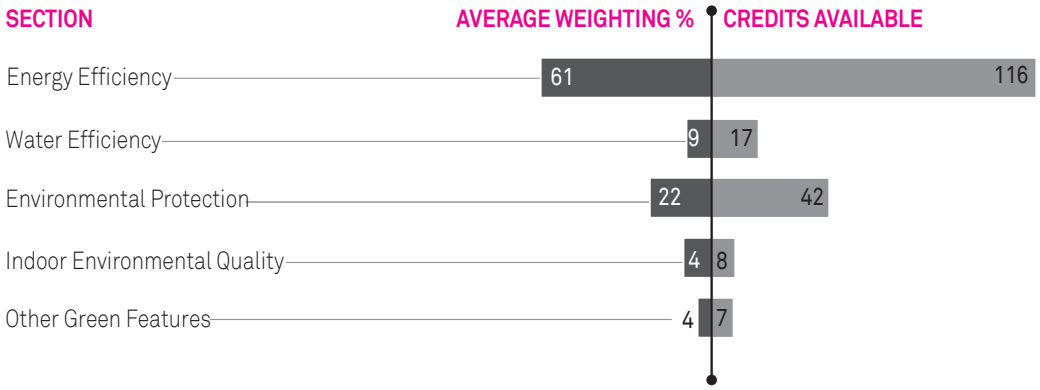
BCA GREEN MARK

Countries with certified or registered projects

BENCHMARKS

* Not eligible for formal certification

DETAILS



2.4 BEAM PLUS

The Hong Kong Building Environmental Assessment Method (HK-BEAM) was one of the early schemes to be developed and launched in 1996, to guide the design and assess the overall performance of new and existing buildings in Hong Kong. It has since then gone through various updates to reflect the continuous improvement in the industry, with the latest version, BEAM Plus (v1.2) launched in July 2012 by Hong Kong Green Building Council (HKGBC).

BEAM Plus integrates the assessment of many key aspects of building performance, embracing the following categories:

- hygiene, health, comfort, and amenity;
- land use, site impacts and transport;
- use of materials, recycling, and waste management;
- water quality, conservation and recycling; and
- energy efficiency, conservation and management.

There are three schemes for BEAM Plus: New Buildings, Existing Buildings and Interior. This document considers only the New Buildings Standard, effective July 2012.

Four levels of certification are available within the BEAM Plus system: Bronze, Silver, Gold and Platinum. Certification is awarded by the Hong Kong Green Building Council (HKGBC) and the assessment is performed by an assigned independent BEAM Assessor (BAS) at BEAM Society Limited (BSL), who is entrusted to facilitate the assessment and will sign an agreement with the Applicant for this purpose. The BSL assessors will review the documentation provided by the project team to support the BEAM Plus certification application. As in the LEED® system, there is the option to appeal denied credits.

BEAM Plus is the dominant sustainability system used in Hong Kong and has also been adopted for projects in Macau and Southern China.

BEAM PLUS: AT A GLANCE

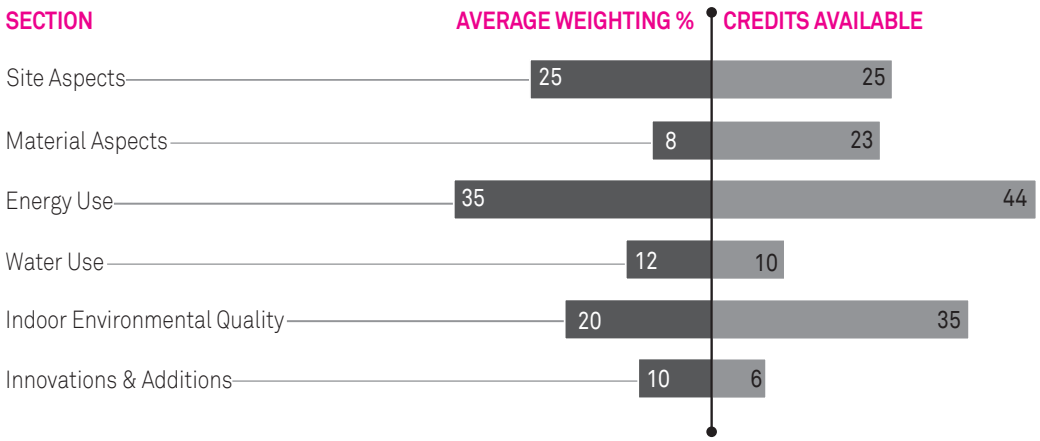
BEAM

Countries with certified or registered projects

BENCHMARKS

* Not eligible for formal certification

DETAILS



2.5 Green Star

Green Star is a voluntary sustainability rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia (GBCA) and considers a range of different building types across all stages of the built environment lifecycle. The building types currently covered include commercial, retail, residential, healthcare and education, with recently specific tool being developed for fit-outs and interiors.

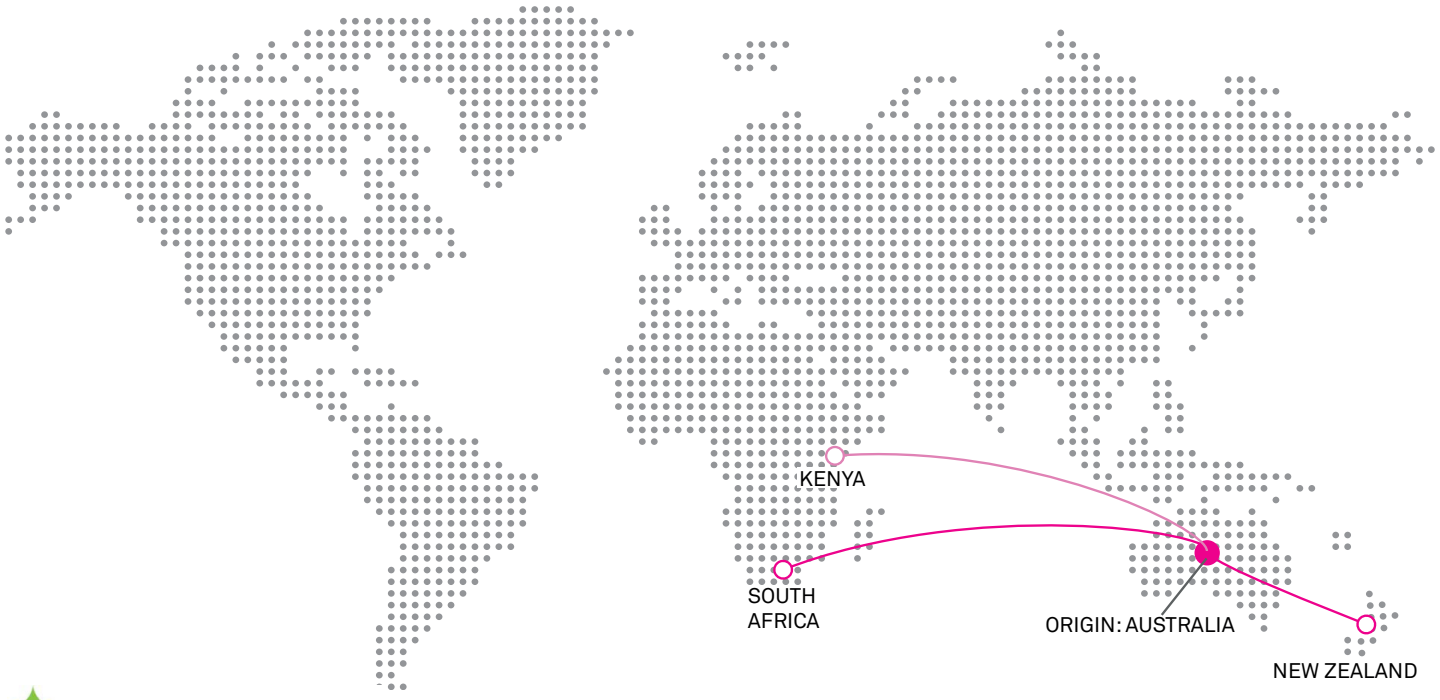
Green Star rating system looks at a building's management, internal environment, energy consumption, water consumption, material selection and ecology degradation to give a building a star ratingBuildings achieve star ratings based on the design of the project, with no requirement to prove results in ongoing operation. . The star ratings start at One Star but formal certification is not awarded below a Four Star level. The ratings are intended to reflect the building performance as-follows: Four Star - Best Practice, Five Star, Australian Excellence; Six Star, World Leadership.

A recent study published in May, 2013 has found that of the over 600 projects in Australia to adopt the tool, a typical Green Star project will emit62% fewer Greenhouse Gases and consume 66% less electricity than the average Australian building. They also consume 51% less potable water, and recycle 96% of their construction and demolition waste.

To obtain building certification, the project team prepares documentary evidence to demonstrate that the project meets the Green Star benchmarks for the targeted level within each credit. This is reviewed by an independent assessment panel who assign the rating based on documentary evidence provided by the team.

The Green Star Accredited Professional (GSAP) qualification is intended for professionals working on Green Star projects and allows them to participate in ongoing training related to this work. To achieve this qualification, individuals must pass an exam and achieve 15 continuing professional development (CPD) points within each 12-month CPD period.

Green Star: AT A GLANCE



greenstar

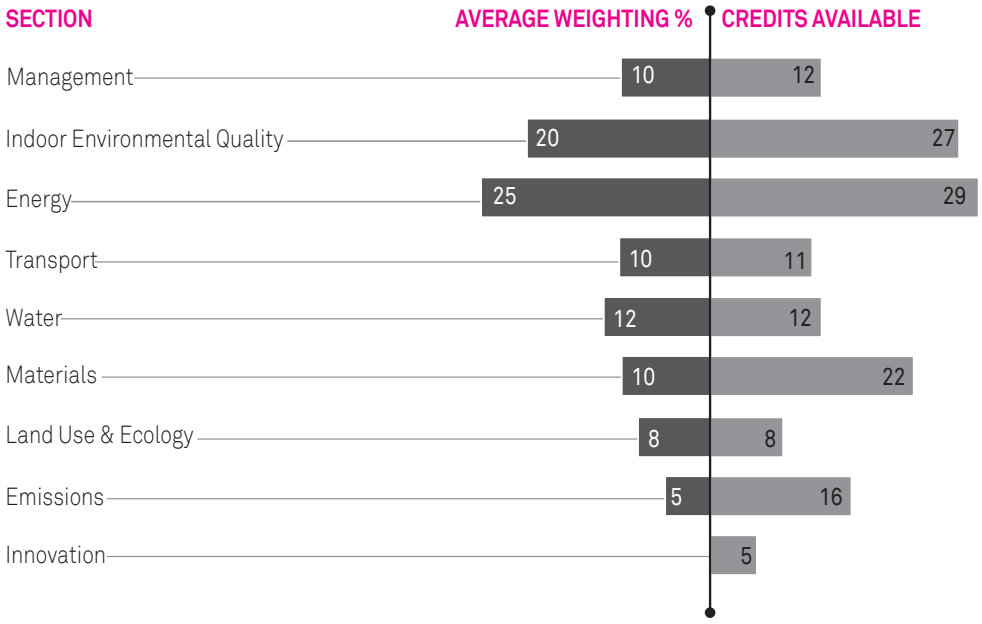
○ Indicates countries with certified or registered projects

BENCHMARKS

ONE STAR* | TWO STAR* | THREE STAR* | FOUR STAR | FIVE STAR | SIX STAR

* Not eligible for formal certification

DETAILS



2.6 NABERS

NABERS (National Australian Built Environment Rating System) was initially developed in New South Wales, Australia (NSW) in 1998. The purpose of this system was to provide energy ratings for offices and was adopted as the Australian Building Greenhouse Rating (ABGR) by the NSW Government's Sustainable Energy Development Authority (SEDA). It was applied nationally in 2000 at the request of the property industry Throughout Australia, commercial buildings over 2,000m2 are now required to advertise their NABERS rating when leasing or selling a property.

The vision statement of NABERS s 'To support a more sustainable built environment through a relevant, reliable and practical measure of building performance.'

In 2006, a second NABERS tool was launched to allow rating of water consumption in offices. Other rating scales have since been developed for Waste and Indoor environment (2008), Energy and Water for shopping centres (2009) and energy for data centres (2013). In 2013, NABERS became international in scope as NABERSNZ was launched in New Zealand.

The tool is tailored for office spaces, hotels, shopping centres, residential homes and data centres. It looks primarily at the amount of energy, water or waste consumed and compares this to a baseline. Assessments of each building are undertaken by third party assessors and a score is assigned on a scale from 0 to 6 stars. Note that NABERS ratings apply to different parts of a building; for example one office tower could have a base building rating, tenancy fit-out rating and whole building rating.

Ratings are awarded based on the findings of independent 'Accredited Assessors' . To receive full accreditation, each assessor is required to attend training, pass an exam and complete two supervised. Note that the online self-assessment tool can be used by anyone but promotion of results until the rating has been certified by the NABERS National Administrator can be promoted using the NABERS trademark.

NABERS Energy for offices ratings are based on, consumption data for the building (e.g. electricity and gas bills) collected by Accredited Assessors along with building data (size, hours of occupation, climate location and density of occupation). 'The NABERS Energy and Water for offices Rules for Collecting and Using Data v.3.0". defines the requirements for this Data. This data is input into the NABERS calculator, which adjusts the building consumption based on building data to compare building peers. The final rating is on a scale from Zero Star (very poor performance) to Six Star (market-leading).

The NABERS Office Water rating is similar except that water consumption is used, hours of operation are not considred and only the whole building water use can be rated, rather than base building, tenancies or whole building as is the case for Energy.

2.7 ENERGY STAR

ENERGY STAR is a voluntary program established in 1992 by the U.S. Environmental Protection Agency (EPA), under the authority of the Clean Air Act. The mandate of the ENERGY STAR Program was defined in the Energy Policy Act (2005) to "identify and promote energy–efficient products and buildings in order to reduce energy consumption, improve energy security, and reduce pollution through voluntary labeling of or other forms of communication about products and buildings that meet the highest energy efficiency standards." (Source: https://www.energystar.gov/about/).

The system consists of both product ratings (e.g. household appliances) and building ratings (residential, commercial and industrial). Buildings are rated using the ENERGY STAR Portfolio Manager (https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager) and commercial Buildings achieving a score of 75 or higher as verified by a Licensed Professional (Professional Engineer or Registered Architect are eligible to apply for the ENERGY STAR rating. A Licensed Professional must verify the following:

1. All energy use is accounted for accurately

2. Building characteristics (e.g. square footage) have been properly reported (including the square footage of the building

3. The building is fully functional in accordance with industry standards, and

4. That each of the indoor environment criteria has been met.

ENERGY STAR estimates cumulative greenhouse gas reductions of 1903 million tonnes of CO2 between 1993 and 2012 from their programmes as a whole, including appliance standards as well as building ratings.

3.0
Guidelines for Selecting a Sustainability Rating System

3.1
Requirements

In each building, a unique combination of factors will influence the decision to pursue one or more Green Building Ratings, and it is not possible to provide a one-size-fits-all recommendation. Instead, this section will first identify the factors that tend to influence this decision, discuss in more detail how these factors are considered, and provide a framework to guide the decision-making process for a particular building in its context. Finally, a sample application of the framework will be provided to walk through this process and illustrate how the approach can be used.

Broadly speaking, the drivers for Green Building certifications are one or more of the following:

1. Legislative Requirements
2. Investor, Owner or Tenant Requirements
3. Building Economics
4. Market Dynamics
5. Incentives
6. Risk Management

When more than one of the drivers is present, an understanding of these drivers and how they may complement one another offers the potential for increased benefit at reduced cost. For example, a developer may be primarily focused on improved building economics while their target tenant is requesting a specific rating system (e.g. LEED or Green Star) to comply with their own Corporate Sustainability policy. In such a case, the developer will realize a double benefit by mandating the design team to achieve a minimum number of credits in each of the energy reduction and water use reduction categories as part of achieving this certification.

The following sections discuss each of these drivers and the factors that may affect each.

3.1.1 Legislative Requirements

There are a number of policies at national/federal, provincial/state and municipal levels around the world that mandate minimum certification requirements for new construction, significant renovations or additions. These may refer to local green standards or green building guidelines or to the international systems discussed in this report. These can take a variety of forms:

1. Federal or regional mandatory disclosure requirements for estimated energy and/or water consumption.

   For example, in Australia, the Commercial Building Disclosure (CBD) Program requires energy efficiency information to be provided in most cases when commercial office space of 2000 square metres or more is offered for sale or lease, and the NABERS rating system is used for this purpose.

   A second example is mandatory building labelling with Energy Performance Certificates within the European Union.

2. Federal, Provincial/State or Municipal codes may mandate sustainable elements consistent with one or more sustainability system requirements

   For example, in Singapore, dual-flush water closets are mandatory (single-flush may not be sold) due to water scarcity. In several other countries the production or import of incandescent light bulbs is banned.

3. Municipal requirements of a minimum standard of achievement for Building Permit application.

   Sometimes this is directly tied to the certification of a building to either a local or international standard, while in other cases project registration is not required but compliance with the requirements for certification must be demonstrated. For example:

   - Bristol is one of several cities in the UK that demands minimum BREEAM “Very Good” for building permit approval

   - In Toronto, compliance with the first tier requirements of the Toronto Green Standard (TGS) is mandatory for building permit application.

   - In Boston, Article 37 requires that LEED scorecards be provided as part of the permitting process to demonstrate that projects would meet the certified level of LEED (a.k.a. “LEED Certifiable”), including all prerequisite requirements (though project certification through GBCI is not mandatory). Article 37 has been in effect since January 2007.

4. Eco-districts where building permits or site plans will not be approved without a commitment to achieve a particular rating or its equivalent.

   For example, new construction in the Marina Bay area in Singapore must achieve Green Mark GoldPLUS or Platinum certification

In each of these cases, this sets the minimum requirement for the project to proceed. Often, there are other factors that drive a higher level of certification than this minimum (as discussed in the following sections), and because a minimum set of requirements is mandatory, the incremental cost for achieving this certification is thus reduced. For example, the TGS has several mandatory elements that overlap with the LEED® rating system, providing “free” credits towards LEED® certification.

3.1.2 Investor, Owner or Tenant Requirements

Several investors, landlords and developers have corporate sustainability mandates to only build or hold as equity sustainable buildings. Similarly, many tenants have corporate sustainability mandates or Green Lease policies to only move into certified space. These mandates often set project requirements high above any legislated minimum requirements. For example, the US General Services Administration (GSA) mandated in 2013 that all new owned federal buildings must achieve LEED® Gold certification (up from LEED® Silver mandated in 2006) while leased space must be LEED® Silver.

In addition to these mandates, certified buildings are often preferred by tenants because of the reduced utility costs, improved indoor environmental quality and connectivity associated with Green Buildings. Market perception of "being Green" also leads to these tenant requests, and drives the trend towards Green Valuation and Green Premium rental rates discussed in section 6.1.4.

In rare cases, a tenant will require an uncommon certification system in the local market due to a particular investor requirement or a characteristic unique to a particular building type. For example, Terminal 4 at the Melbourne Airport is certified within the LEED® system in order to facilitate comparison to building peers (other international airports) rather Green Star.

3.1.3 Economic Factors

The economic driver is particularly strong and it is critical to understand how the selection of an appropriate certification target can decrease the life cycle cost of the building in several ways, including the following:

- Reduced energy consumption from improved efficiency of equipment and systems and overall space planning to minimize dependence on artificial lighting and mechanical ventilation, heating and cooling
- Reduced water consumption (particularly hot water, which further reduces energy) through the use of low-flow fixtures and decreased irrigation and non-potable uses
- Improved system performance confirmed through a rigorous commissioning process
- Improved controls to minimize the use of equipment when not required, decreasing both energy and water consumption while also increasing the equipment life
- Improved system documentation and monitoring to allow trending of data to quickly identify equipment failure, leaks or other sources of waste

For tenants or owner-occupiers who pay their own utility and maintenance costs or landlords who include these costs in the rent, the benefits of the above are readily apparent. For landlords who pass on the utility bills to their tenants, there is still a benefit in markets where properties are compared based on total cost of occupying the space (i.e. gross rents) rather than comparison on the base rent only.

For the landlords and building owners, the implementation of each of these measures will incur a capital cost, which has been a deterrent for some. However, by bundling together the marginal cost items ("low-hanging fruit") with more significant investments that pay back more slowly, significant long-term cost savings can be achieved with a healthy internal rate of return for the investor/landlord. Legislative requirements often contribute strongly to the business case for pursuing certification as many of the measures required for certification will have to be included in the project by law, decreasing the incremental costs of improving the building compared to the baseline case.

As the number of measures implemented is increased, two things should be carefully considered: the trade-offs or synergies between measures, and the potential to add an additional measure that has poor payback in and of itself, but increases the level of certification to one that is more commercially beneficial.

3.1.4 Market Dynamics

There are commercial benefits to achieving certification in several real estate markets. These certifications facilitate a common language in the industry for marketing and competitive advantage recognition purposes. Further, in many markets, increased certification above the norm commonly results in improved absorption and increased rental rates. Where we have noticed consistent market trends indicating an expected level of certification for new commercial buildings, we have described these trends in the region- and country-specific sections of the Appendices.

There is little consensus on the best way assess the value of Green properties against "typical" properties, however real estate trends in several markets show a clear preference for tenants to occupy buildings with a particular certification level. This then corresponds with decreased vacancy rates and increased rent. For example, the Green Building Council in Australia published a series of case studies comparing Green Buildings with their market comparables and found a clear market advantage to certification (GBCA 2009).

3.1.5 Incentives

There is a myriad of incentive programs available globally and each building will be eligible for a particular subset of these incentives based on its location, size, context and type. Typically, incentives are offered by federal or provincial/state government agencies, utility providers and municipal bodies. The following is a non-exhaustive list of incentive types and examples of each:

1. Zoning exemptions. For example, Hong Kong and Singapore both grant permission to developers to build additional gross floor area beyond that which is allowed by zoning by-laws if a minimum certification level is achieved.
2. Rebates on energy-efficient or water-conserving equipment or fixtures. For example, Austin Energy (Texas) provides a rebate for new chillers and other equipment based on both peak demand and first-year annual energy savings compared with the code baseline.
3. Tax benefits. For example, the Government of Canada has created a specific depreciation class for renewable power generation equipment to improve payback periods.

3.1.6 Risk Management

Sustainability rating system credits are earned by providing several features that decrease risk for the building owner/landlord. These include:

- Fundamental and enhanced commissioning requirements that insure that the building is in working order at handover
- Handover documentation requirements to provide the facility manager with all documentation required to properly operate and maintain the building (often included in commissioning)
- Monitoring and verification systems to allow real-time tracking of energy and water consumption and alert the facility manager to equipment malfunction, leaks or sources of waste
- Decreased reliance on conventional energy sources through on-site generation, which improves resilience of the facility in case of power outages
- Incorporation of passive design elements to reduce energy consumption and limit the impact of future energy cost increases

To maximize the benefits of the above, owners/landlords are encouraged to mandate the achievement of these credits as part of the design brief for the project.

There is an intrinsic risk reduction associated with energy conservation. In the majority of countries, the electricity sector faces significant near- and long-term uncertainties including fuel prices, demand growth, and environmental and climate policy. Energy efficiency investments can provide an important tool for managing risk by reducing exposure to uncertain costs (e.g., fossil fuels), deferring major generation investments, and reducing environmental liabilities. Energy efficiency investments have inherent risk mitigation benefits for these very reasons. Energy efficiency investments also minimize the expected value of future costs and protect ratepayers from sudden increases in natural gas prices, etc.

With energy codes being constantly updated and standards increasing, there is an obsolescence risk for buildings that only just meet energy code as they will perform poorly with contemporary buildings that exceed code as well as future buildings designed to increasingly stringent codes. A focus on energy efficiency during design mitigates this risk.

3.2 Decision Making Framework

The framework provided on the next pages consists of questions rather than answers to allow it to be tailored to any project. The series of questions includes the evaluation of relevant factors and focuses extensively on benefits and costs to take advantage of synergies between different drivers and determine the optimal certification for a project.

The framework consists of two flowcharts. The first guides the process to identify the primary sustainability certification system and target rating. In many locations, a local standard may be a legislative requirement and would be the tool identified in this step. The second flowchart is used after the first to identify whether a second certification is likely to be beneficial to the project and provides guidance on how to determine what that should be.

Before the framework can be used, the following preliminary questions must be answered:

1. Where is the project to be located? (Country, City, Neighbourhood)

2. What legislative requirements exist in this location?

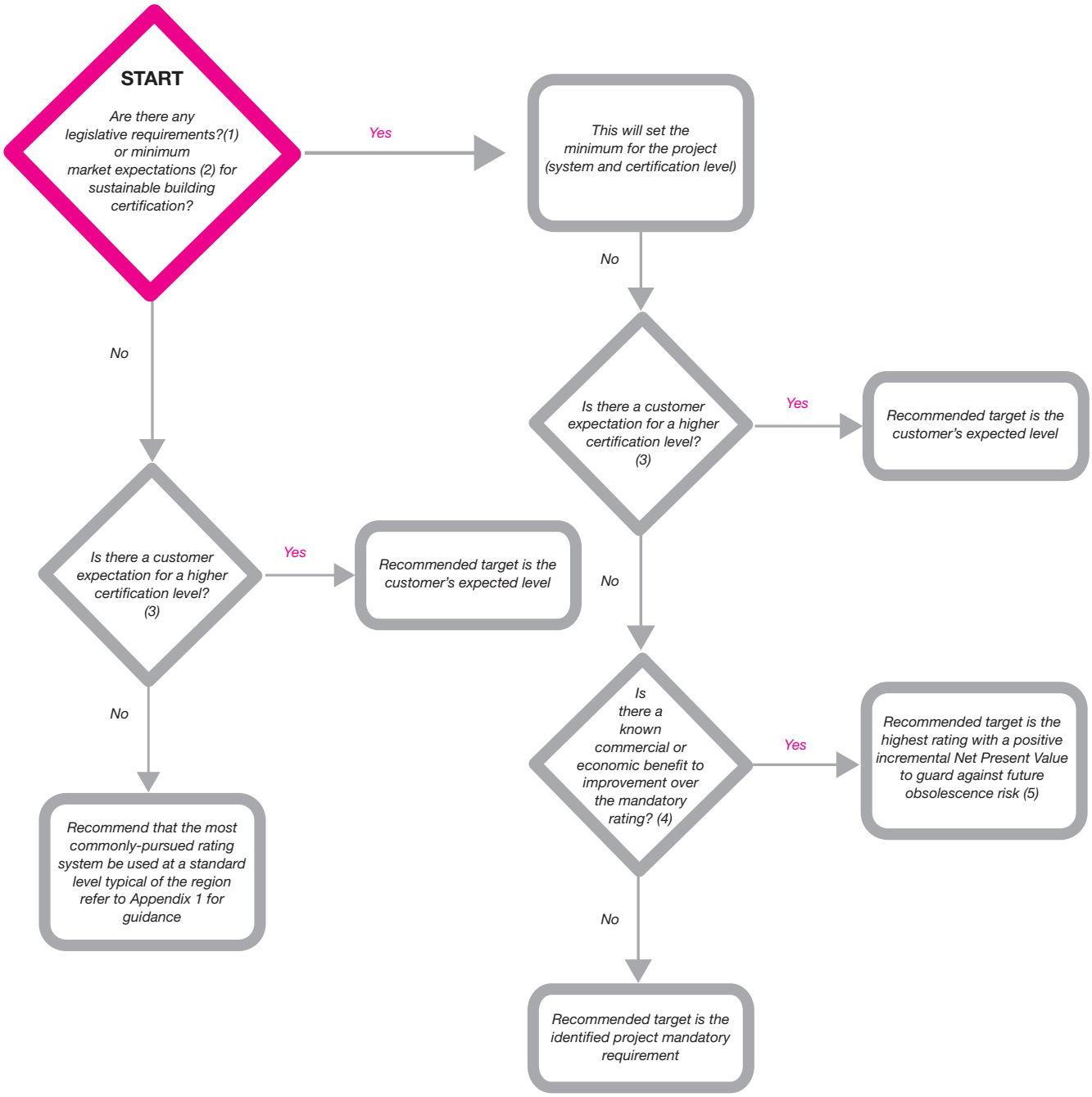
3. What are the local market dynamics/ expectations for new construction?

4. Who are the prospective tenants (names or types) and what requirements have they identified for sustainability certification?

5. Who is investing in this building?

Once this information is known, the flowcharts can be used. Each starts in the top left corner. Numbers in parentheses refer to notes included on that page, which echo the issues discussed in detail in the previous section. Each “Yes” or “No” answer leads to either a follow-up question (diamond), a statement of a resultant project requirement (circle), or a recommendation (rectangle).

DECISION CHART 1 FOR PRIMARY SUSTAINABILITY CERTIFICATION SYSTEM AND TARGET LEVEL



Notes:

1 For example, is there a minimum rating required by the permitting authority, mandatory disclosure (e.g. NABERS for offices exceeding 2000m2) or other incentive (e.g. GFA concessions for buildings achieving BEAM PLUS * in Hong Kong) that effectively mandates adoption of a particular rating system and certification. (Refer to Appendix 1).

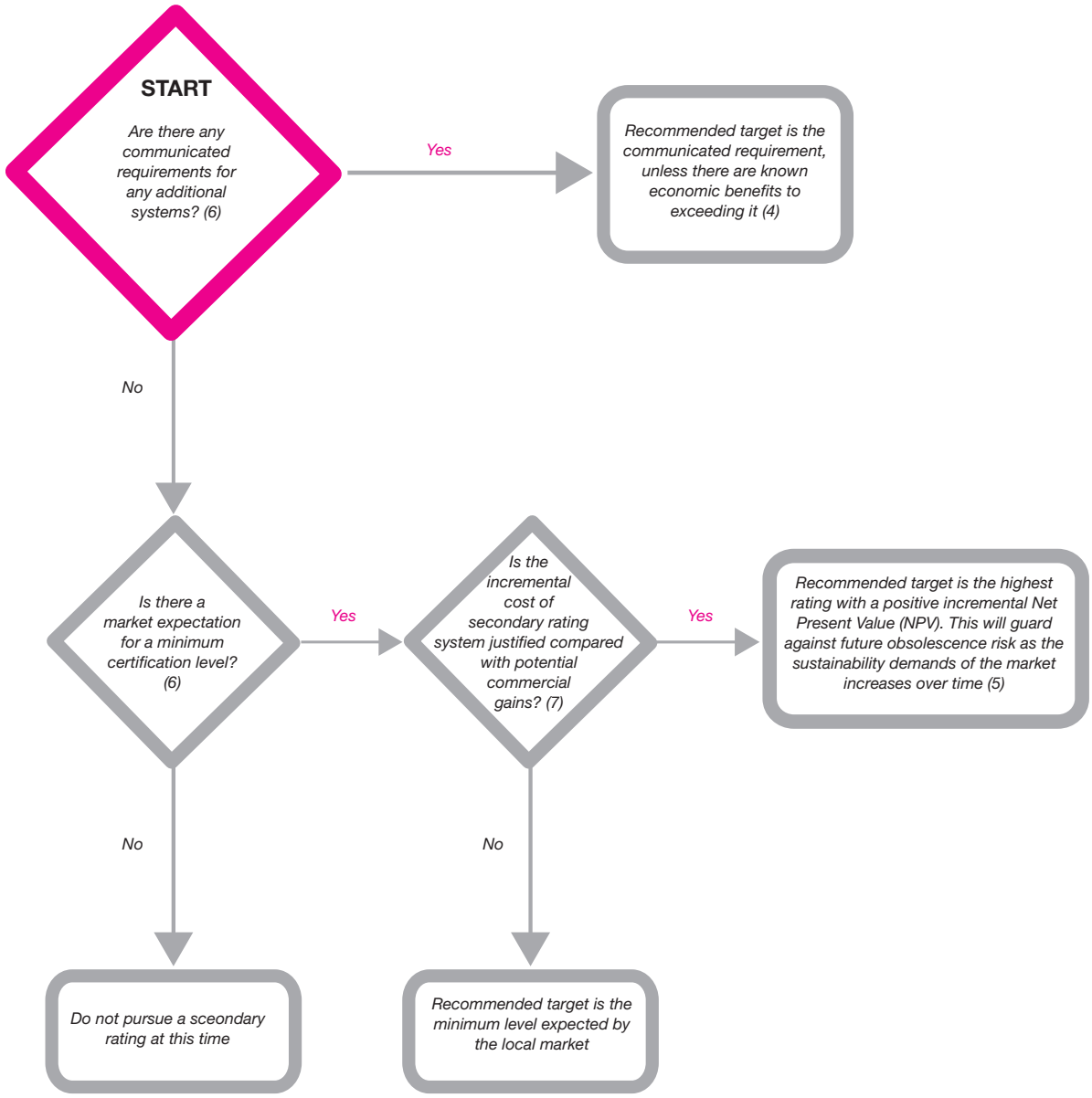
2 Some markets have clear expectations for minimum standards or ratings systems. Refer to the Appendix for trends noted by Arup regarding minimum expectations in commercial office buildings by region/country.

3 This includes both investor and prospective tenants and the decision-making factors for this is similar to that in Question 2

4 Factors that indicate a commercial or economic benefit for an enhanced level of certification include:

1. Market dynamics indicate a correlation with increased rental rates and higher building sustainability ratings
2. Reduced operating cost (either for an owner/occupier scenario or where the market looks primarily at gross rents (i.e. a reduction in OpEx will allow a higher base rent). A financial analysis specific to the proposed building is required to properly asses this factor.
3. A known market demand for higher sustainability ratings that is expected to improve absorption.

DECISION CHART 2 FOR SECONDARY SUSTAINABILITY CERTIFICATION SYSTEM AND TARGET LEVEL



5 Note that in all regions, we have noted a consistently increasing market demand for the achievement of higher sustainability ratings. Further, in regions where operational energy performance labeling is mandatory, a better-performing building will achieve high ratings without additional investment for a longer period than a moderately-performing building as the market baseline increases.

6 For example: 1. Are there investor requirements for a sustainability rating system certification that is otherwise uncommon in the local market(e.g. Corporate Sustainability requirements for investment only in buildings achieving a minimum certification level within a particular standard, 2. Would similar buildings internationally all target a particular rating system that differs from the local (e.g. Airports often pursue LEED® certification, even when this rating system is uncommon locally, for the purposes of international comparison)

7 A similar economic analysis to that indicated in #2 is recommended, considering this time only the incremental cost of achieving a second certification along with any associated incremental gains (rental uplift, reduced risk due to larger potential tenant market, etc) A sustainability specialist with local experience should be consulted to assist with this incremental cost calculation. The energy and water credit comparisons provided in this report will assist with comparison of credits in those categories and allow identification of where achievement of a credit in one system will result in a credit in another system. Note that the full spectrum of category types is beyond the scope of this report.

3.3 Sample Application of the Framework

Consider the following project:

A US-based developer is seeking to construct 500,000sf commercial office building to be constructed in the financial district of Boston, Massachusetts (USA) and attract a major bank ("Bank A") as its anchor tenant.

To begin to use the framework, we must first answer the preliminary questions:

1. Where is the project to be located? **Boston (Financial District)**

2. What legislative requirements exist in this location? **Demonstration of compliance with requirements to achieve LEED® Certification[1].**

3. What are the local market dynamics/ expectations for new construction? **For new office buildings, LEED® Gold is commonly expected; few new buildings target LEED® Silver or Certified ratings.**

4. Who are the prospective tenants (names or types) and what requirements have they identified for sustainability certification? **"Bank A" has not expressed any requirement for certification above LEED® Gold for new office space**

5. Who is investing in this building? **A US-based investor**

Decision Chart 1:

1. There are known legislative requirements (LEED® Certified equivalent) and market expectations (LEED® Gold) so the answer is "YES".

2. LEED® Gold thus forms the project minimum

3. There is no higher customer expectation so the answer is "NO".

4. A market study comparing improved valuation or increased rental rates/ improved absorption associated with a LEED® Platinum certification should be undertaken at this time, as well as a high-level estimate of the incremental cost of achieving LEED® Platinum versus LEED® Gold. Note that because an increasing percentage of credits must be achieved, the cost per credit increases with an increasing number of credits. The outcome of the analysis in (4) will indicate the optimal level of certification.

Decision Chart 2:

1. There are no communicated additional requirements so the answer is "NO".

2. There is no market expectation for a secondary certification so the answer is "NO".

3. Thus the recommendation is not to pursue a secondary certification at this time.

1 (Source: Boston Development Authority Website Development Review Guidelines http://www.bostonredevelopmentauthority.org/getattachment/65dba1c1-0947-4dac-9309-23b395849bb0).

4.0 Energy Credits

Energy Credits are included in sustainability rating systems for a number of reasons, including reducing ongoing energy costs, encouraging the use of more efficient building systems, promoting the use of renewable energy generation and to respond to the current dependence on fossil fuels as the primary energy source globally and its associated geo-political and environmental consequences.

To address these issues, energy credits focus on several design elements to decrease overall energy use, increase equipment efficiencies, improve system controls to decrease operational energy use, increase reliance on passive measures for lighting and ventilation and increase use of renewable energy (either generated on-site or procured by a renewable energy provider). Credits also promote building commissioning and ongoing monitoring and verification activities to establish a building baseline and provide the end-user to contribute to ongoing energy savings.

This section provides an overview of the energy credits found in the sustainability systems under consideration.

For the majority of credits, only the five comprehensive systems (LEED, BREEAM, Green Star, Green Mark and Beam Plus) are discussed as both NABERS and ENERGY STAR are primarily based on the building's relative performance compared with its peers. The exception is the credit related to the overall energy consumption of the building and associated CO2 emissions compared in Section 4.1.

The chart below summarizes the major energy-related credit types across the considered system. These are compared in each of the following subsections, providing an indication of the requirements for this credit type in each category, the associated credit name or number and, where direct comparison is possible across systems, a comparison of the relative requirements of each system.

OVERVIEW OF ENERGY CREDITS

	BREEAM	LEED v4 & LEED 2009	Green Mark	BEAM PLUS	Green Star	NABERS	ENERGY STAR
Country of Origin	UK	USA	Singapore	Hong Kong	Australia	Australia	USA
Energy Efficiency (Design & Equipment)	●	●	○	●	○	○	●
CO_2 Emissions	●	●	○	●	●	●	●
Sub-Metering/ Measurement	●	●	●	●	●	○	○
Commissioning	●	●	○	●	●	○	○
Operation of Equipment	○	○	○	●	○	○	○
Energy Audit	○	○	○	●	○	○	○
Lighting	●	●	●	●	●	○	○
Renewable Energy	●	●	○	●	○	○	○

4.1 Energy Efficiency and CO_2 Emissions

Note that because CO_2 emissions for each unit of energy vary based on the power generation fuel/energy source, which varies dramatically with location, it is not possible to generalize the comparison of carbon dioxide emissions with energy savings. Further, the comparison of actual building performance requires normalization of this data to a common climate for a truly apples-to-apples comparison of building performance compared to the various baselines. Finally, as the LEED assessment for the "Optimize Energy Performance" credit is based on energy cost savings, the regional variations between electricity and natural gas prices further complicate this comparison. As a result, we have not endeavored to provide a direct comparison of the credits for these systems in this report.

Energy efficiency is one of the drivers that has great importance within each of the sustainability frameworks being addressed in this report. However, the purpose and goal of energy credits under each rating system varies as follows.

BREEAM aims to minimize building operational energy consumption through good design through two credits: *Ene 01 Reduction of Emissions* and *Ene 08 Energy Efficient Equipment.* It recognizes and encourages procurement of energy-efficient equipment. Credits achieved under BREEAM are based on the predicted energy performance of the building compared to the performance of an equivalent National building that complies but not improves current building energy performance standard.

The LEED v4 intent for projects to reduce the environmental en economic harms of excessive energy use by achieving a certain level of energy efficiency for the building and its systems and to increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability, and reduce greenhouse gas emissions. There is a Minimum Energy Performance prerequisite as well as the *EA Optimize Energy Performance* credit where points are achieved by demonstrating a building's improvement compared against ASHRAE 90.1- 2010 baseline case.

In LEED 2009, the intent for the energy efficiency credit is to achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use. Again, there is a minimum pre-requisite as well as the *EA Optimize Energy Performance* credit where points are achieved by demonstrating building's improvement compared against ASHRAE 90.1- 2004 baseline case.

Green Star aims to encourage and recognise designs that reduce peak demand on energy supply infrastructure with the *Ene-5 Peak Energy Demand Reduction* credit. The project achieves available points by clearly demonstrating that the demand on the infrastructure will never exceed the established threshold or that the building design ensures a flatter overall electrical demand curve.

In BEAM Plus, there are several credits within that align with energy efficiency. Objectives include encouraging energy conservation and methods to reduce peak electricity demand *(EU 2)*, energy efficient design and control of ventilation systems in large mechanically ventilated car parks *(EU 4)*, adoption of lighting equipment and controls that will provide for energy conservation *(EU 5),* ensuring the installation of air-conditioning units provides for near optimum performance , wider use of energy efficient appliances *(EU 9)*, and energy efficient building layout *(EU 13)*. These credits are awarded by two means, demonstrating percentage improvement (energy consumption) over credit specific requirements, and others by documenting prescriptive paths.

Under the Green Mark scheme, there is a prerequisite for total building energy reduction for GoldPLUS or Platinum ratings. For GoldPLUS, the building must use 25% less energy (annual kWh) than a building designed to the Singapore Standard (SS) baseline. For Platinum rating, this percentage reduction is increased to 30%. In addition, there are several credits addressing energy efficiency based on prescriptive criteria. The objectives of these credits are: encouraging building designers to make use of better energy efficient air-conditioning equipment to minimise energy consumption *(NRB 1-2)*, enhancing the overall thermal performance of building envelope to minimise heat gain *(NRB 1-3)*, designing for good natural or mixed mode ventilation *(NRB 1-4)*, especially in corridors, restrooms and other common areas *(NRB 1-8)*, the use of energy efficient lifts and escalators *(NRB 1-9)* and the use of energy efficient practices and features that are innovative and/ or have positive environmental impact *(NRB 1-10)*. A project achieves credits

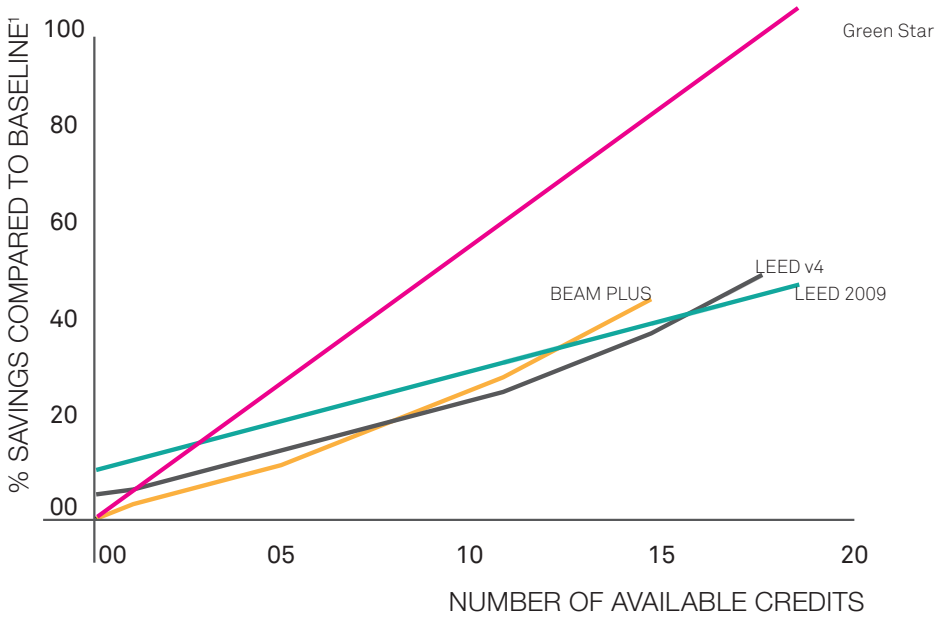
allocated within each category by demonstrating improvement over prescribed efficiencies and/or performance. This is demonstrated through energy modeling of the proposed design against a code compliant building.

NABERS for new buildings require an Energy Commitment Agreement where the building commits to a specific Rating based on the Energy for Offices Calculator and Rules compared to the benchmark applicable. NABERS greenhouse gas emissions points are achieved by attaining increasing reduction from baseline case. Reductions are calculated through the Offices Calculator and Rules.

The Energy STAR Portfolio Manager is used to compare new buildings require an Energy Commitment Agreement where the building commits to a specific Rating based on the Energy for Offices Calculator and Rules compared to the benchmark applicable. NABERS greenhouse gas emissions points are achieved by attaining increasing reduction from baseline case. Reductions are calculated through the Offices Calculator and Rules.

There is some data making a normalized comparison indicating two diverging trends. A commercial office building was modeled in a hot climate (Dubai) LEED was the most demanding, with BREEAM less so and Green Star the least stringent of the three considered (Roderick et al, 2009). In cooler climates, a different trend was noted. In an actual building in Denmark, BREEAM was found to be more demanding (achieving only 8 of 19 credits for energy) while LEED was less so (22 of 36 available credits) (Birgisdottir, 2012). A recent Arup project, 16-storey speculative office in Central London was 33.8% below the BREEAM baseline ("Excellent") and 38% below the LEED 2009 baseline (16 of 21).

INCREMENTAL PERFORMANCE OVER BASELINE
A REQUIREMENT FOR ENERGY CONSERVATION CREDITS



Notes:
1 In Green Star (and NABERS), on-site renewable generation is subtracted from designed consumption. LEED 2009 has a similar approach but this has been removed from the LEED v4 system.
2 Of the baseline standards referenced in these systems, the BEAM Plus baseline standard (BEC) is the least stringent, while ASHRAE 90.1-2010 standard, which forms the basis for Leed v4 is the most stringent. It is difficult to compare these to Green Star which considers a baseline of 110kg/C02/m2/yr, which is highly dependant on climate and fuel sources used by electricity generation facilities in the region where the building is located.
3 BREEAM has been omitted from this table as the Energy Performance Ratio, while linearly related to the number of credits achieved (1 credit fo EPR = 0.06 increasing to 15 credits for EPR = 0.90) is based on the output of the EPC translator, which normalizes CO2 emissions and thus is not directly comparable.

4.2 CO_2 Emissions

CO2 emissions are addressed within the *Ene 01 Reduction of Emissions* credit in BREEAM by using a metric that is unique to this framework, EPRINC, a ratio that defines the building performance in terms of its CO2 emissions, energy demand and primary energy consumption. This is discussed in the previous section.

LEED v4 encourages greenhouse gas emissions reduction through the use of grid-sourced, renewable energy technologies and carbon mitigation projects *(EA Green Power and Carbon Offsets).* Points are achieved by engaging a contract for a minimum of five years for at least 50% of the project's total energy.

Green Star encourages building design to minimize greenhouse gas emissions associated with operational energy consumption through credit *Ene -1 Greenhouse Gas Emissions.* Points are achieved by demonstrating reduction of the Predicted Greenhouse gas emissions.

The BEAM Plus objective encourages a project to reduce the consumption of non-renewable energy resources and the consequent harmful emissions of Carbon dioxide (CO2) to the atmosphere. *EU 1 Reduction of CO2 Emissions* credits are awarded in reference to percentage reduction of CO2 emissions or annual energy consumption compared to the benchmark applicable.

NABERS greenhouse gas emissions points are achieved by attaining incremental reductions from a baseline case. Reductions are calculated through the Offices Calculator and Rules.

BASIS OF PERFORMANCE

	BREEAM	LEED v4 & LEED 2009	Green Mark	BEAM PLUS	Green Star	NABERS	ENERGY STAR
Country of Origin	UK	USA	Singapore	Hong Kong	Australia	Australia	USA
Energy Demand	●	○	○	○	○	○	○
Energy Consumption	●	○	●	●	○	○	○
Energy Cost	○	●	○	○	○	○	○
CO2 Emissions	●	○	○	●	●	○	○
Compliance with Prescribed Standard	○	○	●	○	○	○	○
Compared to a Database*	○	○	○	○	○	●	●

*NABERS Performance is compared with an average building's adjusted CO2 emissions
*ENERGY STAR Percentile of buildings with higher EUI in (equivalent GJ/sqm/yr or Mbtu/sf/yr)

4.3 Sub-Metering/ Measurement

Energy monitoring within BREEAM aims to recognize and encourage monitoring of operational energy consumption through sub-metering. One credit (*Ene 02: Energy Monitoring)* is achieved by implementing energy sub-meters to enable future connection to a BEMS for at least space heating, domestic hot water, humidification, cooling, fans (major), lighting, small power and other major energy-consuming items. A second credit is available by implementing a BEMS or accessible sub-meters to all tenants, or by floor of single occupancy buildings.

Energy measurement is a prerequisite for LEED v4 as well as an optional credit *(EA Prerequisite: Building-Level Energy Metering and EA Credit: Advanced Energy Metering*, respectively). The intent is to support energy management and identify opportunities for additional energy savings by tracking building-level energy use. Buildings must provide building-level energy meters, or sub-meters that can be aggregated to provide total building energy consumption. In addition, all projects are required to share with USGBC the energy consumption and electrical demand data for a five-year period. Advance Energy Metering will allow a project to achieve an additional point by installing advanced energy metering for all whole-building energy sources and any individual energy end uses that represent 10% or more of the total annual consumption of the building.

LEED 2009 encourages projects to provide means for the ongoing accountability of building energy consumption over time in the *EA Credit 5: Measurement and Verification* credit. Projects achieve three points by developing and implementing a Measurement and Verification plan that cover at least 1 year of post-construction occupancy. An alternative compliance for this credit allow projects to achieve 1 point by agreeing to share energy and water usage data through ENERGY STAR's Portfolio Manager tool and the USGBC Release form, for a period of at least 5 years.

In addition projects are encouraged to provide means for the assessment of building occupant thermal comfort under LEED 2009. Projects demonstrate compliance by including permanent monitoring systems and by agreeing to conduct a thermal comfort survey of building occupants within 6 to 18 months after occupancy.

Green Star projects are encouraged to install energy sub-metering to facilitate ongoing management of energy consumption. Projects are awarded one point in the *Ene-2 Energy Sub-metering* credit by providing sub-metering for substantive energy uses within the building and have an effective mechanism for monitoring the energy in place. In addition, if lighting and power sub-metering for each floor or tenant is provided and a monitoring mechanism is in place for this sub-metering, an additional point will be awarded.

The BEAM Plus objective is to enable building operators to measure, monitor and develop measures to improve the performance of the building's systems, especially energy. The *EU 12 Metering and Monitoring* credit can be achieved by installing metering that allows separate monitoring of electricity used by a main chiller plant, by air side of the HVAC system, instruments for monitoring building cooling load and operating parameters and metering for landlord's electricity consumption in common areas.

Green Mark encourages the use of better energy efficient air conditioned equipment by providing permanent measuring instruments for monitoring of water-cooled chilled-water plant efficiency within the *NRB 1-2 Air-Conditioning System* credit. Compliance is demonstrated by installing instrumentation capable to calculate resultant plant efficiency within 5% of its true value and in accordance to ASHRAE Guide 22 and AHRI Standard 550/590.

ENERGY SUBMETERING

● Yes ◍ Maybe ○ No

	BREEAM	LEED v4	LEED 2009	Green Mark	BEAM PLUS	Green Star
	UK	USA	USA	Singapore	Hong Kong	Australia
Boiler Plant	○	◍	◍	○	○	●[1]
Modular Boilers	○	◍	◍	○	○	●[1]
Chillers	○	◍	◍	●	●	●
Chilled Water Pumps	○	◍	◍	●	●	●
Chilled Water Flow Rate	○	◍	◍	○	○	●
Cooling Tower	○	◍	◍	●	○	○
Condenser Water Pump	○	◍	◍	●	○	○
Air-side HVAC Electricity	○	◍	◍	○	○	○
Electric Humidifiers	○	◍	◍	○	○	○
Motor Control Panels (For Fans & Pumps)	○	◍	◍	○	○	○
Substantial Energy Uses	●	◍	◍	○	○	○
Tenancy Areas	●[1]	◍	◍	○	○	●[2]
Landlord/ Common Space Electricity	○	◍	◍	○	●	○
High Energy Load Areas	●	◍	◍	○	○	○
Data Output is Monitored and Recorded by BMS	●	●	○	○	○	●
Notes	[1] Gas and Heat	Metering based on M&V Plan and selection of one of IPMVP Option B or Option D			Implement only one of the above measure	[1] If > 100 kVa [2] To achieve a second point

◍ Maybe : This Indicates that an applicable method is not prescribed; for e.g. a when a monitoring plan needs to be deloveped and could include several elements but none are prescribed

4.4 Lighting

Lighting is addressed in different credits across all systems; in many, these overlap significantly with the energy efficiency credits, while in others specific credits are provided for specific lighting-related energy conservation measures.

BREEAM has four credits related to lighting. *Hea1 Visual Comfort* aims to ensure best practice visual performance and comfort for building occupants. It is mandatory for all projects to install high frequency ballasts in all fluorescent and compact fluorescent lamps. Additional credits can be achieved by demonstrating compliance with national best practice daylighting guide, or meet good practice daylighting criteria or meet daylight illuminance recommendations for relevant building areas. Implementing a glare control strategies will allow projects to achieve one additional credit. One last credit will be awarded when internal and external illuminance levels are specified in accordance with national best practice, electric lighting illuminance uniformity is designed according to approved local standard, implementing adequate zoning controls, amongst others.

BREEAM also addresses effective design measures that promote low risk, safe access to and from the building. Projects are awarded one *Hea 06 Safety and Security* credit by complying with the national best practice road lighting guide for access roads, pedestrian areas, footpaths and cycle lines.

Energy efficiency in lighting is considered as part of *Ene 01 Reduction of Emissions,* and energy efficient light fittings for external areas can earn projects an additional point through the Ene 03 External Lighting credit by meeting or exceeding lighting requirements and providing controls through time switch or daylight sensors.

LEED v4 includes two lighting-related credits whose intent is to promote occupants' productivity, comfort, and well-being by providing high-quality lighting. The *EQ Credit: Interior Lighting* can earn one point by providing lighting controls that enable occupants to adjust the lighting to suit individual tasks and preferences. In addition, the *EQ Credit: Daylight* credit encourages projects to provide connection between building occupants and the outdoors, reinforce circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space. Projects may achieve up to three points by providing glare-control devices for all regularly occupied spaces and demonstrate compliance with spatial daylight autonomy requirements.

Providing a high level of lighting system control by individual occupants of groups in multi-occupant spaces and promote productivity, comfort and well-being is the intent behind LEED 2009 lighting credits. One point in the I*EQ Credit 6.1: Controllability of Systems – Lighting* credit can be achieved by providing individual lighting controls for at least 90% of the building occupants and lighting system controls for all shared multi-occupant spaces to allow adjustments for different needs. The *IEQ Credit 8.1: Daylight and Views - Daylight* credit can be achieved for projects that demonstrate that 75% or more of all regularly occupied spaces comply with daylight illuminance requirements or else through a prescriptive path.

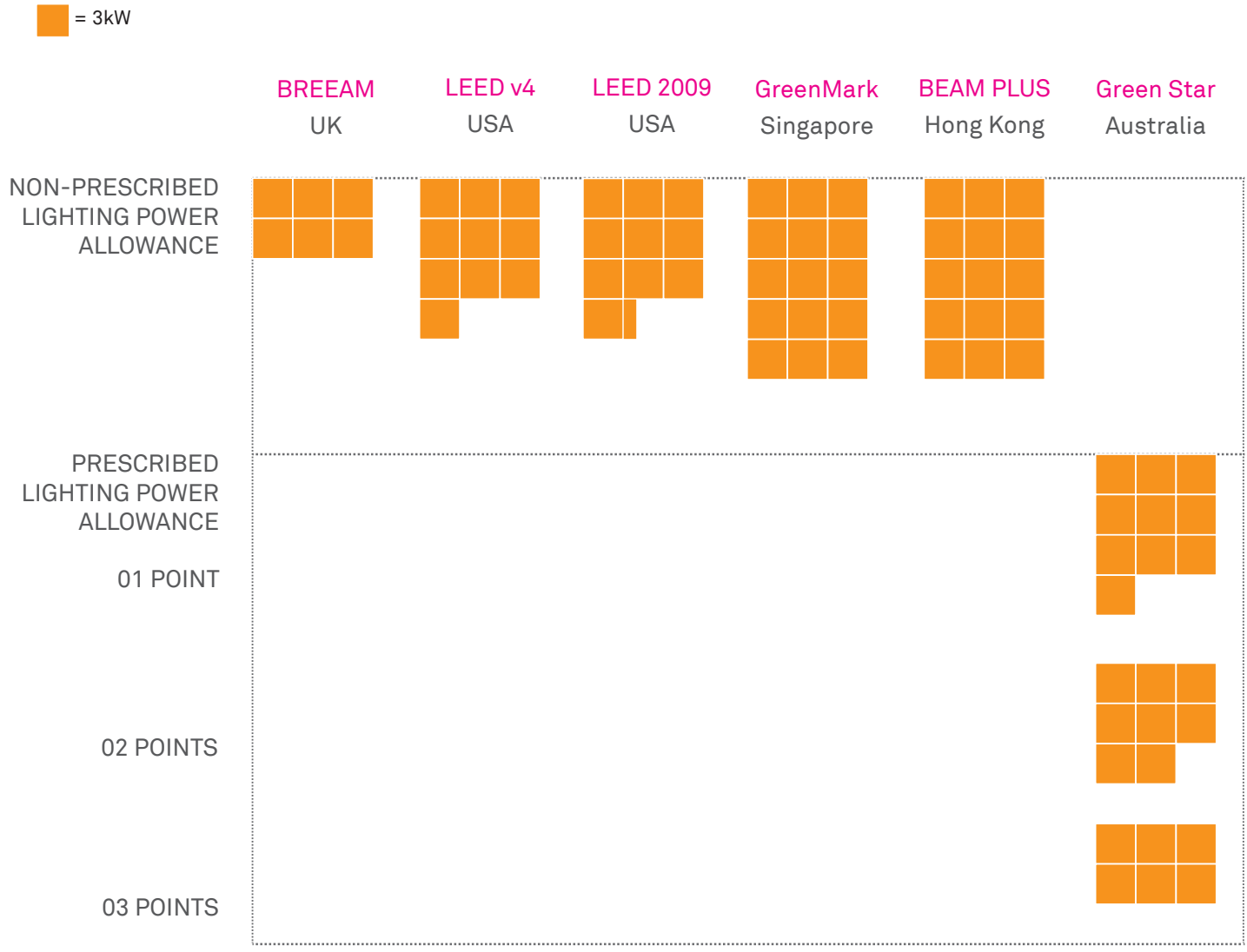
Green Star recognizes designs that provide artificial lighting with minimal energy consumption. Up to three points are awarded in the *Ene-3 Lighting Power Density* credit by demonstrating that lighting power densities comply with maximum W/m2 per 100 lux following required criteria. In addition, projects that implement lighting design practices that offer greater flexibility for light switching, making it easier to light only occupied areas can achieve up to two points in the *Ene-4 Lighting Zoning* credit.

BEAM Plus includes three credits related to lighting and between them, these credits encourage a holistic examination of site layout, building design, and fenestration design, such as to maximize access to daylight for the purposes of improved health and comfort. Projects can achieve up to two

points under the *IEQ 15 Natural Lighting* credit when adequately average daylight factor of 1% is achieved in 80 and 95% of the floor area. In credits *IEQ 16 Interior Lighting in Normally Occupied Areas and IEQ 17 Interior Lighting* in Areas Not Normally Occupied, lighting quality is addressed by ensuring the adequacy and maintenance of visual comfort conditions achieved by electric lighting provisions in occupied spaces, projects can achieve one credit where the prescribed lighting performance complies with specific requirements, plus an additional bonus is awarded by providing automatic control of artificial lighting such as daylight sensors at perimeter zones and/or occupancy sensors. One credit is awarded where the prescribed lighting performance in each type of common or service space in respect of light output and lighting quality is achieved.

Green Mark encourages design that optimizes the use of effective daylighting to reduce energy use for artificial lighting. Up to three points can be achieved within *NRB 1-5 Daylighting* by demonstrating daylighting provisions meet the minimum illuminance level for at least 75% of the units and are within the acceptable glare exposure. Another 12 points are available in the NRB 1-6 Artificial Lighting credit by improving lighting power budget.

RELATIVE LIGHTING POWER ALLOWANCE
FOR AN OFFICE BUILDING - 33,000 SF



4.5 Use of Renewable Energy

BREEAM allocates two points within the *Ene 04: Low and Zero Carbon Technologies* credit for projects that make an appropriate use of local energy generation from renewable sources. Projects shall achieve the first credit by conducting a feasibility study by an energy specialist to establish appropriate local low or zero carbon(LZC) energy source for the building, a local LZC energy technology has been specified and feasibility at procurement stage. An additional credit can be achieved by including a Life Cycle Assessment of the carbon impact of chosen LZC system.

LEED v4 encourages projects to reduce the environmental and economic harm associated with fossil fuel energy by increasing self-supply of renewable energy. Up to three points can be achieved in the E*A Renewable Energy Production* credit by using renewable energy systems to offset building energy costs.

LEED 2009 recognizes projects that increase levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use. Seven points are available within *EA Credit 2: On-site Renewable Energy* by using on-site renewable energy systems to offset building energy costs.

The use of renewable energy is considered within other major energy credits within the Green Star scheme. Where the building produces its own energy on site, this can be included within the energy modeling and use to directly reduce the building's predicted greenhouse gas emissions.

BEAM Plus encourages the wider application of renewable energy sources in buildings. Projects may be awarded with up to five points under *EU 6 Renewable Energy Systems* where 0.5 to 2.5% or more of building energy consumption is obtained from renewable energy sources respectively.

The application of renewable energy sources in buildings is encouraged by Green Mark. Up to 20 points may be achieved in the *NRB 1-11 Renewable Energy* credit based on the expected energy efficiency index and percentage replacement of electricity by renewable energy sources.

NABERS does not address renewable energy generation on site; however it can be excluded from energy consumption calculations.

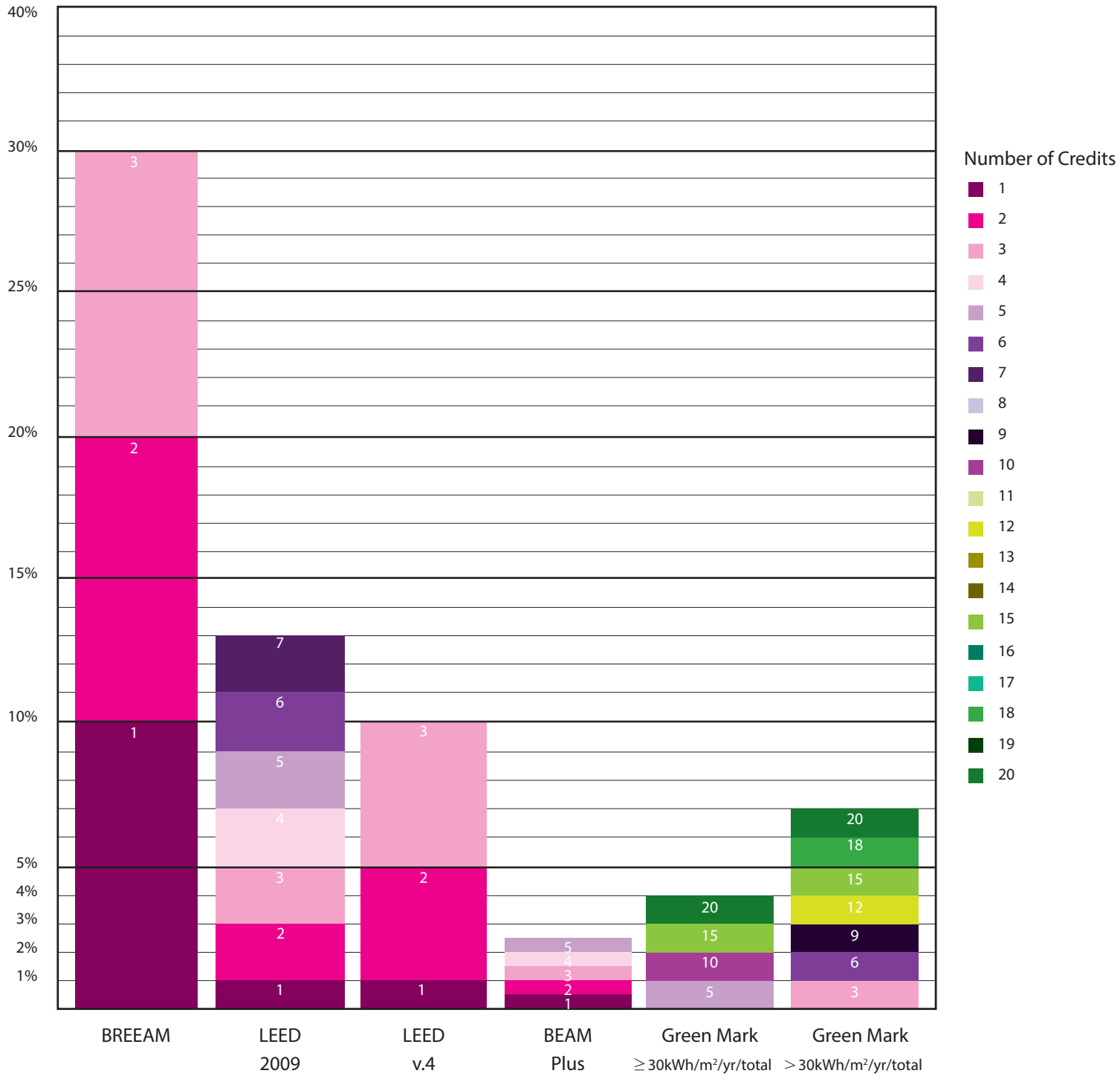
4.6 Heat Loss

BREEAM addresses heat loss within two major credits *(Man 01 Sustainable Procurement and Ene 01 Reduction of Emissions)* that encourage operational energy consumption reduction through good design and ensure delivery of a functional and sustainable asset design and built in accordance with performance expectations. One point is available by performing a thermographic survey that confirms continuity of insulation, avoidance of thermal bridging and air leakage paths through the fabric or performing an air leakage test.

Green Mark encourages projects to enhance the overall thermal performance of building envelope to minimize heat gain thus reducing the overall cooling load requirement for conditioned spaces. Two points are awarded in the *NRB 1-1 Thermal Performance of Building Envelope* credit for every reduction of 1 W/m2 in Envelope Thermal Transfer Value from baseline. There are 12 points available for projects to achieve.

Consideration of the envelope losses are indirectly considered in other codes as part of the *Total Building Energy Consumption* credits.

OVERVIEW OF CREDIT ALLOCATION BASED ON INCREMENTAL RENEWABLE ENERGY GENERATION (%)



4.7 Commissioning

Delivery of a functional and sustainable asset designed and built in accordance with performance expectations is BREEAM's goal with the *Man01 Sustainable Procurement* credit. Thresholds within this credit will award projects to achieve several credits by demonstrating compliance with requirements in different phases of the project such as: Project brief and design, Construction and handover, Commissioning, and Aftercare.

Under LEED v4, projects are required to implement a Commissioning and Verification Process for all energy related systems as part of *EA Prerequisite: Fundamental Commissioning and Verification.* This process is intended to support the design, construction and eventual operation of the project. Up to six additional points are available in *EA Credit: Enhanced Commissioning* by including additional activities for the commissioning authority, including envelope commissioning.

LEED 2009 also requires for projects to engage in a commissioning process to verify that project's energy-related systems are installed, calibrated and perform adequately as part of *EA Prerequisite: Fundamental Commissioning and Verification*. Two additional points can be earned in *EA Credit: Enhanced Commissioning* by including additional activities within the scope of the base commissioning.

For BEAM Plus, commissioning the electrical and mechanical system to ensure the impact on energy use of the systems is adequate. There are 5 points available in the *EU 10 Testing and Commissioning* credit for implementing and documenting commissioning specifications and a commissioning plan, undergoing commissioning activities, providing fully detailed commissioning reports, and having and Independent Commissioning Authority. An additional point can be achieved by transferring project knowledge to the building owner/manager.

Documentation and Handover

Aiming to ensure delivery of a functional and sustainable asset designed and built in accordance with performance expectations, BREEAM includes commissioning, training and aftercare support as part of the requirements to achieve *Man 01 Sustainable Procurement* credit. Also this scheme recognizes projects that design, plan and deliver accessible functional inclusive buildings in consultation with current and future building users and other stakeholders. Project may achieve one credit by developing Building User Guide(s) that are appropriate for all building users.

One credit can be achieved when seasonal commissioning occurs and there is a mechanism in place to collect energy and water consumption, compare this with what was expected and analyze any discrepancies. In addition, a contract or commitment to provide aftercare support to all the building occupiers must be in place. Projects may also achieve two points when documenting relevant section/ clauses of the building specification or contract, manufacturer's product details, documentation confirming compliance with relevant scheme or standard outlined in the criteria for functions and equipment included in energy efficient equipment requirements.

Neither LEED v4 nor LEED 2009 addresses documentation and handover in a separate credit; these requirements are integral to commissioning prerequisite and credit.

BEAM Plus has included the EU 11 Operation and Maintenance credit to enable building operators to implement the design intent, be able to monitor the performance of the building, and maintain the performance. There are three credits available when project develops and provides Operations and Maintenance Manual, Energy Management Manual, and develop and undergo Operator training and demonstrate adequate maintenance facilities are provided for operations and maintenance work.

4.8 Car Park Lighting and Ventilation

While BREEAM, LEED, GREEN STAR, NABERS and ENERGY STAR consider only the overall energy use of a building, BEAM Plus and Green Mark provide specific credits for reductions in Car Park energy use.

Within BEAM Plus, car park ventilation (*EU 4*) and lighting (*EU 5*) obtain specific credits within the BEAM Plus system for improvement relative to baseline by 20% and 25%, for one credit and two credits each, respectively.

In the Green Mark Scheme, up to 4 points are available for energy-efficient ventilation in car parks under credit *NRB 1-7*. Four points are achieved with a naturally-ventilated car park. The use of a fume extract system regulated by a CO sensor achieves 2.5 points and mechanical ventilation system regulated by CO sensors achieves 2 points.

4.9 System-Specific Credits

Several credits are found only in a single sustainability system. These are summarized below:

Demand Response (LEED v4 only)

This credit provides up two credits as follows:

1. Where a Demand Response (DR) Program is available and the building owner participates in this system, providing either fully-automated DR based on external initiation by the DR provider or semi-automated DR. Two credits will be rewarded for satisfying the following requirements:

- minimum one year commitment with the intention of multiyear renewal for at least 10% of the estimated peak demand as calculated in the EA prerequisite "Minimum Energy Performance"

- Development of a comprehensive plan for meeting the contractual commitment during a DR event

- Include DR processes in the scope of work for the Commissioning Authority, including participation in at least one full test of the DR plan.

Where a Demand Response (DR) Program is not available, 1 credit will be provided for the provision of infrastructure to take advantage of future DR programs or dynamic, real-time pricing programs and completion of the following:

- Install interval recording meters with communications and ability for the Building Automation System to accept an external price or signal control

- Development of a comprehensive plan for shedding at least 10% of the building estimated peak demand as calculated in the EA prerequisite "Minimum Energy Performance"

- Include DR processes in the scope of work for the Commissioning Authority, including participation in at least one full test of the DR plan

- Contact local utility representatives to discuss participation in future DR programs.

Peak Demand Limiting (BEAM Plus Eu 2)

This credit provides up to three credits for reduction of the peak energy demand compared with the baseline case as-follows: 15% decrease = 1 credit; 23% decrease = 2 credits and 30% decrease = 3 credits.

Air Conditioner Installation (BEAM Plus Eu 7)

Installation of window Air Conditioning Units according to the guidelines in the BEAM Plus guide achieves one credit in this system.

Use of Energy Efficient Appliances (BEAM Plus Eu 9)

One credit is available when 60% of total appliances are certified energy efficient products. This is increased to 2 credits when 80% of appliances are certified.

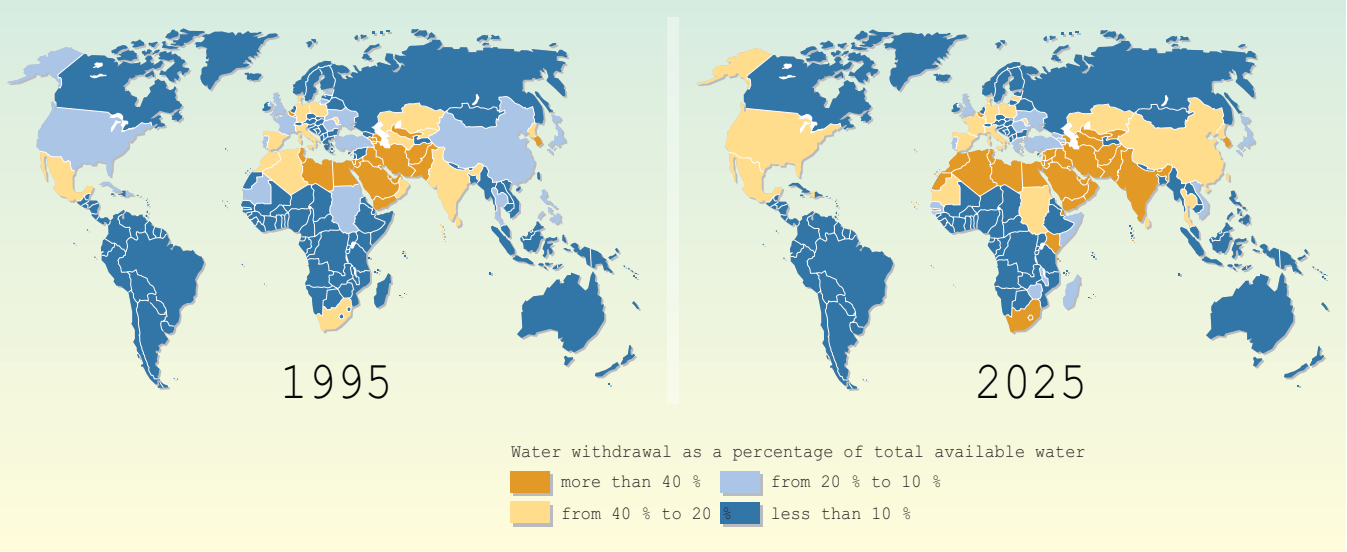
Energy Efficient Building Layout (BEAM Plus Eu 13)

Five strategies are outlined in the BEAM Plus system to optimize the building layout for energy efficiency: consideration of built form and orientation, consideration of optimal space planning, consideration of building permeability for natural ventilation, provision of fixed or movable external shading and provision of movable external shading devices for major atrium façade windows or skylights. If all are implemented, two credits are awarded. If only three are implemented, a single credit is awarded. It should be further noted that if the passive design alternative is used for credit Eu 1, there are several prescriptive requirements including glazing allowance by orientation. Refer to the BEAM Plus guide for more information.

5.0
Water Credits

Water Credits are included sustainability rating systems to respond to the increasing scarcity of potable water resources globally. The figure below shows the increasing water scarcity globally, showing a consistent increase in the increasing water stress globally from 1995 data to 2025 projections.

GLOBAL PROJECTIONS INDICATING INCREASING WATER STRESS (UNEP 2008)



To address this issue, water credits focus on several design elements to decrease both indoor and outdoor water consumption, promote the use of low-flow fixtures, minimize the use of potable water for irrigation, cooling towers and sewage conveyance, monitor for system leaks, as well as increase the use of rainwater harvesting and treated greywater for non-potable purposes.

This section provides an overview of the energy credits found in the sustainability systems under consideration.

The chart below summarizes the major water-related credit types across the considered system. These are compared in each of the following subsections, which will each indicate the requirements for this credit type in each category, the associated credit name or number and, where direct comparison is possible across systems, a comparison of the relative requirements of each system.

OVERVIEW OF WATER CREDITS ACROSS SYSTEMS

● Yes ○ No

	BREEAM UK	LEED v4 USA	LEED 2009 USA	Green Mark Singapore	BEAM PLUS Hong Kong	Green Star Australia
Baseline Water Consumption	●	●	●	●	●	●
Indoor Water Use Reduction	○	●	●	○	○	○
Outdoor Water Use Reduction	○	●	●	○	○	○
Specifications for Water Fittings/ Facilities	●	●	●	●	●	○
Leak Detection System	●	○	○	●	●	○
Water Metering	●	●	○	●	○	●
Flood Risk	●	○	○	○	○	○
Potable Water Consumption	○	○	○	○	●	●
Water Recycling	○	○	●	○	●	●
Water Runoff	○	●	●	○	●	●
Cooling Tower Water	○	●	○	●	●	●
Water Filtration System	○	○	○	○	○	○
Water Modeling During Design	○	●	○	○	○	○
Rainwater Use	○	●	○	○	●	○

5.1 Indoor Water Use Reduction

Water consumption reduction is addressed in a similar way across all the schemes, each rating system has a specific water calculation tool that establishes a baseline case and water consumption reduction prerequisites and thresholds will vary. The individual credits in each system are:

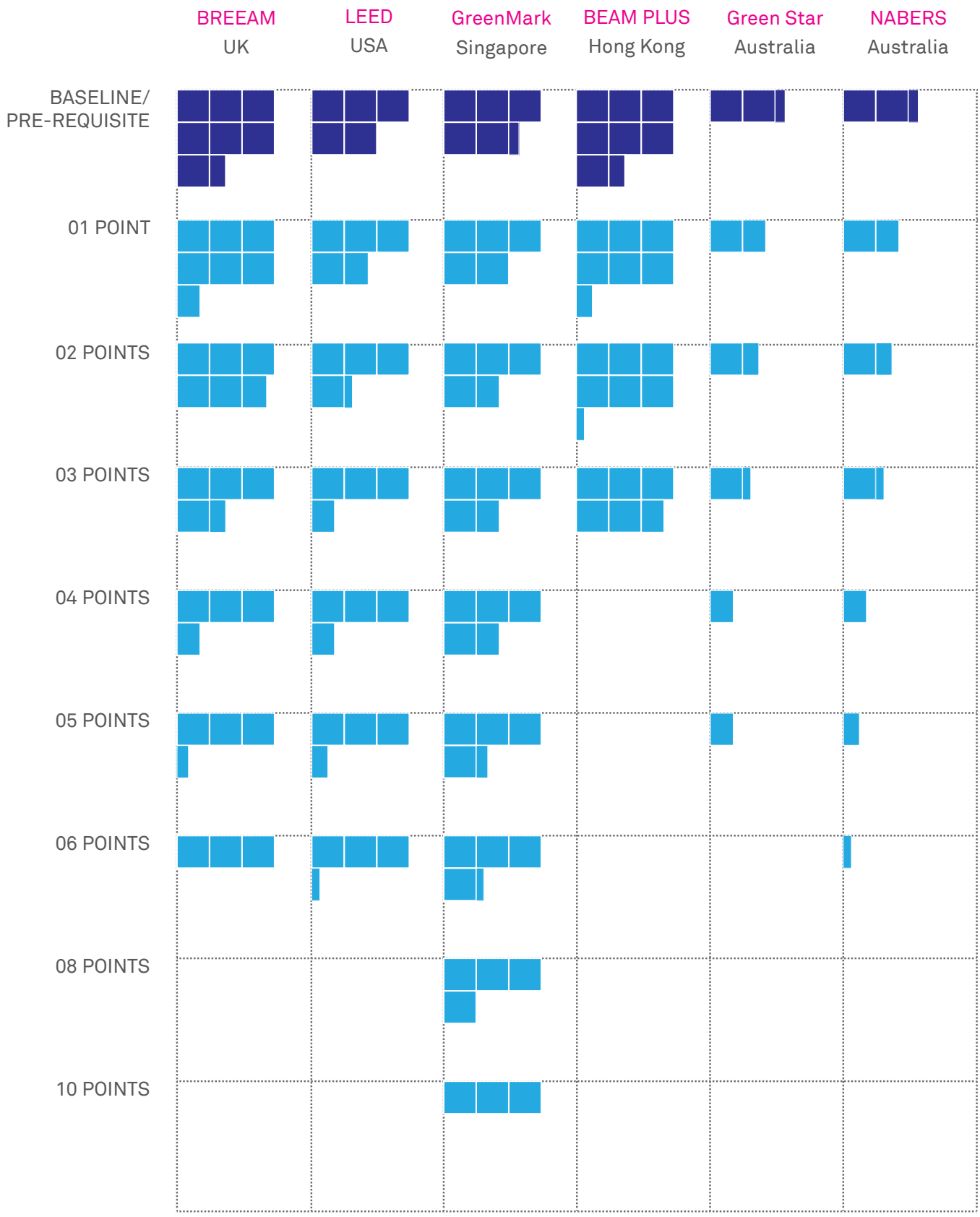
- BREEAM: Wat 01 Water Consumption
- LEED v4: WE Credit: Indoor Water Use Reduction
- LEED 2009: WE Credit 3: Water Use Reduction
- Green Star: Wat 1 Occupant Amenity Water
- Green Mark: NRB 2-1 Water Efficient Fittings
- BEAM Plus: WU P2 Minimum Water Saving Performance.

BEAM Plus has a second credit, *WU 6 Effluent Discharge to foul sewers*, related to decreasing sewage conveyance, which is similar to the LEED 2009 Innovative *WE Credit 2: Innovative Wastewater Technologies* credit.

RELATIVE WATER USE

FOR AN OFFICE BUILDING - 33,000 SF AND 100 FTEs

= 500 liters per day [lpd]



5.2 Outdoor Water Use Reduction

The BREEAM *Wat -4 Water Efficient Equipmen*t credit aims to reduce water dedicated for landscape irrigation require projects to implement irrigation controls, reclaimed water, no irrigation at all or only manual irrigation.

LEED v4 includes a minimum requirement (WE Pre-requisite: Outdoor Water Use Reduction for all projects to achieve at least 30% potable water consumption reduction from baseline, and up to two points available under the WE Credit: Outdoor Water Use Reduction to increase this to 50% and 100% reduction.

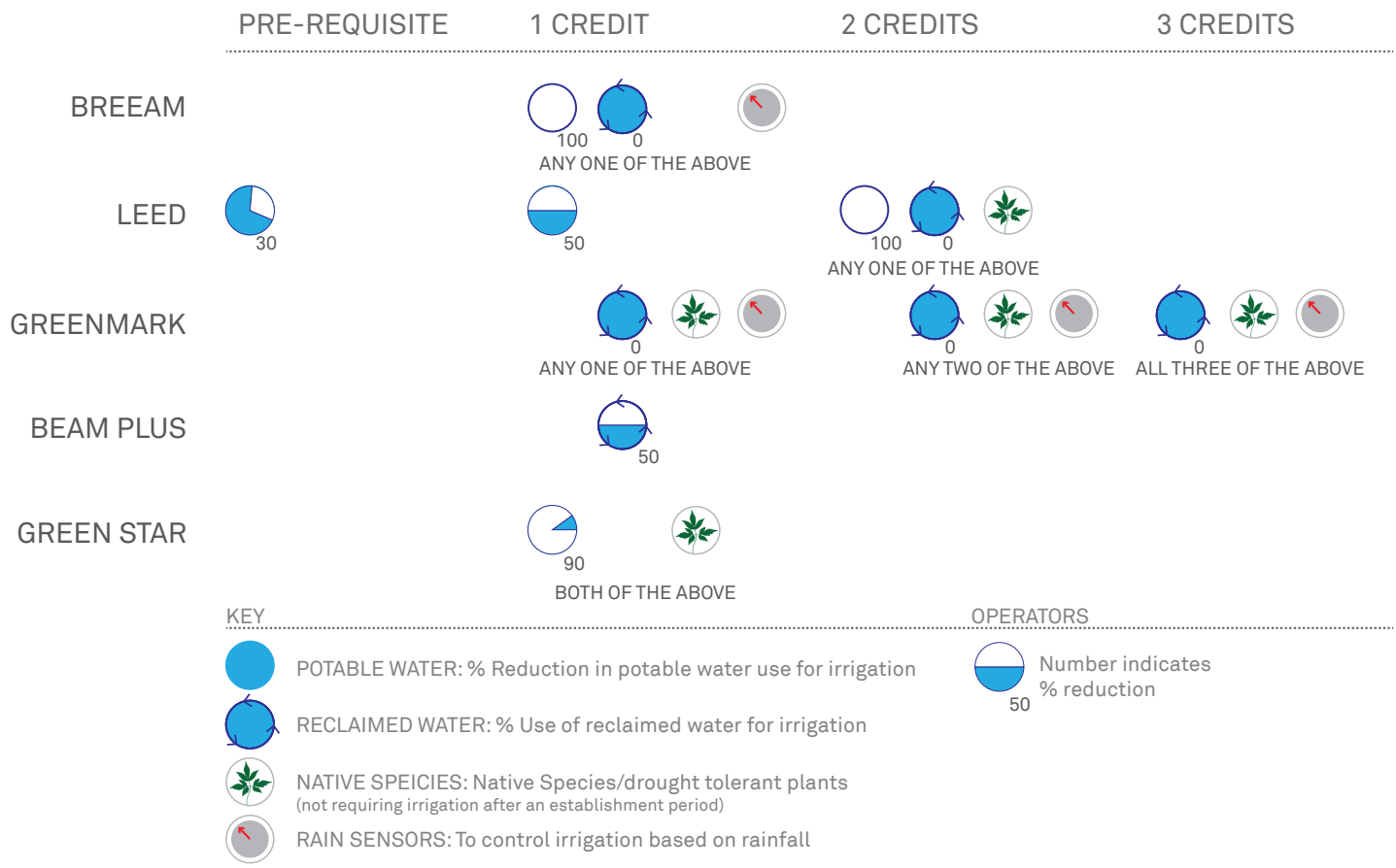
LEED 2009 encourages projects to limit or eliminate the use of potable water used in irrigation awarding with up to 4 points in the WE 1: Water Efficient Landscaping credit by reducing 50% and 100% from midsummer baseline case.

Green Mark projects may achieve up to three points in the Wu 3 Water Efficient Irrigation credit by using non potable water for landscape irrigation, using automatic water efficient irrigation systems (with rain sensor) and using drought tolerant plants.

BEAM Plus awards projects with 1 point in the NRB 2-3 credit by demonstrating that irrigation does not rely on municipal fresh water or using reclaimed water, implementing highly efficient irrigation technologies that reduce water consumption in 50% or more.

NABERS and Green Star will award projects with up to 6 and 5 credits, in the Water Reduction and Wat-1 Occupant Amenity Water credits, respectively by reducing the water consumption dedicated to irrigation over baseline case.

APPROACHES AND CREDIT ALLOCATION



5.3 Fixture Specification Credits

Within the water reduction credits discussed previously, some schemes include prescriptive requirements for water fixtures to comply with local labelling requirements. These include Green Mark, which encourages projects to include water fixtures with rating based on Water Efficiency Labelling Scheme (WELS), and BEAM Plus, which awards projects with one credit when water efficient appliances that have Water Efficiency Labelling Scheme Grade 2 or above.

5.4 Leak Detection Credits

Water leakage is a silent issue that when it is noticed by building managers or occupants, damage to the building can be substantial. Only BREEAM, Green Mark and BEAM Plus provide a credit specific to leak detection, as described in detail below. In other systems (LEED and Green Star), leak detection is indirectly addressed through the water sub-metering credit (see Section 5.5).

BREEAM recognizes projects that reward projects with one point in the *Wat 03 Water Leak Detection and Prevention* credit when leak detection system is in place and one additional credit when flow control devices are included in each WC area/facility.

Similarly, Green Mark awards one point in the *NRB 2-2 Water Usage and Leak Detection* credit when projects include linking all private meters to the Building Management System for leak detection.

BEAM Plus encourages projects to reduce potential leaks during installation of buried pipework within the assessment requirements for Plumbing and Drainage credit.

For Green Star projects, a leak detection system is a requirement within the *Wat-2 Water Meters* credit.

5.5 Water Metering Credits

Monitoring water consumption within buildings encourages water consumption reductions, most sustainability frameworks address metering requirements in specific credits where projects may achieve points by demonstrating compliance by having in place meters and sub-meters for specific water uses.

Water meter on incoming supply to each building and sub-meters for plants or building areas that consume 10% or more of the building's total water demand is required by BREEAM to achieve the *Wat 02 Water Metering* credit. For the NRB 2-2 Water Usage and Leak Detection credit in Green Mark there is one point for projects that include private meters to monitor the major water usage such as irrigation, cooling tower and tenants' use. Green Star considers bathrooms, showers, evaporative heat rejection, irrigation and wash-down systems, recycled and rainwater supply and humidifiers as major water uses that require metering in the *Wat-2 Water Meters* credit

All LEED v4 projects must commit to sharing water usage data with USGBC for a five-year period as part of the *WE Prerequisite: Building-Level Water Metering.* They are also required to have permanent water meters for total potable water use and sub-meters for cooling tower make-up and evaporative condenser systems. One additional point can be earned in the *WE Credit: Water Metering* credit by installing permanent metering for at least two of the water subsystems such as irrigation, indoor plumbing fixtures and fittings, domestic hot water, boilers, reclaimed water and other process water.

WATER SUBMETERING

● Yes ◍ Maybe ○ No

	BREEAM	LEED v4	LEED 2009	Green Mark	BEAM PLUS	Green Star
	UK	USA	USA	Singapore	Hong Kong	Australia
Whole Building Water Metering	○	●[1]	○	○	○	○
Bathrooms	○	○	○	○	○	●
Kitchens	○	○	○	○	○	●
Water-Cooled Heat Rejection (e.g. Cooling Tower)	○	○	○	●	○	●
Irrigation	○	●	○	●	○	●
Reclaimed Water Supply	○	●	○	○	○	●
Rainwater Supply	○	●	○	○	○	●
Wash	○	○	○	○	○	●
Humidification	○	●[2]	○	○	○	●
Boiler Feedwater	○	●	○	○	○	○
Domestic Hot Water	○	●	○	○	○	○
Indoor Plumbing Fixtures and Fittings	○	●	○	○	○	○
Notes		[1]Prerequisite [2]With Process Loads Implement two or more of the above measures, with each submeter serving at least 80% of the total installed for that category		All submeters to be monitored by BMS for leak detection		

5.6 Potable Water Quality

Water quality is considered in few of the sustainability systems, reducing the risk of water contamination and guaranteeing clean and fresh sources of water is the main objective in BREEAM's *Hea 04 Water Quality* credit. All water systems must be designed in compliance with national health and safety best practice guides for microbial contamination avoidance, failsafe humidification system is provided if required, and accessible potable drinking water is supplied in permanently staffed areas.

BEAM Plus requires all projects to demonstrate potable water quality compliance with Water Supplies Department (WSD) Guidelines drinking water quality standards at all points of use as part of the *WU Prerequisite 1 Water Quality Survey.*

5.7 Water Recycling

The use of recycled water within projects is considered as a strategy across all sustainability systems. For Green Star, the use of recycled water counts towards water consumption reduction in Indoor uses. In addition to indoor calculations, BREEAM and LEED v4 consider the use of reclaimed water for irrigation reduction calculations.

LEED 2009 awards projects with up to two points in the *WEC2: Innovative Wastewater* credit when recycled water is used to reduce at least 50% of building sewage conveyance or a minimum of 50% of wastewater is treated on site to tertiary standards.

BEAM Plus allocates three points under the *EU 6* credit for projects that use rainwater and/or greywater to reduce 5% or 10% of fresh water consumption

5.8 Cooling Tower Water Management

Projects can achieve up to two points under *WU Credit: Cooling Tower Water* Use in LEED v4 by achieving maximum number of cycles without exceeding maximum concentrations for specific parameters in condensed water for cooling towers and evaporative condensers (1 point < 10 cycles ≤ 2 points), or by meeting the minimum number of cycles and using a minimum of 20% recycled non potable water.

Green Mark's *NRB 2-4 Water consumption of Cooling Tower* credit is similar but thresholds, projects that achieve 7 or better cycles of concentration at acceptable water quality are awarded with one point and an additional point is available by using NEWater or on-site recycled water from approved sources for cooling purpose.

Green Star recognises projects with up to 4 points in the *Wat-4 Heat Rejection Water* credit when potable water consumption of water-based heat reaction systems is reduced. Thresholds are 50% reduction and 90% reduction or no water-based heat rejection systems are included in the project.

Cooling tower water management does not have its own credit in BEAM Plus, however it is included in other credits.

6.0
Vignettes of Certified Buildings in Various Systems

©Arup

6.1
One Shelley St. Sydney, Australia

Ratings Achieved

- 6 Star Green Star – Office Design v2 rating,
- 6 Star Green Star – Office As-Built v2 rating
- NABERS 5 Star Energy (2013/2014)
- NABERS 5 Star Water (2013/2014)
- NABERS 4.5 Star Indoor Environment (2013/2014)

Awards

- Architectural Steel Design Award, Winner, Australian Steel Institute, Commercial, NSW, 2010
- Structural Engineering Steel Design Award, Winner, Australian Steel Institute, Commercial, NSW, 2010
- Multilevel Steel Building Steel Design Award, Winner, Australian Steel Institute, Commercial NSW, 2010
- Excellence Award, Winner, Engineers Australia, Commercial, National, 2010
- Excellence Award, Winner, Engineers Australia, Commercial, NSW, 2010
- Estate Master Property Development Award, Australian Property Institute Excellence in Property Awards, Commercial, NSW, 2009
- Highly Commended BPN Sustainability Awards - Large Commercial Category, BPN Sustainability Awards, Environmental, NSW, 2009
- Excellence in Constructions Best Use of Steel, Winner, Masters Builders Association, Commercial, NSW, 2009

Key energy- and water-conservation features include a high-performance façade, the use of a passive chilled beam HVAC system, harbour water heat rejection and low flow fixtures.

One Shelley Street was the tenth building in Australia to achieve the Green Star 6 Star certification and achieved it in both 'design' and 'as built' categories. Spanning 33,000 square metres over 11 levels, the project has received much attention for its innovative and unique design. The award-winning property, owned and operated by Brookfield Office Properties, is fully leased to Macquarie Group and was built by Brookfield Multiplex.

A range of sustainable design features have been achieved including a passive chilled beam HVAC system, harbour water heat rejection, low flow water fixtures, and a high performance facade and central atrium that promotes natural light and mitigates solar load. The innovative external steel diagrid structural system encompasses the building's sleek glass facade, eliminating the need for perimeter columns and maximising the flexibility of the internal floor space.

The design has raised industry standards in environmental sustainability and workplace functionality. The triumphant design achieved world's best practice certification and a six-star Green Star rating. Two innovation points were awarded; one for being the first building in Australia to utilise 100 per cent NLA with passive chilled beams and harbour heat rejection and the second for undertaking a study with Macquarie Group to better understand the relationships between green buildings, indoor environmental quality, occupant perception and satisfaction and productivity.

"To achieve a Green Star 'Design' rating requires a commitment to innovation and a holistic approach to green building design. By backing this up with a Green Star 'As Built' rating, Brookfield has confirmed that the sustainable design intentions were implemented during the construction process. We congratulate the project team for delivering a truly world-class green building," says Chief Executive of the Green Building Council of Australia, Romilly Madew.

©Brookfield Properties

6.2 Brookfield Place, Calgary, Canada

This project will has a special focus on neighbourhood connectivity and encouraging both cycling and transit to reduce fossil fuel use and CO2 emissions associated with personal vehicle use.

Rating Targeted:

- LEED® Gold

Brookfield Place Calgary is a full-block commercial development located between 1st & 2nd Streets and 6th & 7th Avenues SW in downtown Calgary. This block represents one of the best remaining undeveloped sites in the city and affords Brookfield the opportunity to create another landmark development that significantly contributes to the public realm.

The development, consisting of 2.4 million square feet, includes what will be the tallest building in western Canada at 56 storeys and 247 meters tall to be located at the northeast corner of the block. Leading North American oil company Cenovus has committed to one million square feet of the east tower as the anchor tenant.

In addition to the east tower, development plans call for an additional office tower totaling approximately one million square feet, a 60-foot-high transparent glass pavilion, restaurants, retail shops and amenities at street level, and underground parking accommodating 1,100 parking stalls.

A half-acre lit public plaza will traverse the site and will feature restaurants and cafés, public art displays, cultural activities and programmed activity provided by Brookfield's award-winning Arts & Events program.

The development will be constructed to a high standard of sustainability and is expected to achieve the LEED Gold standard for Core & Shell development. Commuters will have direct access to the plus-15 skywalk system and the Calgary LRT on 7th Ave. The property will house an innovative bicycle parking facility accessible by dedicated bike ramps separate from vehicular traffic and electric car plug-in recharge stations.

6.3 The Shard, London, UK

This project will has a special focus on neighbourhood connectivity and encouraging both cycling and transit to reduce fossil fuel use and CO2 emissions associated with personal vehicle use.

Rating Achieved

- BREEAM “Excellent”

Awards

- Engineering News Record ENR : Global Best Project Award, 2013
- Constructing Excellence National: Major Project of the Year, 2013
- Council on Tall Buildings and Urban Habitat: Best Tall Building (Europe) , 2013

At 310 metres tall, the Shard is Western Europe’s tallest building. Designed by architects Renzo Piano Building Workshop, the Shard is a model for densely-packed, low-energy, mixed use development. Located above the transport hub of London Bridge Station, it will house a retail area, 25 floors of commercial offices (approx. 60,000m^2), three floors of restaurants, a 20,000m^2 Shangri La hotel, residential apartments and public viewing galleries. The project also includes an upgrade to London Bridge Station Concourse involving a new roof and retail units.

©Thomas Graham / Arup

The environmental strategy was addressed throughout the design and is key to the Shard’s iconic appearance. The project has achieved a BREEAM “Excellent” rating for the offices, aparemtnts and hotel, and includes the following sustainable elements:

- 95% of materials from demolition recycled
- 50% of all steelwork from recycled sources
- 1MW combined heat and power (CHP) generation to reduce CO2 emissions by 10% annually, compared with grid utilities
- Triple skin intelligent façade to maximize daylighting while reducing solar gains in the cooling season
- Winters gardens providing naturally ventilated workspaces
- Connectivity to mainline rail, tube and bus hub integrated into the development to facilitate use of public transit for commuters and residents
- Efficient land use (plot ratio of 32.1%)

©Arup

6.4 Construction Industry Council Zero Carbon Building, Hong Kong

Key strategies to reduce energy and water consumption include high efficiency lighting at an achieved lighting power density of 6 W/m2, advanced building controls including microclimate monitoring stations, a high temperature cooling and dehumidification system and an envelope to optimize energy use. Coupled with energy generation from on-site renewables, this zero-energy building.

Rating Achieved

- BEAM Plus Platinum

Awards

- Grand Award in New Building Category (Building under Construction) of The Green Building Award 2012
- Innovation Award of the Year of the RICS Hong Kong Property Awards 2013;
- One of the first buildings in Hong Kong which achieve Platinum Rating of Building Environmental Assessment Method (BEAM) Plus, the highest rating for excellent building environmental performance; and
- The Champion Award of The Innovative Award for the Engineering Industry 2012/2013

Opened in June 2012, the Construction Industry Council's (CIC) Zero Carbon Building (ZCB) is a pioneering project to showcase state-of-the-art zero carbon building technologies and raise community awareness of sustainable living in Hong Kong.

This building was Hong Kong's first zero carbon building and the first to actively feed on-site renewable energy from a combination of photovoltaic panels and a biodiesel tri-generation system back to the grid to offset the power consumed on an annual basis.

Going beyond traditional zero-carbon performance, the excess energy is exported to the local grid to cover the embodied energy of its construction process and building materials.

The large-scale use of biodiesel as a renewable tri-generation fuel is also a first in Hong Kong. The system uses waste cooking oil to generate power, solving two problems – waste treatment and energy generation – in one go.

The ZCB also features Hong Kong's first urban native woodland with 220 native trees of over 40 species and a diversity of shrubs. The woodland creates a high quality ecosystem embedded in a built-up area to benefit both the environment and people.

6.5 Changi City, Singapore

This mixed-use facility used Universal Design principles from an early stage to incorporate key sustainable feature to achieve significant energy and water savings while providing an enhanced occupant experience through the use of natural light and indoor vegetated areas.

Rating Achieved

- Green Mark Gold^{Plus}

Awards

- BCA Universal Design Award (Silver), 2012

Changi City is Singapore's largest integrated business park, including:

- Changi City Point with three levels of retail and F&B outlets totalling 28,500m^2, a roof-top garden with play grounds, and a 450-seat Arena for arts performances.
- 12-storey hotel development (313 rooms, 19,000m^2)
- ONE@Changi City Commercial Office (71,200m^2)

The Changi City Point Mall was awarded the BCA Universal Design Award (Silver), for the use of natural light and greenery to enhance the ambience of the mall. The mall design demonstrates that shoppers' comfort and convenience were top priorities for the management. For instance, they catered for seamlessly accessible features such as a sheltered bus-stop, taxi stand, passenger drop-off/pick up points and sheltered covered walkway. In addition to family-friendly amenities such as a nursing room, diaper changing station, children toilet, the mall also has first aid rooms and ample seats for the elderly.

Key sustainability features include:

- Estimated energy savings: 15,050,221 kWh/yr; estimated water savings: 299,582 m^3/yr; ETTV: 40.77 W/m^2.
- Designation control system for lifts in office building.
- AHU installed with UVC emitter to improve indoor air quality.
- Skylight at retail atrium to provide natural daylight.
- Recycling of AHU condensate in office building and hotel

7.0 References

The majority of the data regarding individual systems discussed in this report was obtained directly from the official system websites listed below:

LEED®: www.usgbc.org

BREEAM: http://www.breeam.org/

Green Star: http://www.gbca.org.au/green-star/

Green Mark: http://www.bca.gov.sg/sustain/sustain.html

Beam Plus: www.hkgbc.org.hk/eng/beamplus-main.aspx

NABERS: http://nabers.gov.au/

NABERSNZ: http://www.nabersnz.govt.nz/

ENERGY STAR: https://www.energystar.gov/

In addition, a large amount of country-specific information was obtained or cross-checked with the Green Building Council for each country discussed. The World Green Building Council maintains a database of established and emerging Green Building Councils here: http://www.worldgbc.org/worldgbc/members/

The following publications are also referenced within the body of this report:

Asia Green Buildings, “Green Buildings in Asia – Keeping up with the Environmental Pace”, May 10, 2013.

BCA 2009: BCA/GM GFA/2009-04-TD01 URA/PB/2009/04-DCG

(published at http://www.bca.gov.sg/GreenMark/others/gfa_appa02_29042009.pdf)

BCA 2012: BCA/GM GFA/2012-07-TD URA/PB/2012/09-DCG

(Published at http://www.bca.gov.sg/GreenMark/others/gfa_appa01_02072012.pdf)

Harpa Birgisdottir, “Lessons learned from testing four different certification methods for buildings – LEED, BREEAM, DGNB and HQE”, SBI Danish Building Research Institute, 2009.

Richard Bowmand and John Mills, “Valuing Green - How green buildings affect property values and getting the valuation method right”, published by the Green Building Council Australia, 2009

Richard Reed, Sara Wilkinson, Anita Bilos and Karl-Werner Schulte, “A Comparison of International Sustainable Building Tools – An Update”, 17th Annual Pacific Rim Real Estate Society Conference, Gold Coast (Australia), 16-19 January 2011

RICS, “Going for “Green” – Sustainable Building Certification Statistics Europe, Status May 2011”, 2011.

RICS, “Going for “Green” – Sustainable Building Certification Statistics Europe, Status September 2013”, 2013.

Ya Roderick, David McEwan, Craig Wheatley and Carlos Alonso, “Comparison of Energy Performance Assessment between LEED, BREEAM and Green Star”, Eleventh International IBPSA Conference, Glasgow, Scotland, July 27-30, 2009

Thomas Saunders, “A Discussion Document Comparing International Environmental Assessment Methods for Buildings”, BREEAM 2008

UNEP: “An Overview of the State of the World’s Fresh and Marine Waters”, 2nd Edition, 2008

8.0 Glossary

ABGR - Australian Building Greenhouse Rating

AHRI – American Heating and Refrigeration Institute

AQUA - High Environmental Quality (in Portuguese, Brazil)

ASHRAE – American Society for Heating Refrigeration and Air-Conditioning Engineers

BCA – Building Construction Authority (Singapore)

BEC – Building Energy Code (Hong Kong)

BEE - Building Environmental Efficiency score (Japan)

BRE - Building Research Establishment (UK)

BREEAM – BRE Energy Assessment Method

BREEAM-NL – BRE Energy Assessment Method for the Netherlands

CASBEE - Comprehensive Assessment System for Building Environmental Efficiency (Japan)

CDL - City Developments Limited

CFC - Chlorofluorocarbon (refrigerant causing damage to the ozone layer)

CGBL - China Green Building Label

DGNB - Deutsche Gesellschaft für Nachhaltiges Baue

EA – Energy and Atmosphere (LEED® credit category)

EPA - Environmental Protection Agency (USA)

EPBD - Energy Performance of Buildings Directive

EPR - Energy Performance Ratio (BREEAM energy use normalized value)

EU – European Union

GFA - Gross floor area

GGBA - German Green Building Association

GPR - Gross Plot Ratio

HQE - Haute Qualité Environmentale

IEQ – Indoor Environmental Quality

LEED – Leadership in Environmental Excellence and Design

kWh - Kilowatt hour

NABERS - National Australian Built Environment Rating System

NABERSNZ - National Australian Built Environment Rating System adapted for New Zealand

NECB - National Energy Code for Buildings (Canada)

SEDA - Sustainable Energy Development Authority

SF - Square foot

SS – Singapore Standard

URA - Urban Redevelopment Authority (Singapore)

Appendix A

Region-Specific Information

Region-Specific Information

The following sections provide information by region and country. Countries with more than 30 CoreNet Global members as of January 1, 2014 have been provided with their own write-up. All other countries with CoreNet Global members are covered at a higher level in regional discussions.

A1.0 Americas

LEED® is widely used across North America. At the time of this writing, LEED® v4 is being rolled out in the USA and Canada, and LEED® 2009 is still the version most commonly used in Mexico.

As in other regions, the global agreement on alternate compliance paths allows the use of local energy codes for energy savings calculations. In Canada, LEED® 2009 allows the use the Model National Energy Code for Buildings (1997) as an alternative compliance path. For LEED® v4, in Canada, this has been changed to the National Energy Code for Buildings (NECB, 2011).

LEED® is the most common sustainability rating system used in Canada for new construction and LEED® v. 4 is being rolled out in 2014, to replace LEED® 2009 used at present.

Canada

LEED® Gold is considered the standard for any new office construction, and several of the major financial clients now require LEED® Platinum Certification for any new leased spaces.

In many cities, the incremental cost of achieving LEED® Gold is reduced due to the existence of a local Green Standard (for example, the Toronto Green Standard) which is mandatory for permitting and overlaps with several LEED® requirements to achieve a Silver certification.

Green Globes is another Canadian standard but has had limited adoption within the commercial building market. Other sustainability rating systems are rarely used for commercial buildings, and would be typically in response to a particular tenant request.

Incentives, including rebates, tax credits and accelerated depreciation rates, are provided by utilities as well as governments at the federal, provincial and municipal levels. Examples of such incentives are accelerated capital cost allowance for Green Power generation (e.g. on-site photovoltaics) and the High Performance New Construction programme offered by the Ontario Power Authority in cooperation with Enbridge and a number of electrical utilities across Ontario.

United States of America

ENERGY STAR was created in 1992 by the US Environmental Protection Agency and it was created to rate existing buildings based on their energy efficiency performance compared to other buildings nationwide that have the same primary use. However New Buildings are rated as “Design to Earn the ENERGY STAR”. With over 24,000 buildings certified, ENERGY STAR® is the most common certification scheme in the United States.

LEED© was developed by the US Green Building Council and was initially released in 2000, currently there are over 18,600 buildings certified in the United States. Cities, Counties, and States as well as Federal and other public agencies might require buildings to achieve a specific LEED certification level (commonly established for LEED Silver) or else it is stabilised as an alternative to local by-laws. The US General Services Administration uses LEED certification system as a tool for evaluating and measuring achievements in sustainable design.

In addition there are incentives being implemented at city or state, where LEED certified buildings have property tax exemptions and exemption from local taxes to specific construction materials, tax credits, tax breaks etc.

Other sustainability frameworks have been developed by local administration and agencies, mainly based on LEED requirements and threshold.

Created in 2006 Living Building Challenge is a sustainable building certification program, where buildings are assessed based on actual performance rather than modeled or anticipated. There are mandatory requirements for projects pursuing the Living Building Challenge certification. Certification process and requirements are considered to be amongst the most rigorous ones. In 2010 the first project was certified and currently there are over one hundred buildings certified mostly in the United States.

Central & South America

Few Green Building Councils have been established in Central and South America, and LEED® is the dominant system in this area.

Brazil has adopted LEED as the primary green building rating system in the country. The first LEED project was certified in 2004, and since then, Brazil has reached second place worldwide in number of registered or certified projects. In 2014, the country has achieved 843 registered projects and 151 certified projects. 47% of the projects are Commercial office buildings. There is currently no locally adapted version of LEED to Brazil, although local projects can benefit from regional priority credits established for Brazil by the USGBC.

The LEED projects are irregularly geographically distributed and investments are concentrated at the economic centre of the country (Sao Paulo and Rio de Janeiro), which accounts for 77% of the total amount of projects. Business as usual building design does not meet minimum LEED energy standards due to lack of specific buildings codes for energy efficiency. This means that a LEED Level Certified Buildings is already considered of higher performance. Triple A commercial towers of international visibility; however usually aim for Gold, which is becoming a standard for this niche of the market.

The Green Building Council Brasil, associated with the World GBC was founded in 2007. The organisation has focused their efforts in producing a national version for LEED Homes, which is a growing market demand. This is supposed to be launched in August 2014.

There are no mandatory requirements for buildings in Brazil to meet any certification, so it is completely voluntary, including public buildings.

Brazil has its own green building certification that comes in second place of market preference. It is called AQUA (Acronym in Portuguese for High Environmental Quality) which is a local adaptation of the French HQE. It has been applied to commercial and residential buildings. The benchmarks are relatively easy to achieve and are less restrictive than LEED's. The audit process is extremely flexible and the system has recently certified buildings with clearly low environmental performance, which has impacted in reduced credibility of the system nationwide. AQUA is being reformulated at the moment and stricter benchmarks and audit process is expected to take place in the near future.

Procel Edifica is the energy efficiency label for Commercial, public and residential buildings. It is a national energy efficiency certification that considers both the building envelope and systems. It is voluntary and did not grow a lot in the recent years (it was created around 2004-2005). It may become mandatory for public buildings within the next couple of years (not date has been established yet)

Neighbourhoods: There are currently a few projects in the county attempting LEED Neighbourhood Development and AQUA Bairros (Neighbourhood) that are under development. This is expected to grow in the next few years.

The European Union adopted the Energy Performance of Buildings Directive (EPBD) (Directive 2002/91/EC) in 2002 as the central policy for building energy performance improvement. In 2006, mandatory building energy labelling began to be introduced, and is now required across the EU. Energy Performance Certificates have been widely used since 2010 and must include information on the energy needs/consumption of a building, including reference values to allow comparison with other buildings. Further, recommendations for cost-effective improvement options to raise the rating of the building are now mandatory in EPCs. In most countries, ratings are expressed on a letter scale (e.g. A to G, where A is very efficient and G is very inefficient), with some exceptions.

In addition to this mandatory building labeling, throughout Europe, LEED® and BREEAM use is generally driven by tenant desire to occupy certified space, and in many cases, the tenant will have a specific system and rating certification requirement.

There are several notable trends in the adoption of sustainability rating systems in the EU, which are described at a high level as-follows: BREEAM (with local variants) are most dominant in Ireland, Netherlands and Eastern & Central Europe, while LEED® is increasingly common in Germany, Switzerland and Southern Europe. The French HQE (Haute Qualité Environmentale) is used in French-speaking areas (France, Belgium and Luxembourg) but there have been several LEED® and BREEAM projects in each of these areas as well.

Within Eastern Europe, two cities that stand out are Warsaw (Poland) and Prague (Czech Republic) where BREEAM Very Good is a typical requirement (and market expectation) for a new office building, while BREEAM Excellent is becoming more commonly pursued. Outside of these areas, BREEAM Good (or LEED® Silver) is more common, with BREEAM Very Good (or LEED® Gold) considered ambitious.

The Netherlands

The Netherlands obtained a localized version of BREEAM (BREEAM-NL, http://www.breeam.nl/) in 2008, which is the dominant sustainability system in the region, with 25 BREEAM-NL certified buildings as of 2013 (RICS, 2013). The BREEAM-NL rating is frequently requested by tenants and has marketing value for a new property. Further, because it is based on Dutch regulations and building practices, the incremental work to achieve the certification is relatively small and the increasing number of online tools is further decreasing this level of effort. The BREEAM-NL system is understood to have marketing value and is frequently requested by tenants. In Amsterdam's financial district, for example, BREEAM-NL Excellent (4-star rating) has become the standard expectation and BREEAM-NL Outstanding (5-stars) is required to distinguish a building as being particularly sustainable. Elsewhere in the Netherlands, the expectations drop to BREEAM-NL Very Good (3-star rating) has become the standard expectation and BREEAM-NL Excellent (4-star rating), respectively.

Two other rating systems are commonly used in the Netherlands. The first is GPR http://www.gprgebouw.nl/, which is commonly requested by several municipalities. This is a relatively simple (web) tool for advisors and is a validated on the building site by visual inspections. Like BREEAM-NL, it is based on Dutch regulation and building practice and can be combined with BREEAM-NL certification without duplication of effort. The market expectation for GPR certification is 3 stars, while 4-star and 5-star buildings are considered exceptional.

The other common rating system is Energielabel (http://www.rijksoverheid.

nl/onderwerpen/energielabel-gebouwen/uitleg-energielabel), which is based on the demanded EPC calculation (based on EPBD) for building permits and is mandatory for building, selling or leasing a building.

Expectations and requests for certification to a particular standard vary across the country. GPR is requested by many municipalities for permitting. Like BREEAM-NL, it is based on Dutch standards.

United Kingdom

The United Kingdom (UK) developed the first sustainability rating system (BREEAM) in 1990. This is by far the most commonly used system in the UK, with over 99% of building certifications (approximately 4000 in 2011, compared with 8 LEED® certifications, rising to 6940 BREEAM certifications, compared with 38 LEED® in 2013).

BREEAM Excellent is considered the standard for any new office construction in a major urban centre, while "Very Good" is standard in suburban contexts and smaller centres. Several of the major financial clients require BREEAM Excellent or Outstanding Certification, notably in the financial districts. It should be further noted that many cities and municipalities across the country require a BREEAM "Very Good" as a planning requirement.

In the UK, many local planning authorities required a BREEAM assessment to be undertaken when constructing a new building. It is also a requirement than new publically funded buildings obtain BREEAM certification.

Germany

Germany developed its own sustainability rating system, the Deutsche Gesellschaft für Nachhaltiges Baue (DGNB, http://www.dgnb-system.de/en/schemes/scheme-overview/?pk_campaign=evtilesystem) in 2005. This system can be tailored to other regional contexts and has been used for several building certifications. In September 2013, it was the dominant system only in Germany and Austria but there have been several new certified buildings in eastern Europe under this system, from Czech Republic to Turkey (RICS, 2011).

There has been significant growth in sustainable building certifications in Germany over the past couple years and a strong shift toward the LEED® system. As of 2013, 359 of the certified buildings in Germany were certified to DGNB, compared with 46 LEED, 9 BREEAM and 1 HQE (RICS, 2013). This is a significant increase from 2011 when the breakdown for certified buildings were 171 for DGNB, 9 for LEED® and 6 for BREEAM (RICS, 2011) and shows a dramatic increase in the number of LEED-certified buildings (nearly 500%) compared with DGNB (210%) and BREEAM (150%). A key impetus to this increasing market share for LEED® was the 2012 LEED® agreement between the German Green Building Association (GGBA) and USGBC.

The market expectations for sustainable building certification vary widely across the country. Public sector buildings typically use a separate system (developed as an off-shoot of DGNB) and are rarely LEED® certified. At the other extreme, in the financial district of Frankfurt, LEED® Gold is considered a minimum rating, while an increasing number of tenants are seeking to occupy LEED® Platinum space. In other urban areas, this same trend is present but less pronounced, while in suburban areas, there are few certified buildings.

France

France was one of the first countries to develop its own certification system, the Haute Qualité Environmentale (HQE, http://assohqe.org/hqe/spip.php?rubrique9) in 1996. HQE is clearly dominant in France, though there has been a noticeable increase in the adoption of LEED® (up to 11 certified buildings in 2013 from one in 2011 and BREEAM (83 in 2013, up from 15 in 2011. At the same time, the number of HQE-certified buildings in France rose from 579 to 955. (All data from RICS 2013 and 2011)

Switzerland

In 2011, Switzerland only had one certified building and it was certified under the DGNB (RICS, 2011). By 2013, this had increased to 11, of which 9 used the LEED® certification system (RICS, 2013). As of the time of this writing, there was no common expectation in the market of a particular minimum level of building certification.

Spain

Sustainable building certification in Spain has picked up dramatically since 2011, with an increase in certified commercial buildings from 15 (12 LEED® and 3 BREEAM) to 44 (35 LEED® and 9 BREEAM) between 2011 and 2013 (RICS 2011 & 2013).

A3.0 Oceania

For new office construction, we have noted an increasing trend towards LEED® rather than BREEAM as the preferred system and LEED® is perceived to add value to the project in the form of reduced energy and water costs, while BREEAM is seen as more holistic in nature.

Australia

NABERS (http://www.nabers.gov.au/) and Green Star (www.gbca.org.au/green-star/) are the two most common systems used in Australia. LEED® is also used to a lesser extent, typically when a landlord is looking to attract a US-based corporate tenant or investor, or for airport projects.

NABERS is an energy benchmarking standard that is mandatory for any commercial building >2000m2 (21,520sf) in Australia. Several portfolio owners use the NABERS ratings to measure portfolio performance.

Green Star is a voluntary ratings system that is more comprehensive in nature (i.e. addresses water, sustainable materials, etc., and not just energy). Green Star has the benefit of access to a wider tenant market. The federal and any state governments, as well as large corporates, have office leasing standards that list a green star rating as one of the requirements. Certification to a 4 or 5 Star level is a de facto requirement of an A-Class building in this market.

The NABERS Energy rating is set such that the average of all existing buildings achieves 2.5 stars. For new construction, the market expectation is a 4 star NABERS energy rating for a typical building as this correlates with the code baseline. 5 star Green Star is an achievable benchmark for a building adopting excellent practice in design. 5 star Green Star and 4.5 to 5 star NABERS are fairly standard. Higher office Green Star ratings tend to occur in response to a brief from a major tenant looking for a new building. 6 star Green Star is a lot more difficult and tends to require significant onsite generation and/or water recycling plant. 6 star NABERS only came into existence in the past couple of years and is still quite rare.

The NABERS Water rating is increasingly common and reflects the water scarcity in many parts of Australia.

New Zealand

New Zealand has adapted the Green Star sustainability system and the energy component of the NABERS system (adapted for the New Zealand context in 2013, http://www.nabersnz.govt.nz/). As in Australia, the push for Green Star has been market driven and through government buildings setting minimum criteria for their accommodation.

Premium offices are currently targeting 5 star NABERS minimum, with several targeting a higher rating of "5 star + 50%". There is a sense in the market that the incremental cost to achieve 6 star does not correlate with a similar increase in building value, and thus while there was an initial push for 6 star ratings, these are not commonly pursued at this time. As the system is still new, mandatory disclosure is not yet required for NABERS ratings, and only 12 buildings had received NABERS Energy ratings as of this writing.

NABERS water is just starting to penetrate the New Zealand market and a 4 star water rating is considered achievable.

A4.0 Asia

There is a strong trend in the adoption of LEED® across all parts of Asia (Gulf region, Central Asia, South Asia, East Asia and Central Asia. In addition, there are systems used in specific countries or regional blocks as follows:

The Estidama Pearls system and design guide (developed in Abu Dhabi in 2010) is quite widely used in Abu Dhabi. It has been used elsewhere in the Gulf region, albeit to a lesser extent than LEED.

BEAM Plus is the dominant system in Hong Kong and has found some traction in Macau and southern China (Guangdong Province).

Singapore's Green Mark (http://greenmark.sg/) has been gaining popularity with certified buildings in Indonesia, Malaysia, Thailand as well as eastern China.

BREEAM has limited adoption at present in this region. Similarly CASBEE's application is limited to projects in Japan at the time.

China

LEED® has been tailored to the Chinese context and China is one of the countries with the most LEED®-certified buildings. LEED® Gold is typical for new construction, although some of the very large developments only pursue a Silver certification. We have not noted much variation between cities within China, but have found this to be a fairly consistent requirement for sustainable buildings. In general, the Chinese building codes have more stringent pump and fan power requirements than LEED®, however the envelope and chiller and boiler efficiencies are less stringent and must be upgrades from the code minimum to meet the LEED baseline.

In addition, China has a national building energy labelling system known as the China Green Building Label (CGBL), and commonly referred as "3-star" which was still voluntary at the time of this writing, but as each province has an agreed target for the number of certified buildings to be ach. 3 star rating is typically requested by tenants and is eligible for an incentive of 80rmb/m^2 (approx. US$13/$m^2$) of gross floor area, upon completion of both the "Design" and "Operation" stages of certification. As the 3 star rating is difficult to achieve, 2 star is the most common and is eligible for a reduced incentive of 45rmb/m^2 (approx. $US 7/$m^2$) of GFA. No incentive is provided for achievement of a 1 star rating. Additional financial incentives can also be applied for from Provincial Governments but these vary from Province to Province. Each province has a mandated number of buildings to achieve the CGBL

accreditation, resulting in pressure from the municipal and provincial bodies to achieve this accreditation.

BREEAM is rare in China, but Outstanding and Excellent building ratings have been achieved on ambitious projects.

Hong Kong

The BEAM Plus system described in detail in the report is the most common sustainability standard used in this area. For new government buildings in HK, the target is BEAM Plus Gold or above. Major developers for commercial buildings commonly set a target of BEAM Plus Gold as well. For developers, a key benefit of BEAM Plus certification in this market is that the HKSAR Government has provided a concession on the allowable Gross Floor Area (GFA) of up to 10% for sustainable elements for a certified building. This allows developers to build more on a site than otherwise permitted by zoning ordinances.

LEED® is commonly adopted in Hong Kong, while BREEAM is extremely rare.

India

LEED® has been tailored to the Indian context and designed primarily for new commercial office buildings. Since its first certified green building in 2003, India has the second largest number of green buildings per square foot after the US. It has 269 LEED certified buildings, up from just five in 2005. (Asia Green Buildings, 2013)

There is a reduced number of credits overall, so while most of the credit categories have been maintained (exclusions below), the number of credits available for each has been decreased. There is thus a corresponding reduction in the number of credits required to achieve each rating level: Certified (26), Silver (33), Gold (39) and Platinum (52). The following energy and water credits are noticeably different from LEED 2009:

- There is no prerequisite for water use reduction
- The Innovative Wastewater Technology credits Option 2 is more stringent, requiring on-site treatment of 100% of wastewater to tertiary standards
- Energy Credits: The baseline for LEED® India is ASHRAE 90.1-2004 and the number of credits has been reduced to 10 (achieved with a 42% savings relative to the baseline)
- Refrigerant management credits are somewhat different, with the Fundamental Refrigerant Management prerequisite limited to not using CFCs and a credit available for avoiding the use of HCFCs and Halons
- The Green Power credits are dramatically different; with LEED® 2009, this credit refers to the contracting to purchase a minimum 35% green power for the facility. In LEED® India, 50% is required to be generated by the company (i.e. the building owner) at any location within the country. There are several incentive programmes for the purchase of solar panels and other green power systems from the Ministry of Non-Conventional Energy Sources (MNES) to help subsidize this credit requirement.

Japan

Japan was one of the first countries to develop a sustainability rating system. The CASBEE Sustainability Rating system was developed in 2001. In its current version, it is specifically for use in Japan and is heavily based on the Japanese building code. As a result, it is not used to any measurable extent outside Japan but is widely used within the country. The system is broken into two broad themes – Built Environment Quality (covering Indoor Environment (including lighting, acoustics and indoor air pollution, Quality of Service (i.e. operational considerations) and Outdoor Environment on-Site) and Built Environment Load Reduction (covering Energy, Resources and Materials (including water conservation, recycled materials and avoiding CFCs, Halons, etc.) and Off-site Environment (including consideration of global warming, air pollution, heat island effect , local infrastructure and light pollution).

Each credit lists prescriptive

requirements to achieve Level 1 through Level 5 for that credit. The building overall rating is based as "BEE" (total of Built Environment Quality scores / total of Built Environment Load scores). The overall rank is showed as C (poor) through S (Excellent).

Singapore

Singapore's Green Mark Scheme has been very successfully adopted across Singapore. One of the largest developers in the city/state, CDL (City Developments Limited) made a commitment to GoldPLUS or higher for all new projects (source: http://www.cdl.com.sg/app/cdl/csr_and_sustainability/csr_philosophy.xml). In addition, the government also set goals for 80% of existing buildings to meet certified status by 2030 (source: http://app.mewr.gov.sg/web/Contents/ContentsSSS.aspx?ContId=1034).

The local building codes in Singapore are more stringent than the LEED® baseline for both energy and water, and buildings designed to the Singapore Building Code minimum requirements are well on their way to achieving the LEED® Minimum Energy Performance pre-requisite and will typically meet the Indoor Water Use Reduction prerequisite. Despite this, dual certification is still uncommon in Singapore; Green Mark is the most typical overall building rating, while LEED® Commercial Interiors is beginning to become more popular than the Green Mark Office Interiors rating for individual tenant spaces.

To encourage the private sector to develop buildings that attain higher tier Green Mark ratings (i.e. Green Mark Platinum or Green Mark GoldPLUS), the Urban Redevelopment Authority (URA) and BCA identified four "strategic growth areas to be developed in an environmentally sustainable manner" and set, minimum Green Mark standards of certification for projects developed on government sales sites and as a land sales condition as-follows:

- Marina Bay & Downtown core: Platinum/ GoldPLUS rating is the minimum requirement
- Jurong Gateway in Jurong Lake District: GoldPLUS
- Kallang Riverside: GoldPLUS
- Paya Lebar Central: GoldPLUS

In addition to these minimum standards, Gross Floor Area (GFA) incentives are available to new private developments (including Major Retrofitting of existing buildings over 10 years old with "Energy Enhancements"). For buildings attaining Green Mark Platinum or GoldPLUS, URA will grant additional floor area over and above the Master Plan Gross Plot Ratio (GPR) control as follows:

- Green Mark Rating of Platinum: up to 2% to a maximum of 5,000 sqm
- Green Mark Rating of GoldPLUS: up to 1% to a maximum of 2,500 sqm

The allowable additional GFA is calculated as follows:

Maximum allowable GFA = (Proposed GFA based on allowable intensity) x (Prescribed Green Premium) divided by Land Value (source: BCA 2009, 2012).

It must be noted that a security deposit of 50% of the market value of the allowable of the allowable GFA is retained by the BCA upon application of the GFA incentive and there are significant financial penalties for failing to achieve the agreed level of compliance, which may exceed the security deposit value. (source: BCA 2009, 2012).Finally, projects funded by the Government are often mandated to achieve a higher Green Mark rating.

A5.0 Africa

Sustainable building rating systems have been adopted to a limited extent in Africa. South Africa is the notable exception, with 50 Green Star certified buildings. Interest in Green Star has also been rising in East Africa (Kenya).

BREEAM and LEED® have both found limited traction in Africa to date and where there have been projects seeking certification, this has generally been due to a request from a specific investor or tenant.

Brookfield

ARUP

For further information contact:

sustainability@arup.com