Trade Impact of Green Commercial Building Rating Systems in the Asia-Pacific Region

APEC SCSC Case Study 2

APEC Sub-committee on Standards and Conformance
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Executive Summary

This study focuses on green building rating systems in APEC economies. It is one of two case studies requested by the APEC Subcommittee on Standards and Conformance (APEC SCSC) for the United States host year, which included a focus on promoting green growth and regulatory cooperation and convergence. The objectives of the two case studies are to raise awareness of existing "green" standards, conformity assessment procedures, or codes being developed internationally, in advance of regulation; to understand which APEC economies use voluntary and/or mandatory programs for "green" commercial construction; and discuss how member economies may cooperate on the development of standards, conformity assessment and codes that underpin these policies, with a view to facilitating trade and avoiding technical barriers. The analysis seeks to answer the question, "What is the trade impact of green building rating systems in the Asia Pacific?"

This case study adapts the structure used in "Sustainable Building Rating Systems Summary,"[i1] for analyzing the rating systems' broad-based criteria. In addition, technical criteria, including technical categories and associated points, standards and procedures used to certify conformance, and methods for modeling and monitoring building performance after construction of the rating systems, are analyzed. An overview and detailed analysis of rating systems in use or under development in the APEC region is included. The commonalities and differences among rating systems and trends in development and implementation of rating systems that may affect trade are analyzed, followed by recommendations for promoting harmonization and overcoming existing or potential barriers to trade resulting from the implementation of green building rating systems.

Potential barriers to trade include varying criteria, varying standards and processes used for conformity assessment, degree of stakeholder involvement, lack of information on criteria or conformity assessment procedures in the public domain, and rating system selection for products, materials etc. that favor in-country certification programs. Although the Leadership in Energy and Environmental Design program in the United States (LEED-USA) has spread rapidly throughout the world, other economies may have good technical reasons for developing non-LEED systems, particularly where climate and building product markets are similar. Some rating systems are adopting or using tools that allow comparison of the environmental performance of buildings under different systems, including building energy performance and carbon metrics. Though most rating systems appear to be design-based—that is, certification is based on estimated impacts of the design or construction phases of the building—some require performance monitoring of the building's operational phase once occupied (i.e., post-construction phase), to earn initial certification or to maintain certification status. Use of common rating system tools and greater transparency and harmonization of conformity assessment criteria and processes have the potential to facilitate trade in the APEC region.

[1] Kim M. Fowler and E. M. Rauch. 2006. U.S. Department of Energy Pacific Northwest National Laboratory. This study compares five rating systems, three of which—LEED-USA, Green Globes-USA, and CASBEE—overlap with this study.

1. Background

This study, along with an additional study on the Trade Impact of Life Cycle Analysis in Multi-Attribute Certification Programs for Flooring and Plumbing Fixtures in the Asia-Pacific Region, focuses on the Trade Impact of Green Commercial Building Rating Systems in the Asia-Pacific Region. Both case studies were presented at the APEC-ASEAN workshop titled "Green Buildings and Green Growth: Approaches to Encouraging a Positive Green Building Climate," from Sept. 12-13, 2011 in Singapore.

Key objectives of this case study are to:

- Raise awareness of existing "green" standards, conformity assessment procedures, or codes being developed internationally, in advance of regulation
- Understand which APEC economies use voluntary or mandatory programs for "green" commercial construction
- Discuss how member economies may cooperate on the development of standards, conformity assessment and codes that underpin these policies, with a view to facilitating trade and avoiding technical barriers.

The analysis of this study seeks to answer: "What is the trade impact of green building rating systems in the Asia Pacific?" It includes incorporation of the following detailed questions that were considered in the development of the case study:

- Criteria and other technical issues
    - — What criteria must be met for each rating system?
    - — Is there variability in the criteria, standards and weight assigned to individual criterion among the rating systems (e.g., points assigned for various levels of the established criteria?)
    - — Are rating systems more useful than standards to achieve high performing green buildings?
    - — What are the economies with no rating system?
    - — Which rating systems most accurately reflect a reduction in the size of a building's carbon footprint through the implementation of environmentally friendly design features?
    - — What are the differences between named programs (such as Australia's Green Star) and Members of the LEED International Roundtable? Are the requirements different?
- Conformity assessment
    - — Is it important that the standard and/or rating system developing organization be verified/validated?

— Do differences exist in how the programs are administered and how conformity assessment is verified?

- Communication and stakeholder involvement

— Are the certification requirements readily available/accessible and understandable to manufacturers producing green building materials for export and those involved in the construction industry on an international level?

— Are the perspectives of all private sector stakeholders, particularly industry, taken into consideration when the rating systems are developed and revised?

- Harmonization of certification requirements and potential trade barriers

— To what degree are the certification requirements (standards and certification procedures) under various systems harmonized? Do they all measure green performance in the same way?

— What place do international standards, such as ISO 50001, have in the certification of green buildings under the various rating systems?

— Are there reported instances of trade barriers resulting from these programs?

- Relationship with green building products

— What effect do the rating systems have on the manufacture of building materials or products intended for use in green buildings?

- Professional accreditation

— Do all the rating systems provide a path for professional credentials?

This case study draws from the 2006 study by Kim M. Fowler and E. M. Rauch of the U.S. Department of Energy Pacific Northwest National Laboratory, "Sustainable Building Rating Systems Summary."[ii][2] The structure adapted for this case study includes the following broad-based rating system criteria, i.e., (1) Applicability: i.e., types of projects and types of buildings; (2) Development, i.e., system management, development approach, and certification body for green buildings and professionals associated with the rating system; (3) Usability, i.e., product support, openness of operations, and transparency of rating system; (4) System maturity, i.e., system age, number of buildings, stability of system, and paths for professional certification; and e) Communicability, i.e., clarity and versatility, and results presentation and product, as well as Technical Content, Measurement and Verification Review Criteria, including internationally-recognized standards cited in rating system documentation. Carbon footprint and/or climate change-related information is also cited when available.

[2] This study compares five rating systems, three of which—LEED-USA, Green Globes-USA, and CASBEE—overlap with this APEC case study.

In Sections 2 and 3, criteria for rating systems in use in the APEC region are discussed, i.e., the five broad-based review criteria listed above, as well as technical information. Section 2 provides an overview of rating systems in terms of their relationship with the LEED-USA International Roundtable and the World Green Business Council (WGBC) and a short description of the four categories of rating systems. Section 3 provides a detailed description of all rating systems included in each of the categories. Where the rating system program is fairly mature and administered by a local member organization of the WGBC, available information is typically relatively comprehensive and easily accessed. On the other end of the spectrum, e.g., in the case of a member economy with a rating system administered by a government agency, or a system that has only recently been developed or is still under development, information is scarcer.

In the course of conducting this research, the dynamic and "emerging" nature of rating system development in the APEC region quickly became obvious. For example, the LOTUS pilot tool that Vietnam has been developing was downloadable from the internet in June in pilot status, no longer available in August, and available for a price if registering a building project in October. Another example is the case of the CASBEE tool used in Japan, which was only available to persons registering to have a building certified in Japan in June, but available by August on a "guest pass" basis to persons first completing a detailed personal information form.

Section 4 provides an analysis of commonalities and differences among rating systems in use in APEC economies, trends in terms of criteria and other technical characteristics of rating systems, and factors impacting trade and those contributing to the use of LEED worldwide.

Lastly, Section 5 provides case study recommendations in terms of promoting harmonization and overcoming existing or potential barriers to trade resulting from the implementation of green building rating systems worldwide.

2. APEC Member Economy Rating System Categories

LEED-USA was among the first rating systems established in APEC economies, in 1998. Many APEC economies have subsequently established, or are developing, unique green building rating systems adapted to their unique climates and building product markets. A review and adaptation of LEED-USA and other established rating systems normally precedes design of these new systems. In-country Green Building Councils (with various levels of membership in the World Green Building Council) lead development and management of these systems, though in some cases the rating systems are developed and/or managed by a government agency. Many multinational companies seek a common rating system worldwide; therefore buildings are certified to LEED-USA (by the USGBC) in many economies even though they may have, or are developing, a unique rating system. Some economies are just beginning to develop their own system. A few economies do not have the resources to develop a unique system. In these cases, LEED-USA may be the only rating system operating in-country. In addition, LEED-USA has developed an International Roundtable to develop consistency in application of the LEED-USA rating system worldwide.

World Green Building Council and LEED International Roundtable

The World Green Building Council (WGBC), a coalition of national Green Building Councils (GBCs), was launched in 2002 by its nine founding GBCs, six of which are in APEC economies (Australia, Canada, Japan, Mexico, Korea and the United States). Its mission is to facilitate the global transformation of the building industry towards sustainability through market driven mechanisms. WGBC provides these councils with tools and strategies to establish strong organizations and work with them to promote local green building actions and to address global issues such as climate change by ensuring that green buildings are a part of any comprehensive strategy to deliver carbon emission reductions.

The following table shows the four categories of WGBC membership, the definitions of those categories and the APEC member economies associated with each.

Table 3-1. World Green Building Council Membership Categories

Membership Category	Definition	APEC economies
Associated Groups	Those that have begun communicating with WGBC around developing a GBC in their economy, have received some initial guidance and are working on bringing together all of the interested stakeholders across the building industry to head this initiative.	Brunei, China, Thailand and Vietnam
Prospective GBCs	A group who has been officially recognized by WGBC as the entity establishing a GBC in their economy and working towards gaining Emerging Member status	Hong Kong, S. Korea and Philippines

Membership Category	Definition	APEC economies
Emerging GBCs	A Green Building Council working towards achieving Established member status; has submitted an expression of interest	Chile, Indonesia, Malaysia and Russia
Established GBCs	A Green Building Council with GBC "Established Member" status	Australia, Canada, Chinese Taipei, Japan, Mexico, New Zealand, Peru and Singapore

The US Green Building Council (USGBC), a founding member of the WGBC, launched the LEED-USA rating system in 1998. Since that time, LEED certifications have expanded to be used in many other countries and economies, leading the USGBC to develop an International Roundtable to develop global consistency in the application of LEED as well as regional approaches and local outreach and support. In general, it is important to note that LEED is a design tool and not a performance measurement tool, as certification does not require monitoring building performance post-construction. LEED is defined in a way that fits with standards and codes in the US, making it easy to define how it is better than the minimum code. However, LEED is not designed to incorporate technologies, techniques and practices outside the U.S. APEC economies that are members of the International roundtable include Canada, South Korea, Mexico, and the United States. Included in the regional approach is the development of "alternative paths" to achieving LEED credits. Performance metrics will replace referenced standards whenever possible. This will make it possible, for example, for an economy to certify that a building is a certain percentage above the economy's own code rather than a percentage above a referenced standard such as the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

As a result of this study's research, a set of four categories of APEC green building rating systems was developed to demonstrate the similarities and differences between these rating systems (Table 1 summarizes the rating systems by category with a note on WGBC and LEED International Roundtable Status.) Detailed website and contact information for each rating system and green building council may be found in Annex A. The four rating system categories associated with APEC's 21 member economies are as follows, with relevant economies listed and further details provided in Section 3.

Category 1: Economies Using LEED-USA Green Building Rating System

Nine member economies use LEED-USA Green Building rating system: Chile, China, Korea, Mexico, Peru, Philippines, Russia, United States of America and Thailand. LEED was first established in the United States in 1998. Subsequently, Canada adopted its own version of LEED, LEED-Canada. This category includes economies that have adopted LEED as the only rating system as well as economies that have adopted LEED in addition to other rating systems. A LEED-certified building is marketable because of its brand value; large multinational companies prefer one standard (e.g., LEED Gold, for example) anywhere in the world. This one standard approach, however, may not be appropriate for everywhere in the world because of differences in climate and regional markets for green building products.

The USGBC, rather than local GBCs, certifies and registers buildings to the LEED standard while the local GBC usually runs the LEED training, providing a percentage of revenue to USGBC. LEED-USA is

in use in Chile, China, South Korea, Mexico, Peru, the Philippines, Russia and Thailand. The Building Research Establishment Environmental Assessment Method (BREEAM) from the UK is also in use in China and Russia.

Category 2: Economies Using Other Green Building Rating Systems

Category 2 includes 14 countries: Australia, Canada, China, Chinese Taipei, Hong Kong China, Indonesia, Japan, South Korea, Malaysia, New Zealand, Philippines, Singapore, United States of America, and Vietnam. Many economies' Green Building Councils and government agencies have reviewed BREEAM (the UK rating system), LEED-USA, and/or other rating systems in use in the APEC region, and used parts of each to develop a unique rating system designed for their climate and how building product sales are managed in the region. Several economies are just beginning to develop their own rating system. In some cases—China, Chinese Taipei, Japan, S. Korea, and Singapore—a government agency rather than a Green Building Council manages rating system development and implementation while the GBCs provide management or product support for the lead government agency.

- China Green Building Council (CGBC) provides management support to the Ministry of Housing and Urban-Rural Development
- Japan Sustainable Business Consortium (JSBC) provides management support to the Ministry of Land, Infrastructure, Transport and Tourism
- Singapore Green Building Council (SGBC) provides product support to the Building Construction Authority in Singapore

In several cases, such as Mexico, LEED criteria are so much stricter than the member economy's building codes or practices that those economies require a rating system that falls between their building code and the LEED system.

Category 3: Economies with a Rating System under Development

Category 3 includes four economies: Brunei Darussalam, Papua New Guinea, Russia and Thailand. It covers organizations in some economies that are in the process of developing a rating system adapted to the unique needs of the economy. Brunei Darussalam, Papua New Guinea and Russia are only in the beginning stages, whereas Thailand is more advanced in this process.

Category No. 4: Economies with No Rating System

In some economies, although a Green Building Council exists, there is no unique rating system associated with the GBC. APEC economies with no rating system as well as those with no nascent green building industry (as demonstrated by the lack of a Green Building Council) are not included in this analysis.

Table 3-2. Overview of APEC Member Economy Rating Systems

Member Economy	Rating and Certification Program(s)	Green Business Council or Other Organization a)	Affiliation with WGBC	LEED International Roundtable Member
CATEGORY 1: LEED SYSTEM IN USE				
Chile	LEED USA	Chile Green Building Council	Emerging GBC	
China	LEED USA (and BREEAM – UK)	USGBC		
Korea, South	LEED USA	Korea Sustainable Building Council	Prospective GBC	Yes
Mexico	LEED-USA	Mexico Green Building Council	Established GBC	Yes
Peru	LEED-USA	Peru Green Building Council	Established GBC	
Philippines	LEED-USA	USGBC		
Russia	(BREEAM and) LEED-USA	Green Building Council Russia	Emerging GBC	
Thailand	LEED-USA	Thai Green Building Institute	Associated group	
United States	LEED-USA	U.S. Green Building Council	Established GBC	Yes
CATEGORY 2: OTHER RATING SYSTEMS				
Australia	Green Star Australia	Green Building Council Australia	Established GBC	
Canada	LEED-Canada	Canada Green Building Council	Established GBC	Yes
	Green Globes	ECD Energy and Environment Canada; and Building Owners & Managers Association		
China	ESGB ("Three Star" System)	China Academy of Building Research, Ministry of Housing and Urban-Rural Development, with support from CGBC		
Chinese Taipei	Certified Green Building Label (CGBL)	Chinese Taipei Council for Economic Planning and Development		
Hong Kong, China	BEAM	BEAM Society Ltd.		
Indonesia	GREENSHIP	Green Building Council Indonesia	Emerging GBC	
Japan	CASBEE	Ministry of Land, Infrastructure, Transport, Tourism, with support from Japan Sustainable Building Consortium (JSBC)	Established GBC (JSBC)	

Member Economy	Rating and Certification Program(s)	Green Business Council or Other Organization a)	Affiliation with WGBC	LEED International Roundtable Member
Korea, South	Korea Green Building Certification	Ministry of Environment and Ministry of Construction and Transportation, with industry support by Ministry of Environment-approved Korea Green Building Council		
Malaysia	Green Building Index (GBI)	Malaysia Green Building Confederation[a]	Emerging GBC	
New Zealand	Green Star New Zealand	New Zealand Green Building Council	Established GBC	
Philippines	BERDE	Philippines Green Building Council	Prospective GBC	
Singapore	Green Mark	Singapore Building and Construction Authority, with support from Singapore Green Building Council	Established GBC	
USA	Green Globes	Green Building Initiative		
Vietnam	LOTUS	Vietnam Green Building Council	Associated Group	
CATEGORY NO. 3 RATING SYSTEM IN DEVELOPMENT				
Brunei Darussalam	Early development stage	Name of Green Building Council not yet announced	Associated Group	
Papua New Guinea	Early development stage	National Institute of Standards & Industrial Technology NISIT of PNG		
Thailand	Advanced development Stage	Thai Green Building Institute	Associated Group	
Russia	Early development stage	Green Building Council Russia	Emerging GBC	
CATEGORY NO. 4 GBCS - NO ASSOCIATED RATING SYSTEM				
Chinese Taipei	N/A	Chinese-Taipei Green Building Council	Established GBC	
Hong Kong, China	N/A	Hong Kong Green Building Council	Prospective GBC	
Korea, South	N/A	Korea Sustainable Building Council	Prospective GBC	Yes

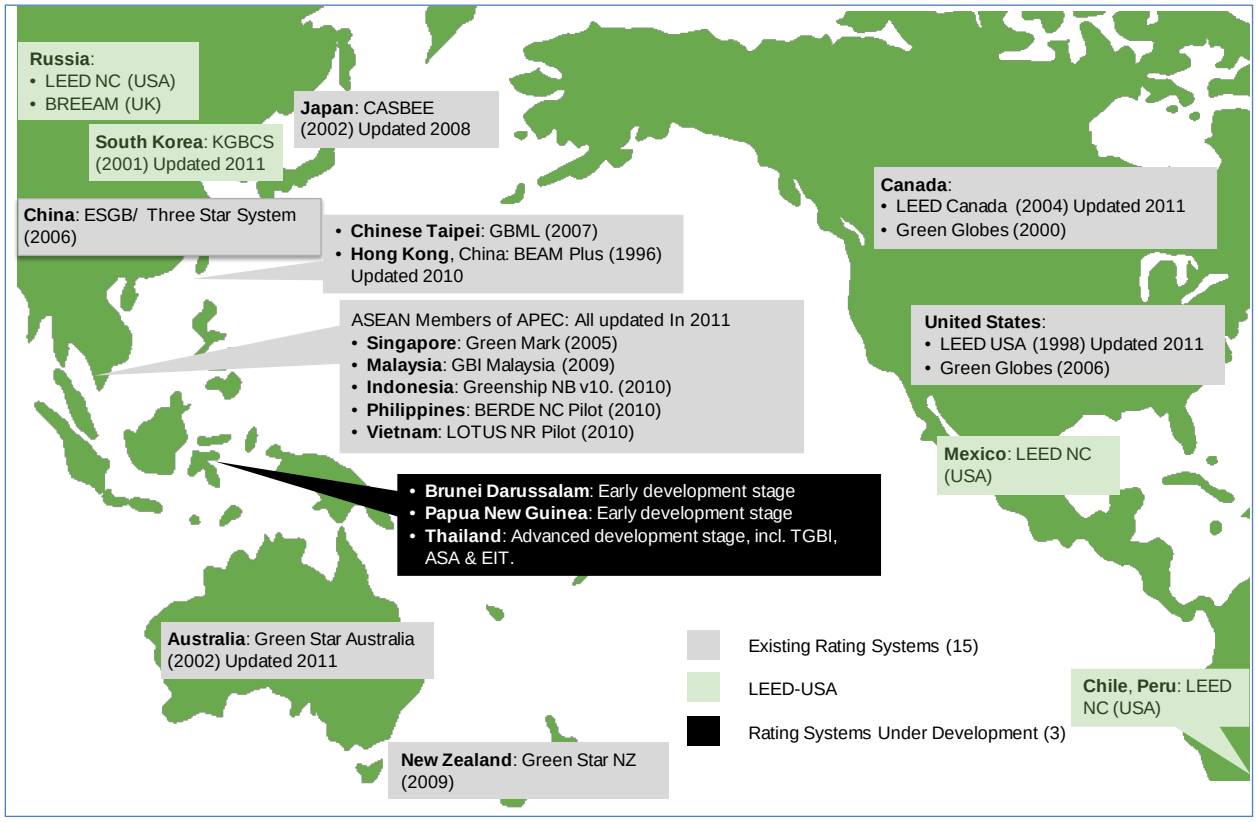
[a] *The WGBC website lists the Malaysia Green Building Council as its Emerging Green Building Council affiliate. This is the same organization as the Malaysia Green Building Confederation; the organization was unable to register in Malaysia with the name Malaysia Green Building Council.*

Note: For economies where a local organization involved in providing LEED-USA training cannot be identified, the USGBC was listed as contact.

3. Rating System Descriptions

Figure 3-1 maps the economies that use LEED-USA, the 15 unique rating systems in the APEC economies, and the three economies that are developing unique rating systems, and documents the dates the systems were established. Here we discuss these rating systems in detail.

Figure 3-1.APEC Economy Rating Systems



Category 1: LEED-USA

LEED-USA is a voluntary rating system developed by the US Green Building Council (USGBC). However, LEED ratings have been adopted as a requirement for public and other buildings in 442 localities and 34 states and numerous public school districts, and LEED initiatives are being implemented by 14 Federal agencies or departments (including the Departments of Defense, Agriculture, Energy and State). Information on adoption of LEED as a government requirement for public or private buildings in other APEC economies was not confirmed during this research project.

Broad-based Rating System Criteria

The Leadership in Energy and Environmental Design (LEED)-USA rating system sets performance standards for certifying the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private, and new or existing. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Applicability

LEED project types now include New Construction and Existing Buildings: Operation & Maintenance (EB:O&M), devoted to building operational and maintenance systems, as well as rating systems for specific building typologies, sectors and project scopes, including for core and shell development, schools, neighborhood development, retail, healthcare, homes, and commercial interiors.

Development

LEED-USA green building rating system development is voluntary, consensus-based, and market-driven, and includes expert opinion. USGBC leads system management, in cooperation with government and industry. They evaluate environmental performance from a whole-building perspective over a building's life cycle, providing a definitive standard for what constitutes a green building in design, construction, and operation. LEED development is based on accepted energy and environmental principles and strikes a balance between known, established practices and emerging concepts.

The newest version of LEED New Construction—New Construction and Major Renovations—applies to new commercial buildings and is typically referenced as NC v3 (2009, updated in May 2011). LEED Existing Buildings was launched in 2002, updated in 2004, and overhauled in 2006. The current version, Existing Buildings: Operations and Maintenance, was launched in 2008.

Usability

LEED-USA has extensive product support available on its web portal. Information on the openness of operations, e.g., membership of 20,000 organizations and individuals, is available. However, there is evidence in the press that the openness and transparency of its operations may be an issue. For example, legislatures in state capitals in the U.S. are reportedly being lobbied to pass laws that do not generically support the use of any reputable green building rating system to rate public school buildings, but attempt to tie legislation to a specific service product, representing unfair competition to other reputable rating systems.

System Maturity

The U.S. Green Business Council (USGBC), formed in 1993, developed the LEED rating system in 1998, after studying the design and metrics of the first rating system to be launched globally, the Building Research Establishment Environmental Assessment Method (BREEAM) for the United Kingdom. LEED continues to evolve since its original inception to more accurately represent and incorporate emerging green building technologies, while expanding the range of building and project types that can be assessed. The green building field is growing and changing daily. New technologies and products are being

introduced into the marketplace, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will continue to evolve as well. To earn LEED certification, applicant projects must satisfy all the prerequisites of the program, at which point they are then rated according to their degree of compliance within the rating system, and must qualify for a minimum number of points to attain a specific project rating. Registration for LEED professional credentialing program courses and exams includes pathways to LEED Green Associate, LEED AP with specialty credentials, and LEED Project Review professional certificates. The Green Building Certification Institute provides professional training and certification.

Communicability

Certifications are awarded according to the following scale: Certified: 40-49 points; Silver: 50-59 points; Gold 60-79 points; and Platinum 80 points and above. Green Building Certification Institute (GBCI) recognizes buildings that achieve one of these ratings with a formal award letter, certificate, and plaque. The results are well-defined and easily communicated, with the process and rating system information clearly understood. LEED has served as the basis for development of many other rating systems in the Asia-Pacific region and elsewhere.

Technical Categories, Measurement and Verification

Each LEED rating system tool is organized into five environmental categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere (EA), Materials and Resources, and Indoor Environmental Quality. All LEED systems have 100 base points. An additional category, Innovation in Design (ID), addresses sustainable building expertise as well as design measures not covered under the five environmental categories, with up to five points available, and an additional point for having a LEED accredited professional on the design team. USGBC regional councils and chapters have identified six credits per rating system that are of particular importance to specific areas. A total of four additional Regional Priority (RP) points may be earned, a feature of LEED that acknowledges the importance of local conditions in determining best environmental design and construction practices.

Possible points in LEED 2009 v3 (100 total) are allocated between five environmental categories. The points allocated to Sustainable Sites, Water Efficiency and EA categories increased relative to the others in version 2 and version 3 added alternative transportation and heat island effects for Sustainable Sites. Prerequisites include water use reduction, innovative wastewater technologies for Water Efficiency, fundamental commissioning of Building Energy Systems (BESs) and Minimum Energy Performance, as well as optimized energy performance and on-site renewable energy for EA; storage and collection of recyclables; and building and materials reuse for materials and resources; and prerequisites of minimum indoor air quality (IAQ) performance and environmental tobacco smoke control for indoor environmental quality. Each category in version 3 includes many subcategories.

In the current LEED 2009 (v3) the allocation of points between credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. Many of the credits are referenced to internationally recognized standards. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building,

such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, and indoor environmental conditions. A combination of approaches, including energy modeling, life-cycle assessment, and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.[3] Each credit is allocated points based on the relative importance of the building-related impacts that it addresses. The result is a weighted average that combines building impacts and the relative value of the impact categories Credit weights also reflect a decision by LEED to recognize the market implications of point allocation. The result is a significant change in allocation of points compared with previous LEED rating systems. Overall, the changes have increased the relative emphasis on the reduction of energy consumption and greenhouse gas emissions associated with building systems, transportation, the embodied energy of water and of materials, and where applicable, solid waste. The details of the weightings process vary slightly among individual rating systems. For example, LEED EB:O&M includes credits related to solid waste management, but LEED NC does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points. The credit weightings process is reevaluated over time to incorporate changes in values ascribed to different building impacts and building types, based on both market reality and evolving scientific knowledge related to buildings.

Annex B Table 1 provides detailed information on standards used for certification. For illustrative purposes, the categories and subcategories that are more heavily weighted than others, and associated assessment references, include the following: EA Category (35 points): Credit 1- Minimum Energy Performance Prerequisite and Credit 1 Optimized energy performance (19 points): Whole Building energy efficiency assessment per ANSI/IESNA/ASHRAE Std. 90.1-2007 Appendix G; ASHRAE AEDG; or NBI ABCPG; Credit 2-On-site Renewable Energy (7 points) USDOE CBECS database; and Credit 5 (3 points); IPMVP vol. III. In the indoor environmental quality category many internationally recognized standards are referenced, including a range of ASHRAE, ASTM, CIBSE and NIST standards.

Conformity Assessment

LEED certification provides independent, third-party verification that a building or community was designed and built using strategies aimed at achieving performance in five key areas of human and environmental health, sustainable development, water savings, energy efficiency, materials selection and indoor environmental quality. Certification occurs through the Green Building Certification Institute (GBCI), an independent nonprofit that was established in 2008 with the support of the USGBC. GBCI includes a network of ISO-compliant international certifying bodies, ensuring the consistency, capacity and integrity of the LEED certification process.

Project teams interact with the GBCI for project registration and certification. GBCI was established in 2008 as a separately incorporated entity with the support of the USGBC. These programs support the application of proven strategies for increasing and measuring the performance of buildings and communities as defined by industry systems such as LEED. Project teams comply with the version of the

[3] LEED 2009 uses the U.S. Environmental Protection Agency's TRACI environmental impact categories for weighting credits. It also takes into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories and assign a relative weight to each. Together the two approaches provide the foundation for determining the point value of each credit in LEED 2009.

rating system that is current at the time of their registration. Projects can be registered on the GBCI website, where information on registration costs is also available. Registration provides contact with GBCI and access to software tools, errata, critical communications, and other essential information. Projects are viable candidates for certification if they meet all pre-requisites and can achieve the minimum number of points necessary to earn the Certified level.

Annex B Charts #1- 6 provide an overview of the LEED-USA suite of tools, the points allocated to each category, conformity assessment procedures and standards used, and the project certification review process.

Other Economies: Chile, China, Korea Mexico, Peru, Philippines, Russia, and Thailand

The implementation of LEED-USA in other economies is most likely implemented on a voluntary basis only. Websites for GBCs associated with the use of LEED-USA in other APEC economies typically included information primarily on domestic or international training and public outreach events, with limited information on domestic LEED-certified buildings, typically citing high-end buildings seeking the branding that LEED-USA offers, or occasionally a limited number of government buildings (e.g., in Thailand). No references to reference to LEED-USA in domestic regulations were found. As mentioned above, the USGBC manages implementation of the LEED-USA rating system in all economies, though the local Green Building Councils often implement associated training.

Chile: The Green Building Council-Chile, officially launched in November 2010 with 15 founding members, is an emerging member of the WGBC. Through hyperlinks from the GBC-Chile website to the USGBC and GBCI websites, both building projects and professionals can register for certification and credentialing processes associated with LEED-USA. This provides a useful platform to develop a cadre of well-informed and qualified in-country professionals. A relatively modest number of commercial buildings in Chile have been certified to LEED-USA criteria.

China: As reported in an article on the USGBC website, the China Green Building Council was established in 2008, and signed an MOU with the USGBC on April 2, 2010, with MOHURD and the USDOE present. While the CGBC has increasingly been assuming responsibility for building certification within the domestic rating system, it also plays a role in certifying high-end building projects in China are that are registered with the LEED-USA rating system, including projects in Shanghai and Beijing.

Korea: The Korea Sustainable Building Council (KSBC) was established in 2009. The KSBC is working on merging initiatives from multiple industries interested in green buildings. It is a prospective WGBC member, and has eight core founders, including academia, developers, investors, researchers, and consulting and construction industries. The KSBC webpage also includes hyperlinks to USGBC and GBCI associated with LEED-USA. A building project in New Songdo City in Korea is registered with LEED-USA.

Mexico*:* The Mexico Green Building Council (MGBC) is an established member of the WGBC and a member of the USGBC International Roundtable. The MGBC envisions becoming the leading organization in Mexico representing the industry and national building and construction issues related to

environmental and social responsibility. Through hyperlinks to the USGBC and GBCI websites associated with LEED-USA, members of the MGBC are able to register buildings for certification and professionals for credentialing associated with the LEED-USA rating system.

Peru: The Peru Green Building Council, an established member of the WGBC, is a private, nonprofit organization whose mission is to lead the transformation of construction activities and urban development into more sustainable realities, with a focus on changing the way buildings are designed, built and operated, thus reducing the negative impact of the built environment to the planet. Membership in 2011 continued to grow steadily, with a total of 79 member organizations in mid-2011. Initial events in Peru, including a Green Building Fair and workshops on LEED in 2011 are opening pathways to future certification of both buildings and professionals associated with the LEED-USA rating system.

Philippines*:* The Philippines Green Building Council is a prospective member of the WGBC. High-end building projects in Metro Manila, Philippines are registered with LEED-USA.

Russia*:* The Green Building Council Russia (RuGBC) is a not-for-profit industry organization dedicated to accelerating development and adoption of market-based green building practices. The RuGBC Mission is to encourage the development of an entirely new industry. The RuGBC purpose is to confirm that the "green" technologies are an integral part of the real estate industry. The RuGBC webpage includes an e-brochure, a list of members and joint working groups, a program of events, a featured project of the month, and an annual report for 2010. It also includes information on three events in 2011 including a BREEAM Assessor course, governmental regulation of Green Buildings, a Seminar on certifications, standards and rating systems (BREEAM, LEED and DGNB Germany) and an International Exhibition.

Thailand: The Thailand Green Building Institute is associated with implementation of LEED-USA projects in Thailand. There are approximately seven building projects in Bangkok that are registered with LEED-USA.

Detailed information about LEED-USA broad-based and technical criteria and conformity assessment may be found in Annex B.

Category 2: Other Green Building Rating Systems

Fourteen economies have developed their own unique rating systems: Australia, Canada, China, Chinese Taipei, Hong Kong China, Indonesia, Japan, Korea and Singapore, all of which have sizable commercial building sectors. China is expected to become the largest construction market in the world in the near future, yet less than 1 percent of the new built environment is certified green floor space at present. Every year 2 billion square meters of new floor area of building are added. The market in China already has four times as much floor space as Western Europe, and two times as much as the United States, and has surpassed the housing market in Japan. The population of China is nearly half that of the entire APEC region. In view of the enormous scale of the building environment in China, both new and existing, the rate of new construction dwarfs rates anywhere else in the world.

One-half of all new buildings worldwide are being constructed in China This combined with the large commercial building sectors in the APEC economies with other rating systems has the potential to

provide a significant solution to the global climate change challenges and supports the need for harmonization, where applicable, among the different rating systems.

Hong Kong is also part of the global climate change solution as well since its government has made a significant commitment to rating public buildings; 30 percent of all assessed buildings belong to the Hong Kong government. The government sector also provides leadership for the commercial sector; 37 percent of Hong Kong's commercial space has been registered under the rating system. On a per capita basis, the rating system is one of the most widely adopted voluntary schemes of its kind in the world. With the largest economies in APEC, e.g., Australia, Canada, China, Hong Kong China, Chinese Taipei, Japan, Indonesia, Korea and Singapore, developing unique rating systems, these systems have the potential to greatly influence the impact of APEC buildings on the environment. Also, harmonization of rating systems criteria and conformity assessment in these economies is critical to increasing trade of green building products.

The APEC Economy Profiles in Annex S provide additional information for each economy, including the size of the economy, exports and imports and associated trade partners (most of which takes place within the APEC region) and the degree of urbanization.

Australia: Green Star Australia

In Australia, promotion of the green commercial built environment is integral to national goals for reducing greenhouse gas (GHG) emissions. From 2009 to 2011 government policies for green buildings were adopted at all levels of government, i.e., federal, state and local levels. At the federal level government offers a range of measures and initiatives, including a) regulation through green building codes; (2) a national strategy on energy efficiency; (3) tax breaks for green buildings; (4) mandatory disclosure schemes; and e) an investment of $1 billion towards Australia's "Clean Energy Future". Multiple state governments are committing to achieving better built environment outcomes through the development of "green door" policies targeted at a range of building types, including office buildings. Local governments have started to mandate and incentivize the attainment of ratings through a range of incentives, e.g., in Melbourne's "1200 Buildings" program; Sydney's "Better Buildings Partnership"; and Fremantle's mandates for Green Star rating for certain developments.

A commercial building sector baseline study found that office buildings and hospitals are the two largest emitters by building type, causing around 40 percent of total building sector emissions. The property industry is well placed to deliver significant long-term environmental improvements but barriers to adopting efficiency measures within the property industry remain. The Green Building Council Australia (GBCA) was created to address some of these barriers.

Launched in 2002, GBCA is a national, not-for-profit organization with a mission to develop a sustainable property industry for Australia by encouraging the adoption of green building practices through market-based solutions. GBCA, an established member of the WGBC, has strong support from both industry and governments across the economy. It's key objectives are to drive the transition of the Australian property industry towards sustainability by promoting and mainstreaming green building programs, including environmentally-friendly design, construction and operational aspects, and associated best practices and advanced technologies.

Broad-Based Rating System Evaluation Criteria:

Applicability

Available for public use since 2003, the Green Star Rating System is applicable to a wide range of building projects and types, including commercial office buildings as new construction and existing buildings project types, and covering both tropical and subtropical climate zones. The system also includes Green Star (GS) Office Interiors, Retail Center, and Office Design tools; as well as Education, Healthcare, Industrial, and Multi Unit Residential tools; with multiple new tools in the Pilot phase, i.e., the Custom, Convention Center Design, and Public Building tools; and two tools currently in the Under Development phase, i.e., GS-Communities; and GS-Performance, as noted above. GS rating tool development includes extensive testing and development, and a system for revisions.

Development

Green Star Office V.3 (2011) has been revised from V2.0 (2008) to award industry leadership through raised benchmarks, new credits, and updated references to standards, as well as relevant and clearer conformity assessment requirements. In development terms, this system is one of the most mature in use in the APEC region, with objectives being met through the extensive piloting and revision processes noted above. The development process has been consensus-based, and includes life-cycle analysis and expert opinion. In terms of usability, product support includes case studies, records of inquiries, and Frequently Asked Questions (FAQs). Membership includes more than 900 companies. The rating system is transparent, with a checklist, credit interpretations, application guides, FAQs, and an e-mail help desk. The rating system has matured since 2003, with 350 projects having completed the certification process, including overseas projects, representing Total Floor Area (TFA) of more than 4 million square meters. This total includes 56 certified local, state and federal government building projects. The GS professional training program offers 173 courses, and has trained more than 21,000 people.

Usability

The green building rating system that GBCA has developed for this purpose in Australia is Green Star , a comprehensive, national, voluntary environmental rating system that evaluates the environmental design and construction of buildings. Green Star was developed for the property industry in order to: (1) establish a common language; (2) set a standard of measurement for green buildings; (3) promote integrated, whole-building design; (4) recognize environmental leadership; (5) identify building life-cycle impacts; and (6) raise awareness of green building benefits. There are many business benefits for choosing Green Star for a building project, including: (1) lower operating costs; (2) higher returns on investment; (3) greater tenant attraction; (4) enhanced marketability; (5) productivity benefits; (6) reduced liability and risk; (7) a healthier place to live and work; (8) demonstration of Corporate Social Responsibility (CSR); (9) future proofed assets; and (10) competitive advantage.

System Maturity

In 2009 GBCA consulted with its members and other industry and government stakeholders to identify potential opportunities for GBCA support of the 2010-2013 national cities agenda through its green building advocacy role. There are five overall priorities for the green building agenda in Australia that

GBCA actively supports. With its core business being the development and administration of comprehensive and robust rating tools, the GBCA was asked by government and industry to lead the development of a rating tool for sustainable communities. The development of Green Star-Communities (GS-C) has involved a two-staged process, including: Stage 1: development of a national framework for sustainable communities, including the five national best practice guiding principles listed above, and Stage 2: development of the GS-C rating tool, designed to assesses sustainable communities against best practice sustainable benchmarks, including aggregated assessment of GHG emission reductions from greener building practices, and improved integration of land use and transport in implementing Healthy Spaces and Places.

Communicability

The Green Star –Australia building certification system includes a total of six levels of stars, but only the top three levels receive awards, as follows: 4 Stars – Best Practice (54-59 points); 5 Stars – Australia Excellence (60-74 points); and 6 Stars – World Leadership (75-143 points). A framed certificate, award letter, marketing kit, and relevant GS logos are provided at the time of award. Certification results are communicated in a manner that is clear and easily-understood. The basis for its development is versatile, as demonstrated by the fact that most of its neighbors, i.e., New Zealand and multiple ASEAN economies that have developed rating systems since 2003, as well as economies in other regions, e.g., South Africa, have consulted GBCA and visited Australia before designing their own system. The GBCA webpage notes that the current version represents a milestone in the assessment of the environmental attributes of buildings, reflects global leadership in rating tool development, and is expected to further progress sustainable building design and construction in Australia. Although Green Star certification requires a formal process, any project can be freely downloaded.

Technical Content, Measurement and Verification:

In the credit summary for Green Star – Office Design v3 and Office As Built v3 (with a combined Technical Manual in 2011 for GS Office), there are eight primary attribute categories, and a ninth Innovation category for bonus points. Each category assesses environmental impact that is a direct consequence of a project's site selection, design, construction, and maintenance. The nine categories, with the rating system checklist acronym and potential points indicated in parentheses, including Management (Man), Indoor Air Quality, Energy (Ene), Transport (Tra), Water (Wat), Materials (Mat), Land Use and Ecology (Eco), Emissions (Emi), and Innovation (Ino) for a total potential of 143 points in the eight categories, plus 5 Bonus points. These nine categories are included within all Green Star rating tools, with varying point totals for each tool, and each category divided into credits, each of which addresses an initiative that improves or has the potential to improve environmental performance. Points are awarded in each credit line item for actions that demonstrate that the project has met the overall objectives of Green Star. Many credit categories reference internationally recognized standards.

Conformity Assessment:

Green Star Office v3 in general approaches measurement and verification in each environmental attribute category rigorously and comprehensively through energy and transport modeling and an eco-calculator,

post construction monitoring and metering, building commissioning and re-commissioning post construction, and site visits.
Five product certification standard schemes are recognized by GBCA at present, including one (recently announced) international scheme:, i.e., the Institute for Market Transformation to Sustainability (MTS) Sustainable Materials Rating Technology standard version 4.0 (SMaRT 4.0); and four domestic schemes, as follows: (1) Ecospecifier's GreenTag and GreenRate, now incorporated into the Green Star ® Green Building Rating Tool compliance assessment; (2) Good Environmental Choice Australia Ltd.; (3) Australasian Furnishing Research and Development Institute Limited's Sustainability Standard 150; and (4) the Carpet Institute of Australia's Environmental Certification Scheme.

International standards are referenced to earn credits for commissioning, ventilation systems, noise levels, fuel efficient transport, responsible forest management practices, and treating and filtering storm water. The contractor is required to have a valid ISOS 14001 Environmental Management System (EMS) accreditation prior to and throughout the project. Greenhouse Gas Emissions are determined by energy modeling, in accordance with the Australian Building Greenhouse Rating (ABGR) Validation Protocol for Computer Simulations, or the final and current version of the Green Star Energy Calculator, both of which reference international GHG protocols.

New Zealand first adopted, and then adapted the Green Star building rating system to better fit the local context. Both GS Australia and GS New Zealand contain references to design and construction criteria that cite relevant standards in both Australia and New Zealand.

Detailed information about broad-based and technical criteria and conformity assessment may be found in Annex C.

Canada: Green Globes Canada

Green Globes is North America's first interactive, web-based design guidance, environmental assessment, and green building rating system. Green Globes incorporates Life Cycle Assessment (LCA), requires third-party site visits for certification, and is cost-effective and user-friendly. It serves as an alternative rating system to LEED-Canada. Details of licensing and operation of Green Globes rating system tools in Canada are provided below.

Broad-based Rating System Review Criteria

Applicability

The licensed operation of the two main Green Globes rating tools are by the following entities in Canada: (1) Green Globes ™ Design for New Buildings and Retrofits, by ECD Energy and Environment Canada Ltd (ECD); and (2) BOMA BESt for Existing Buildings, by the Building Owners and Managers Association (BOMA) of Canada Building Environmental Standards. Both tools are applicable to multiple types of commercial and government building types. Other Green Globes (auxiliary) assessment tools owned by ECD ; include the following: (1) Building Emergency Management Assessment (BEMA), used to help building owners and managers evaluate the emergency management of their assets with respect to disasters and incidents of all kinds; (2) Fit-Up, a tool, applicable for the design of new, or the remodeling

of existing, commercial interiors; and (3) Building Intelligence Quotient (BIQ™), used online as an Intelligent Building ranking tool to increase market penetrability of Intelligent Building technology with building owners, operators, managers and designers by demonstrating value and providing guidance. The Building Intelligence Quotient Consortium (BIQC) was chosen by Canadian Automated Buildings Association (CABA) consortium members to engage experts in their respective fields with their fellow CABA Intelligent and Integrated Buildings Council (IIBC) members in developing the infrastructure for the Building Intelligence Certification Process. ECD is a partner of CABA. New rating tool modules for BOMA BESt are under development for Enclosed Shopping Centers, Open Air Retail and Light Industrial buildings.

Development

The Green Globes assessment and rating system represents more than eleven years of research and refinement by a wide range of prominent international organizations and experts. The genesis of the system was the Building Research Establishment's Environmental Assessment Method (BREEAM), developed in the United Kingdom in 1992. In 1996 the Canadian Standards Association (CSA) published BREEAM Canada for Existing Buildings. In 2000 the system took a leap forward in its evolution, becoming an online assessment and rating tool under the name Green Globes for Existing Buildings. In addition, multiple national Canadian government agencies supported the development of the Design for New Buildings tool, which underwent a further iteration in 2002 by a team of experts representing the Arizona State University and the Athena Institute in the United States, and multiple federal agencies of the Government of Canada. In 2004 Green Globes for Existing Buildings was adopted by BOMA, where it now operates under the name BOMA BESt. In addition, the Green Building Initiative (GBI) acquired the rights to distribute Green Globes in the United States in 2004.

Usability

Product support for the Green Globes Design for New Buildings and Retrofits Rating System is primarily available through the interactive online registration and two-stage assessment process, with an on-site visit after the initial assessment process also contributing to the information exchange process between the project team and the ECD Energy and Environment Canada Ltd. rating system operator in Canada. A similar product support process is available for BOMA BESt with BOMA, with a lengthy and informative annual report, e.g., 2010 BOMA BESt Energy and Environmental Report (BBEER), downloadable on the www.bomabest.com website. The purpose of the BBEER is to examine data gathered from the program's certified office buildings and inform the Canadian commercial real estate industry and its stakeholders re: energy and environmental performance of these existing office buildings; energy and water performance benchmarks, and areas or trends that warrant further investigation by BOMA Canada or other similarly interested organizations. It also provides background information and commentary on the new modules that BOMA BESt is developing (See Applicability section above).

System Maturity

In eleven years since its establishment in Canada, the Green Globes system has matured sufficiently to be used by large developers and property management companies, as well as the Canadian federal government, which has adopted the program for its entire real estate portfolio. By 2011 more than 950 buildings were certified by Green Globes. From June 1, 2009 to June 1, 2010, a total of 294 existing

buildings were certified by BOMA in Canada. Green Globes is web-based, cost-effective, user-friendly, and incorporates LCA.

Communicability

For Green Globes New Design, the third-party assessment procedure includes the following steps: (1) complete an online survey; (2) assessment by a highly-qualified third-party assessor; (3) a preliminary rating given at the schematic design stage, coinciding with planning approval; (4) on-site visit and interview; and (5) a final rating given at the construction documents stage, corresponding with building system approval. During the online survey session scores are provided for each assessment category, allowing for iterative revisions early-on to improve the score.

In the case of BOMA BESt, there are approximately 175 questions online, typically requiring a "yes or no" response, and providing building managers and their teams a hands-on practical education opportunity. The program guides managers through a building review from an environmental perspective, where they must revisit all aspects of building operations over time, in an effort to understand the environmental impacts of the operation, and in the process learning what they can do to improve building performance. Verification is through a third-party audit of energy and water utility data, a review of documented policies and procedures, and operations manuals, as well as a walk-through of the building, including the plant room and a typical occupant space. A growing number of building owners and managers, including major property management firms and many government organizations, are measuring the energy and environmental performance of their buildings using BOMA BESt.

Green Globes New Design™ projects use the following scoring system: 1 Globe 15-34 percent; 2 Globes 35-54 percent; 3 Globes 55-69 percent; 4 Globes 70-84 percent; and 5 Globes 85-100 percent, with the latter three ratings comparable to silver, gold and platinum ratings with LEED-Canada. A Green Globes certification plaque is awarded for each certified building. Minimum percentages of points are required for standards compliance at each of the four certification levels, i.e., for Project Management 50 percent, for Site 24 percent (0 for major renovations), for Energy 50 percent if Performance Path A and 33 percent if Prescriptive Path B, for Water 26 percent, for Resources/Materials 29 percent, for Emissions 9 percent, and for Indoor Environment 32 percent.

Green Globes BOMA BESt projects use the following scoring system: Level 1 (basic) indicates that a building has met all of the BOMA BESt Practices required at every certification level, including performing on energy audit and a water audit, continually monitoring resource consumption and having a preventative maintenance program; Level 2 certification requires a score of 70-79 percent, and demonstrates that a building is moving towards excellence in energy and environmental performance through better management; Level 3 certification requires a score of 80-89 percent, demonstrating higher performance and excellence in management; and Level 4 certification requires a score of at least 90 percent, with these high performing buildings demonstrating low energy consumption, excellent management and often combining new technologies and industry leadership.

The LCA credit calculator is a free tool that helps architectural design and engineering teams understand various cradle-to-grave environmental impacts of building assemblies. The LCA tool takes into consideration the following impact indicators: building material lifespan, embodies energy, solid waste, air and water pollution and global warming potential. The tool provides results for hundreds of common

building assemblies in low and high rise categories. Based on the Athena EcoCalculator for Assemblies, it is a free downloadable, easy to use software. Design teams who use the LCA Credit Calculator as part of their evaluation process receive LCA related education credits within the Green Globes NC assessment protocol and rating system. The next version will fully incorporate the GG LCA Calculator.

Technical Content, Measurement and Verification

There are seven assessment categories in the ECD Green Globes™ Design rating system for new buildings, for a total of 1000 points, with the following weightings for each category: project management 5 percent, site 11.5 percent, energy 38 percent, water 8.5 percent, resources 10 percent, emissions, effluents and other impacts 7 percent, and indoor environment 20 percent.

Conformity Assessment

Green Globes Design is both a guide to integrating green design principles and an assessment tool. The program is questionnaire-based and consists of approximately 150 questions that require between 2 to 3 hours to answer. Questions are typically of a YES/NO/NA type and are grouped broadly under seven areas of building environmental performance. Once the questionnaire has been completed, a printable report is automatically generated that provides:

- Percentage eco-ratings for: Project Management; Site; Energy; Water; Resources;
- Emissions; Effluents and Other Impacts; Indoor Environment, Highlights of the design
- Suggestions for further improvements to the design
- Hyper-links to information on building systems and management.

Green Globes Design is intended to guide the project through the project delivery stages. Once a building project has been registered, one can choose from seven project stages, i.e., project initiation; programming, concept (schematic) design, design development, construction documents, construction, and commissioning. The latter stage moves the completed project from a “static” construction state to a “dynamic” operating state, and ensures orderly transfer of the built-works from the “implementer” to the “Client/User”. Percentage ratings are given for two of the seven stages: Concept Design (a preliminary rating) and Construction Documents (the final rating).

Because assessment occurs in two stages, it relates to the development approval process during preliminary assessment at the Concept Design Stage (corresponding with planning approval by municipal governments) and during final assessment at the construction documents stage (which typically corresponds with municipal building permit approval). These phases enable verification that environmental claims are being met as the project develops. The Green Globes Existing Buildings tool can be used to compare design and as-built performance ratings and assists in the monitoring of performance levels over time. Equivalent information was not available on the website for the BOMA BESt rating system for Existing Buildings, as the information is proprietary and must be purchased.

Detailed information about broad-based and technical criteria and conformity assessment may be found in Annex D.

Canada: LEED Canada

Broad-based Rating System Review Criteria

The Mission of the Canadian Green Business Council (CaGBC), an established member of the WGBC and a member of the USGBC International Roundtable, is to lead and accelerate the transformation to high-performing, healthy green buildings, homes and communities throughout Canada. The vision of the CaGBC, is a transformed built environment leading to a sustainable future, in recognition that the built environment has a profound impact on our natural environment, economy, health and productivity, and that breakthroughs in building science, technology, and operations are now available to designers, builders, operators and owners who want to build green and maximize both economic and environmental performance. Growing awareness and concern in Canada, especially during the last decade, with the environmental and health impacts of buildings has led to widespread demand for a common method of independently certifying the merits of given buildings.

In response to this demand, the CaGBC, the representative green voice of the Canadian building industry, bought the Canadian license for LEED certification, and implements the LEED Canadian green building rating system in Canada on the premise that it is so ingrained in the building industry that even those outside of it understand its significance. CaGBC supports members during the implementation of these efforts, helping them to understand the specific rules and regulations of the LEED certification process. The aim has been to create rating tools that both recognize high health, energy and environmental performance, while being practical and easy to apply to Canadian building projects. International third party LEED certification is adapted to the Canadian market through an inclusive process that engages stakeholders and exerts representing the various sectors of the Canadian industry.

Applicability

The LEED Canada rating system is carefully tailored to the specifics of the Canadian building sector, and as of 2011 sets guidelines for six categories, including new construction, core and shell, commercial interiors, existing buildings, homes, and neighborhood development, while continuing to work on developing the next generation of green building ratings. The LEED® Canada NC and CS tools addresse design and construction activities for both new buildings and major renovations of existing buildings. If the project scope does not involve significant design and construction activities and focuses more on operations and maintenance activities, the *LEED®Canada for Existing Buildings:Operations & Maintenance (EB:O&M)* tool is more appropriate because it addresses operational and maintenance issues of working buildings. Many projects neatly fit the defined scope of only one LEED rating system tool, while others may be eligible for two or more. The project is a viable candidate for LEED certification if it can meet all prerequisites and achieve the minimum points required. If more than one rating tool applies, the project team can decide which one of the two tools to use. The combined LEED® Canada NC and CS standards cover new construction and major renovation project types, including most commercial office building applications. Exceptions include the EB:O&M or the Commercial Interior (CI) standards relevant in specific operations and maintenance, or interior design applications respectively, when whole building design and construction aspects are no longer key. As in other rating system families, the Neighborhood Development standard has been recently introduced to the LEED family, taking into consideration a broader view of the context of a whole building within a neighborhood, especially in an

urbanized context, with climate change emissions, for example, having global impacts as well as local impacts. In terms of building types, the LEED® Canada rating systems are designed for rating new and existing commercial, institutional, and residential buildings.

Development

The LEED® Canada rating system was developed primarily by a non-government organization, representing the building industry, coordinated with government. It was developed in a consensus-based manner, using expert opinion, and including life cycle analysis of the whole building. The CaGBC public website notes third party certification of buildings, without further clarification thereof. The rating system is implemented on a voluntary basis in general, but in specific contexts, as the result of government laws, codes or regulations issued at a specific level of government, e.g., in a local, state or federal context, and citing a specific standard that represents a specific proprietary product, e.g., LEED® Canada (rather than a general standard that is agnostic to the specifics of any particular product) and it is required on a mandatory basis.

Canada adopted version 2.1 of *USGBC's LEED for New Construction and Major Renovations (NC)* in 2002 as an interim measure, meanwhile adapting the USGBC version specifically for Canadian climates, construction practices and regulations. This resulted in the launch of LEED ®Canada NC version 1.0 in 2004. By 2007 CaGBC released an addendum to the LEED® Canada NC version 1.0 rating tool and Reference Guide, introducing new compliance paths and adaptations from the release of USGBC's LEED® NC version 2.2, as well as incorporating changes based on the experience of Canadian users.

In 2006 the USGBC released *LEED for Core and Shell Development (CS)* tool version 2.0 after a pilot version. Introduction of CS acknowledges that some projects are designed and constructed to be partially occupied by the owner or developer, and partially occupied by other tenants. The CS tool was developed to serve the speculative development market, in which project teams do not control all scopes of a whole building's design and construction, and acknowledging the limited level of influence a developer can exert in a speculatively developed building. Either NC or CS may apply in projects where the owner or developer has direct influence over a portion of the work that they occupy, with NC applicable if at least 50 percent of the building's floor area must be fit-up for their needs for the certification application; while CS is applicable if 50 percent or less of the building's floor area is fit-up (and is not under the design and construction control of the owner or developer). Due to its similarities otherwise to LEED NC, CaGBC released the new CS rating tool as an adaptation to LEED Canada NC v1.0 in 2008, allowing for an expedited release process and for building owners to switch between rating systems if tenant expectations change.

In 2009 the USGBC re-launched its suite of rating system tools and aligned LEED NC and CS 2009 v.3 into one reference guide, with LEED®Canada following suit with its NC and CS 2009 rating system tools, merging the documentation as well as the reference guide content for ease of use. The intent of NC and CS combined is to promote and set performance standards for certifying the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. CS can also be used for projects in which the developer controls the design and construction of the entire core and shell base building (e.g., mechanical, electrical, plumbing, and fire protection

systems), but has no control over the design and construction of the tenant-fit-out. Examples of this type of project can be a commercial office building, medical office building, retail center, warehouse of lab facility.

The LEED Green Building Rating Systems as a whole are voluntary, consensus-based, and market-driven. Based on existing and proven technology, they evaluate environmental performance from a whole building perspective, over a building's life cycle, providing a definitive standard for what constitutes a green building in design, construction, and operation. Teams wishing to certify their products with LEED are required to use the version of the rating system that is current at the time of their registration. The CaGBC highlights new developments on its website on a continual basis.

Usability

Product support exists in terms of records of inquiry, FAQs and training availability. Membership in 2011 included eight local chapters across Canada, and a total of more than 2300 member organizations and individuals. Public information on the website is extensive regarding rating system and reference guide documentation, as well as other associated resources such as chapters, programs, and education resources.

System Maturity

The system was adopted in 2002 from USGBC, adapted by 2004, and the 2009 NC and CS version updated in 2011, with 3400 buildings registered and 470 having completed the certification process. The system undergoes continuous testing and development, with a system for revisions, and a path for professional credentialing, including LEED Accredited Professionals, as well as a full semester post-secondary course at approved institutions titled LEED Canada Core Concepts and Strategies. More than 10,000 people had become LEED APs in Canada by 2010.

Communicability

Project teams interested in earning LEED Canada for New Construction and Major Renovations or Core and Shell Development certification for their buildings must first register the project with the CaGBC. This can be done online on the CaGBC website. Registration of a project provides online access to essential information, software tools and communications for LEED users, such as the LEED Canada NC/CS Letter Templates and Scorecard spreadsheet, and allows the team to submit credit interpretation requests. To earn LEED certification, the project must satisfy all the prerequisites and credits worth the minimum number of points to attain the desired project rating. Projects need to comply with the version that is current at the time of project registration. Applications for certification should follow the requirements noted on the CaGBC website, within this rating system, and within the LEED Canada Reference Guide for Green Building Design and Construction, as well as the LEED Canada NC/CS Letter Templates. Building rating scores are used to certify buildings based on the following number of required points for the four levels of certification respectively, i.e., (1) Certified: 40-49 points; (2) Silver: 50-59 points; (3) Gold: 60-79 points; and (4) Platinum: 80-110 points. Results are communicated in a well-defined and easily-understood manner, with an award letter, certificate, and plaque provided as further product results of the certification process. They are based on accepted energy and environmental principles and strike a balance between known, established practices and emerging concepts.

Technical Content, Measurement and Verification

As with other LEED rating systems, LEED® Canada shares five environmental attribute categories with all of the other systems, for a total potential of 100 points, plus 10 Bonus points. The category acronym and possible points are noted in parentheses, i.e., Sustainable Sites (26); Water Efficiency (10); Energy and Atmosphere (35); Materials and Resources (14); and Indoor Environmental Quality (15). An additional category, Innovation in Design (or Operations), offers up to five bonus points, and includes measures not covered under the five environmental categories, with a sixth point ID for having a LEED® Accredited Professional on the design team. The Regional Priority (RP) bonus category, with 4 potential for points, is another feature of LEED that acknowledges the importance of local conditions in determining best environmental design and construction practices. The point allocation and subcategory details for LEED-Canada are essentially the same as for LEED-USA.

In LEED 2009, the allocation of the total of 100 points between credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, and indoor environmental conditions. A combination of approaches, including energy modeling, life-cycle assessment (LCA), and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.[4] The LEED 2009 credit weightings process is based on the following parameters, which maintain consistency and usability across rating systems: (1) All LEED credits are worth a minimum of one point; (2) All LEED credits are positive, whole numbers; there are no fractions or negative values; (3) All LEED credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location; and (4) All LEED rating systems have 100 base points; Innovation in Design (or Operations) and Regional Priority credits provide opportunities for up to 10 bonus points.

Given the above criteria, the LEED 2009 credit weightings process involves four steps: (1) A reference building is used to estimate the environmental impacts in 13 categories associated with a typical building pursuing LEED certification; (2) The relative importance of building impacts in each category are set to reflect values based on the NIST weightings; (3) Data that quantify building impacts on environmental and human health are used to assign points to individual credit; (4) Each credit is allocated points based on the relative importance of the building-related impacts that it addresses. The result is a weighted average that combines building impacts and the relative value of the impact categories. Credits that most directly address the most important impacts are given the greatest weight, subject to the system design parameters described above. Credit weights also reflect a decision by LEED to recognize the market implications of point allocation.

[4] LEED® Canada also 2009 uses TRACI environment impact categories of the U.S. Environmental Protection Agency (USEPA) as the basis for weighting each credit. TRACI was developed to assist with impact evaluation for LCA, industrial ecology, process design, and pollution prevention. LEED® Canada NC and CS 2009 also take into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories with one another and assign a relative weight to each. The two approaches together provide a solid foundation for determining the point value of each credit in LEED 2009.

The result has been a significant change in allocation of points compared with previous LEED rating systems. Overall, the changes increase the relative emphasis on the reduction of energy consumption and greenhouse gas emissions associated with building systems, transportation, the embodied energy of water, the embodied energy of materials, and where applicable, solid waste. The details of the weightings process vary slightly among individual rating systems. For example, *LEED Canada for Existing Buildings: Operations and Maintenance* includes credits related to solid waste management within the building, but LEED Canada for NC & MRs does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points. The weightings process for each rating system is fully documented in a weightings workbook. The credit weightings process will be reevaluated over time to incorporate changes in values ascribed to different building impacts on building types, based on both market reality and evolving scientific knowledge related to buildings.

Other programs operated by the Canada GBC include (1) GREEN UP – Canada's Building Performance Program; (2) Smart Growth – Policies and Principles for Sustainable Communities; and (3) Living Building Challenge – Beyond LEED. The LEED® Canada-associated GREEN UP program provides tools, performance standards and resources to help building owners and operators understand, measure and compare on-going performance of their building portfolio – helping them find efficiencies and improvements to achieve deep reductions in energy use, water use and greenhouse gas emissions. Initiated for commercial office buildings in 2008 as a pilot program, the program established a national performance database of 65 buildings totaling more than 3 million square meters. The database continues to grow. GREEN UP is an online green building performance system audit tool that enables owners to assess and improve the performance of whole building portfolios to maximize energy, water and emissions savings in building. This process also allows for assessment of the potential for LEED EB:OM certification of a building. The results of the pilot and experience of the participants are defining national performance standards and best practices for commercial office buildings in Canada. The aggregated results also serve to track performance improvements across the sector. Fifty-seven buildings saved an average of 2.4 percent of their total energy use, reducing greenhouse gas emissions by 4,100 tons by 2010.

Conformity Assessment

Several credits are referenced to internationally accepted standards. Light Pollution Reduction is referenced to ANSI/ASHRAE/IESNA St. 90.1-2007. Water use reduction and water flows are referenced to ASME 112-18.1-2005, ASME standard for public lavatory faucets and the US Energy Policy Act 1992 standard baselines. The EA Prerequisite on Commissioning is referenced to either the Model National Energy Code for Buildings (MNECB) or ASHRAE 90.1-2007. Energy Standard for Buildings follows the ANSI/ASHRAE/IESNA 90.1-2007, the LEED Canada Energy Modeling Rules, or ASHRAE Advanced Energy Design Guide. Also referenced are the U.S.EPA Clean Air Act Title VI for refrigerant management or ASHRAE 90.1-2007 with use of a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures in designing the building envelope.

The measurability of LEED® Canada includes benchmarks, checklists, established collection procedures, numeric measurements, and national and regional or international standards, with carbon metrics under development outside of the formal rating system at present. Verification measures include multiple rounds of documentation and extensive checking of documentation by LEED AP-qualified assessors. Measurement and verification includes sub-metering provided by a centrally monitored electronic metering network that is capable of being expanded to accommodate future tenant sub-metering. Renewable sources are those that meet the Environmental Choice EcoLogo Program requirements for renewable, low-impact generation. All purchases of green power are to be based on the quantity of energy consumed, not the cost. Recycled Content is based on ISO 14021 Environmental Labels and Declarations – Self-declared Environmental Claims (Type II environmental labeling) for recycled content and certified wood is based on an FSC certification. The ANSI/ASTM-E-779-03 Standard Test Method is used for testing environmental tobacco smoke—thermal comfort is tested using the ASHRAE 55-2004 Thermal Comfort evaluation.

Detailed information about broad-based and technical criteria and conformity assessment may be found in Annex E.

China: Evaluation Standard for Green Building (ESGB), i.e., "Three Star System"

The China Green Building Council (CGBC), founded in March 2008, has established local chapters in 20 provinces and cities as of Sept. 2010, and has issued Green Building Annual Reports since 2008. The CGBC provides oversight for local green building assessment. The 15 professional working groups focus on the following: (1) policies and regulations; (2) theory and practice; (3) planning and design; (4) technology; (5) intelligence, inspection, humanities, campuses; (6) building structure, materials, construction, industry, public buildings, and the like.

Development trends for green buildings in China include the following: (1) focus on planning and construction of green buildings at the regional level; (2) developing a related industrial chain for green buildings; (3) increasing the technological content of green buildings; (4) developing suitable technology for green buildings; and (5) improving a system of standards for green buildings. It is intended that green building actions will play a key role in China's efforts to meet its carbon emission reduction target.

The Evaluation Standard for Green Building (ESGB) GB/T 50378-2006, China's official rating system (also referred to as the "Three Star System," or "The Standard") was established by the Ministry of Construction, now the Ministry of Housing and Urban Rural Development (MOHURD), and is China's first attempt to create a domestic green building standard. It is administered by the China Green Building Council at the provincial and municipal levels. The purpose of formulating this standard is to regulate evaluation of green buildings and promote the development of green buildings. The standard is further detailed by MOHURD as follows:

- The standard has been formulated to implement national technological and economic policies for resource saving and environmental protection, promote sustainable development, and standardize the evaluation of a green building.

- The standard shall be used to evaluate a residential or a public building, such as an office, supermarket or hotel building.
- During evaluating a green building, the dialectical relations between the conservation of energy, land, water and material, environmental protection and the fulfillment of architectural functions shall be considered overall in the life cycle of a building.
- During evaluating a green building, it shall be evaluated according to the principle of adaptation to local conditions and to the characteristics of the climate, resources, natural environment, economy, culture, etc. of the area where the building will be located.
- The evaluation of a green building shall conform to national laws, regulations and relevant standards as well as the Standard so as to realize the integration of economic, social and environmental effects.

Under ESGB, a Green Building is defined as a building which, during its life cycle, to a maximum degree, can save resources such as energy, land, water and material; help protect the environment; help diminish pollution; provide healthy, suitable and high-performance spaces for people to use; and coexist harmoniously with nature.

Broad-based Rating System Review Criteria

Applicability

ESGB has two standards, one for large commercial or public buildings, including offices, supermarkets or hotel buildings, and one for residential buildings

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Development

ESGB was jointly issued on March 7, 2006, and Implemented from June 1, 2006, by the Ministry of Construction and the Ministry of Science and Technology (MOST) National Head Office for Quality Supervision, Inspection and Quarantine of the People's Republic of China. The purpose of the standard is to create a voluntary rating system that will encourage green development. Evaluation and promotion of green buildings is also underway through the pilot phase of the Green Building Rating and Labeling Management Method for 1-Star and 2-Star Green Buildings. There are two labels: Green Building Label (GBL); and Green Building Design Label (GBDL). At the national level the Center of Science and Technology Promotion of MOHURD and the Chinese Society for Urban Studies are working together to promote the green building label. At the local level 19 green building evaluation organizations have been established. There are schedules for training and evaluation for one- and two-star Green Building Labels. The ESGB is unique in that it was the first major rating system in the APEC region to stipulate that a performance monitoring evaluation of a newly built, expanded or reconstructed public or residential building must be done post-occupancy, in this case one year after turnover to the property owner, before officially being certified. While further details were not available, on the assumption that "post-occupancy" can be defined as the operational phase of the building (i.e., after the design and construction phases, and once the building has been occupied), the requirement of a successful performance evaluation in order to officially certify the building would categorize ESGB as a "performance-based rating system". The ESGB standard complements BREEAM and LEED, which are used in China for evaluation of

upscale office buildings and apartments, with the latter two representing design-based rating systems, while the former is used for commercial building categories with widespread use in China.

Usability

Information on the usability of ESGB was not available.

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System Maturity

The number of Public Buildings evaluated and certified as of mid-2010 was: 28, i.e., 16 at 3-stars, 8 at 2-stars, and 4 at 1-star. By the end of 2010, there were 400 renewable energy and 200 low-energy demonstration buildings; and 113 certified green buildings. By the end of 2011 the certification of more than 300 buildings is planned.

Communicability

For public buildings there are a total of 83 items: 26 controlling items; 43 general items; and 14 preference items. In addition to satisfying all controlling items, to be rated a building must also satisfy the requirements of general items and preference items in each category. When a certain item is not applicable to the conditions of a building, for example the region, climate or building type, the item can be excluded from evaluation. The total items for that evaluation are then reduced, and the requirement for the number of items is adjusted proportionally.

Ratings are awarded after a building has been operating for one year. Organizations applying for a certification are called a “Party Applying for Such Evaluation (PASE)”. Any PASE is required to carry out the technical and economic analyses for the life cycle of a building, reasonably determine the scale of the building, select suitable construction techniques, equipment and materials, and submit a relevant analysis report. Any PASE is also required to carry out the process control for the phases of planning, design and construction according to the related requirements of the Standard and submit relevant documents. The evaluation is completed on a pass or fail basis, i.e., the building is judged to have Passed (including all essential requirements, i.e., pre-requisites) or Not Passed. It includes up to three stars of rating, and, as mentioned above, is also called the “Three Star System”. For certification purposes, of the total of 57 potential points, the number required for the three certification levels is as follows: one star 22-34; two stars 35-48, and three stars 46-57 points.

Technical Content, Measurement and Verification

The ESGB rates buildings in six categories, using a variety of “control items” or mandatory prerequisites; and “general items” or credits. These categories include the following, with point distribution as follows: Prerequisites 23 percent, Land Savings and Outdoor Environment 11 percent; Energy Savings 18 percent; Water Savings 11 percent; Material Savings 14 percent; Indoor Environmental Quality 11 percent; and Operations and Management 12 percent. The standard also includes a seventh category of “preference items,” e.g., strategies that are both cutting-edge and harder to implement. The Standard’s credit-based system allows developers and designers to be flexible in deciding which credits they wish to pursue.

- Land-saving and environment: (1) building site; (2) land-saving; (3) reduction of environmental load; (4) greening; and e) traffic facilities

- Energy-saving and energy use: (1) reduced load of building energy consumption; b) improved energy efficiency of the system; and (3) use of renewable energy
- Water-saving and water resources utilization; (1) improved water-using efficiency; b) treatment and disposal for rain water and sewage water; and (3) water-saving index
- Materials-saving and material resources: (1) use of green building materials; and b) materials-saving
- Indoor environmental quality: (1) lighting and field of view; b) thermal comfort; (3) acoustical environment; (4) indoor air quality; and e) retrofit
- Operation and management: (1) intelligent system; b) property management; and (3) establishment of ISO 14000 EMS.

Conformity Assessment

The ESGB requires authentication of the environmental management system (ISO 14001). The remaining requirements are referenced as standards and regulations. Buildings seeking a 1-star or a 2-star rating go through a local certification process that is typically run by local universities and research institutes, with assistance from the CGBC. For buildings seeking 3-star certification, the rating must be approved by the Beijing Office of MOHURD. The Green Building Design Label (GBDL) serves as a form of pre-certification. Developers can submit their design plans and earn a GBDL, which confirms that the building was designed to meet the Three Star rating system. The developers can use this pre-certification to market the sustainability of the building to potential occupants or investors. Information about the assessment process, as well as independence and qualifications of assessors was not found.
Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex F.

Hong Kong, China: BEAM

The Hong Kong Green Building Council (HKGBC) is a prospective member of the WGBC. Its founding partners are the Construction Industry Council (CIC), the Business Environment Council (BEC), the BEAM Society Ltd. (BSL), and the Professional Green Building Council (PGBC). BSL is a nonprofit organization that owns and operates BEAM on a self-financing basis, and oversees the on-going development and implementation of BEAM standards for building assessment, performance improvement, certification and labeling. BSL promotes BEAM as the essential tool for tracking green buildings' quality, and helping industry and the public choose sustainable buildings tailor-made for Hong Kong, China.

Broad-based Rating System Review Criteria

Applicability

BEAM (Building Environmental Assessment Method) NB (New Buildings) and EB (Existing Buildings), v1.1 (2010:04) are the most recent updates of the two basic BEAM rating system tools, i.e., NB and EB by BSL, and have also been recognized by the HKGBC. The newest versions are called BEAM-Plus. The

manuals for BEAM Plus New Buildings and Existing Buildings are downloadable from both the BEAM Society and HKGBC websites.

Development:

BSL oversees the development, updating and implementation of BEAM standards. This process is an industry-led, volunteer-based initiative. The Business Environment Council (BEC), an independent, nonprofit, environmental information center, is the only organization licensed to conduct BEAM assessments. It also serves the Society's secretariat for administration, promotion and development work. The NB and EB companion tools together represent a comprehensive standard, a means to benchmark and improve performance, and together they adopt a whole lifecycle approach to sustainable buildings. The standards define more than 100 best practice criteria used across the planning, design, construction, commissioning, operation, management and maintenance processes, reducing environmental impacts from the planning through to the final demolition phase of the building life cycle. Many of the standards referenced in the NB Framework; Summary of Credits; and Reference Guide for the design and construction phases only of the building's life-cycle are also referenced in the companion EB framework document for assessment of building performance during its operational phase, once it has been occupied.

Usability

Information on the usability of the BEAM rating system was not available.

System Maturity

BEAM was launched by the BEAM Society in 1996. The BEAM Society is a nonprofit, member-based organization, with more than 300 members. As of March 2010, over 210 green building developments encompassing more than 10 million square meters of space had applied for voluntary, third-party BEAM certification, and 200 projects had already been certified.

The HKGBC website offers a one-day training, with a set of prerequisites to be met, and an exam to be passed, if individuals are interested in becoming an accredited BEAM Pro. The Hong Kong Examinations Assessment Authority (HKEAA) carries out the BEAM Professionals Examinations. To retain BEAM Pro status, one must take Continuing Professional Development (CPD) seminars or courses, with 15 CPD hours required per year.

Communicability

In December 2011 the HKGBC posted the BEAM-Plus v.1.1 Procedure Manual v.3 (12.20.12), with a flowchart and brief overview of steps that BSL, the applicant, the BEAM Assessor (BAS), and the Technical Review Committee take, the role of the Credit Interpretation Report (CIR) and the appeals process available to the applicant. There is no mention in this flowchart of "certification" other than as a generic final step, per results of the CIR. In a separate discussion of registration fees is it noted that there is an initial fee and a final assessment fee in both the NB and EB processes, with an interim provisional assessment fee that applies only for NBs. While certification at the end of the NB process qualifies the system as being "design-based," the significance of certification at the end of the EB process is unclear, as is the potential status of the BEAM rating system as a "performance-based" rating system. Applicants for project registration are referred online to the beamplus_enquiry@hkgbc.org.hk, the BEAM-Plus Project Registration Secretariat.

Of the total of 100 possible points in the BEAM-Plus rating system, the four levels of the certification scoring system require the following points, as follows: Bronze 50-54; Silver 55-64; Gold 65-74; and Platinum 75-100.

Technical Content, Measurement and Verification

According to the BEAM manual BEAM sets targets and standards which are independently assessed to help minimize false claims or distortions, provide recognition for buildings where the quality has been enhanced and environmental impacts have been reduced, and help stimulate the market for more sustainable buildings. While BEAM endeavors to provide for a comprehensive and fair assessment, it recognizes that truly scientific assessment criteria and assessment methods covering sustainable building practices remain under development, and continue to evolve. The reference manual notes that since the collective knowledge as to what constitutes a sustainable building will continue to develop, BEAM will need to respond accordingly, requiring a dynamic system able to incorporate periodic changes and updates. With wider implementation it is also expected that the scheme will be subject to further scrutiny by, and feedback from, an increasing number of stakeholders. BEAM documentation is to be reviewed on an annual basis and revised as frequently as possible. Where changes in regulations necessitate changes to the assessment criteria, these will be issued to all parties involved in an assessment, and will be announced on the BEAM Society's website.

BEAM rewards buildings that are built, operated, and maintained using sustainable building practices throughout the buildings' life cycle. BEAM emphasizes indoor environmental quality more than other green building rating systems because it is a subtropical, high-density and high-rise community. In order of priority, this rating system prioritizes safety, health, comfort, function and efficiency, while protecting local, regional and global ecosystems throughout a building's life cycle.

Having reviewed local and international assessment schemes and other relevant information, a weighting percentage for each environmental performance category has been assigned to reflect its importance and global trends, as follows for the five environmental assessment categories that credits are awarded in, with weighting indicated in percentages, for a total of 100 percent, as well as the potential number of points that can be awarded for conformity to individual criteria in the respective categories of Site Aspects (SA), Materials Aspects (MA), Energy Use (EU), Water Use (WU), Indoor Environmental Quality and Innovation and Additions (IA). If an assessment is not applicable to the particular circumstances or building type, Not Applicable (NA) is noted on the score sheet and the total points possible are adjusted accordingly.

Conformity Assessment

BEAM assessments are currently undertaken by the BEC, an independent, nonprofit, environmental information center under the guidance of the BEAM Society Executive Committee. Assessment by other parties, such as licensed BEAM assessors, is under consideration for implementation. Per the HKGBC website, BEAM assessment seeks to establish that the specified levels of performance benchmarking are acceptable and have been achieved. Where performance standards are not well defined (e.g., energy use), BEAM establishes its own performance benchmarks based on available data and stakeholder consensus. Credits are awarded for achieving higher levels of performance. Where issues are rather subjective, i.e.,

performance criteria cannot be quantified or determined through a compliance specification, BEAM uses checklists to facilitate equitable and consistent assessments. However, BEAM does not seek to be overly prescriptive in setting assessment criteria and in defining methods of compliance, and encourages Client's representatives to consider alternative approaches that meet the objectives of BEAM. The manual also notes that BEAM recognizes the need to include social and economic dimensions when assessing building performance. Where there is consensus amongst stakeholders that an issue is important, and where a reasonably objective assessment can be made, the issue is included. Responding to environmental priorities and to social and economic issues, BEAM strives to improve the overall performance of buildings by raising standards. For a voluntary scheme, the extent to which performance can be enhanced is determined by market acceptance of the assessment criteria, the cost of undertaking assessments, the relative weighting of the credits counting towards the overall grade awarded, and the perceived benefits to the Client. The criteria included in BEAM are considered to be realistic and attainable in practice. Regarding transparency, BEAM recognizes that assessment criteria and methods to achieve compliance need to be transparent, providing details of the benchmarks (baselines), data assumptions and issues taken into account in the assessment and the credit ratings. Note that information on the BEAM certification process and a list of assessors is only available on the HKGBC site at present.

The manual notes that in terms of absolute vs. relative performance, through an opinion survey of BEAM Society members, it is clear that there should be a balance between assessment of "absolute" performance, i.e., issues over which the Client may have little or no control, and "relative" performance, i.e., issues that can be influenced by the Client. In addition, BEAM takes the position that assessment of some aspects of building performance should not be penalized, because of externalities that are not under control of the Client, such as the efficiency of the utility supplying energy sources to a building. In this case only consumption is quantified (e.g., kWh) and rated, and not the consequent environmental loadings (e.g., CO2-kg) unless the mix of energy sources (gas, oil, electricity) is significant.

BEAM uses local performance standards, codes and guides where these are available (e.g., indoor air quality). Where these are not available (e.g., impact noise) international or national standards, codes and guides are referenced. Where there are differences in the performance criteria set by the various authorities, BEAM will generally avoid specifying the performance criteria (e.g., thermal comfort), allowing the Client to specify what they consider to be appropriate for their building.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex G.

Chinese Taipei: Certified Green Building Label (CGBL)

The Chinese-Taipei Taiwan Green Building Council, a nongovernment organization and established member of the WGBC, has been very active in working with a number of international organizations to coordinate a series of large, international green building conferences in Chinese Taipei during the past decade.

Broad-based Rating System Review Criteria: Applicability

The CGBL is applicable, only to public buildings in Chinese Taipei, and it is mandatory for all public buildings.

Development

The context for the establishment of the Chinese Taipei environmental rating systems for buildings began a decade ago, with the National Green Building Policy Initiative from 2001 to 2007. This policy initiative was designed to promote green buildings in the public sector, in order to gradually forge a market mechanism in the private sector. The three major tasks of the initiative included: (1) requirement of mandatory "Green Building" design in the public sector; (2) all new government buildings must achieve green building certification prior to the issuance of building licenses; and (3) the establishment of a goal to achieve a rapid growth rate for green buildings by the end of 2010.

This goal for the first phase of the National Green Building Policy Initiative was implemented with outstanding results, and praised by international green building organizations. For example, the UN Environment Program; iiSBE; WGBC; and CIB have organized relevant international conferences in Chinese Taipei, such as the 2002 and 2005 Sustainable Building conferences, including the promotion of green building concepts, knowledge, guidance, and achievement being effectively used to further achieve integration efforts. The first phase of the "Green Building Promotion Program" was mainly controlled by public-sector-based policies; and the second phase continues the development of green buildings and expansion to ecological community or ecological city concepts. This project has been developed in order to achieve the overall goal of a sustainable economy, whether for promotion of best practices internationally, or for the implementation of eco-community and eco-city concepts.

In 2004 a Green Building Material Labeling System was launched, followed by a Green Building Labeling System in 2007. The 2004 effort was put into effect in conjunction with revisions to the Green Building Chapter of Chinese Taipei's Building Code, including: (1) Regulation of green building material utilization in the Building Code, e.g., Article 321; and (2) Legislation requiring that public and private buildings above a certain size carry out green building planning & design. As a result, since July 2009, green materials must be used for interior finishings and flooring, and must constitute at least 30 percent of all decorating materials. These regulations are now part of legalizing a green building.

In 2007 a new rating system was established to improve green building design. It was classified into five levels (see Communicability section below), each receiving a Chinese Taipei Certified Green Building label. The following incentive measures for green buildings were established:

- Rewarding the private sector for improving and demonstrating construction of green buildings
- Making green building improvements, with a survey indicating that improving existing buildings (97 percent of the building stock) will obtain the best effect. The market survey statistics showed that "healthy green buildings" are the primary focus (77 percent), vs. high performance (15 percent); recycled (8 percent); and ecological aspects of green buildings (0.4 percent);

- Establishing a budget for rewarding existing buildings for conducting green building design and improvement, including rewards for environmental protection; energy saving; waste reduction; and health of indoors

- Subsidizing local governments to promote green buildings, including (1) Improvement of public buildings as green buildings; and (2) Strengthening of inspection for the green building design requirement for construction licenses; and (3) Establishing green building lecture, training, and awareness campaigns.

Managed by the Chinese Taipei Council for Economic Planning and Development, the CGBL has achieved significant results and is now aimed at incentivizing the private sector to conduct further research and development on green building technologies, and assist in creating eco communities and eco cities throughout Chinese Taipei.

Usability

Information to assess the usability of the CGBL system was not available.

System Maturity

The total number of buildings certified by this government system by early 2011 was 2749. The environmental contributions of certified green buildings include the following, as reported in aggregate only: 1) Total building floor areas: 34.8 million square meters; 2) Water & electricity cost savings: annually US$7.6 million; 3) Water saving: 38.9 million tons; 4) Energy saving: 876 million kWh; 5) Annual CO2 emission reduction of 584 million CO2-kg/year; and 6) Other benefits: ecology, water retention & infiltration, waste reduction, resource conservation, etc.

Communicability

Details of the certification process for CGBL are not available. The Chinese Taipei CGBL scoring system is based on the following scoring system for the five tiers of building certification: 1) Certified: 12-25 points; 2) Bronze: 26-34 points; 3) Silver: 35-41 points; 4) Gold: 42-52 points; and 5) Diamond: 53–100 points

Technical Content, Measurement and Verification

The range of potential points available for each subcategory are as follows: 1) Ecology, Total = 27 points: (1) Biodiversity (2-9 points); b) Greenery (2-9 points); and (3) Soil Water content (2-9 points); 2) Energy Savings, Total = 28 points: (1) Shell (2-12 points); b) HVAC (2-10 points); and (3) Lighting (2-6 points); 3) Waste Reduction, Total = 18 points: (1) CO2 emission (2-9 points); and b) Waste reduction (2-9 points); and 4) Health: Total = 27 points: (1) Indoor environmental quality (2-12 points); b) Water Conservation (2-9 points); and Sewage & Garbage (2-6 points), for a total of 100 points for all attribute categories. Information on the conformity assessment process as well as the independence and qualifications of assessors was not available.

Detailed information about broad-based and technical criteria may be found in Annex H.

Indonesia: GREENSHIP

In December 2007 Indonesia hosted the United Nations Framework Convention on Climate Change (UNFCC Conference of the Parties (COP) 13 international climate change meetings in Bali. Beginning in 2007, the President of Indonesia has been delivering strong messages at multiple U.N. FCCC and G20 Summits, and each time his messages confirm that Indonesia is taking the global climate change challenge seriously, and intends to significantly reduce its GHG emissions by 2020, with a focus on greening the built environment as a key strategic and integrative thrust of meeting its emissions reduction strategies. In the interim there have been multiple Presidential Decrees and Instructions, as well as government regulations and standards issued by a wide range of ministries associated with energy, environment, and public works. Since hosting the UNFCCC climate change conference in Bali, Indonesia, Indonesia's climate policy has been closely integrated with its agriculture, forestry, energy and environmental policies. The Finance Ministry published a green paper in 2009 declaring that all environmental strategies must be synchronized with economic goals, and includes incentive strategies for investors and local government.

In this environment, the Green Building Council Indonesia (GBCIndonesia), an emerging member of the WGBC, was established in April 2008 as the nation's foremost coalition of leaders from across the building industry. It is a not-for-profit organization that works closely with the government, and has been an emerging member of the WGBC since 2010. The primary mission is developing and managing a rating system specifically for Indonesia's context, for use on a voluntary basis. It was launched by seven founders, and soon joined by 50 professionals, i.e., developers, designers, architects; engineers (esp. mechanical & electrical), building and facility managers, contractors, suppliers, interior designers, landscaping specialists etc., who then formed multiple Technical Advisory Groups (TAGs). By 2011 membership included more than 120 companies and organizations.

The guiding concept of a "green building," as defined on the GBCIndonesia webpage, is a building which, in the planning, construction, operation and maintenance phases pays attention to aspects such as protection, conservation, and reduced use of natural resources, maintaining the quality of both the building and the quality of indoor air and health of all occupants based on the principles of sustainable development. The main principles guiding the preparation of the rating system are: (1) simplicity; (2) applicability, i.e., able and easy to implement; (3) technology availability; and (4) use of assessment criteria based, as far as possible, on local standards. The rating system tool developers anticipated that once the building industry is more involved in the use of this tool, the basic green building concepts used will become general goals of the building developers as well.

At high levels, the government of Indonesia continues to improve its green building evaluation process. At the September 12, 2011 APEC- ASEAN Green Buildings workshop, Liana Bratasida, a high-level government representative referenced government support for GREENSHIP in her presentations. Moreover, at the September 14, 2011 WGBC-APN workshop Indonesian officials also noted their government's support. Key messages from both presentations were that the building sector of today has an oversized environmental impact footprint; developing countries have the opportunity to lay the foundation of energy efficient building stocks for decades to come; and the role of public policy and leadership by example is vital in triggering the greening of the building sector.

Broad-Based Rating System Review Criteria

Applicability

In reference to project and building types, only brief information re: the pilot version of GREENSHIP New Building (NB) Version 1.0 (June 2010) was accessible for review purposes in the public domain in 2011, with a detailed, updated V.2 still scheduled for release. The NB tool applies to commercial new building project and building types. A tool for Existing Buildings (EBs) is under development. The Green Building Council Indonesia (GBCIndonesia) has established a development process for a more comprehensive rating system toolkit, with specific rating tools for specific contexts, through a monthly consultative process of the TAG experts, ongoing since Oct. 2009. As a result, other GREENSHIP rating tools are under development in 2011. In addition to the EB tool, standards are being developed for 1) Interior Space (IS), i.e., for tenant fit-out purposes, with the aim of achieving healthy and comfortable working environments that increase productivity of occupants and reduce harm to the environment; 2) Home (HS); and 3) Neighborhood Development, a "beyond-building" module that is increasingly of interest in the APEC region, and expands assessment beyond that of a "whole building" to a neighborhood, especially in urban areas; or an entire city, an emerging rating system trend using various labels such as green-city, eco-city, smart-city etc. to summarize the target and intent of the system.

Development

The development process for the GREENSHIP rating system included comparisons of multiple rating systems in use in other economies, including LEED in the USA, the Green Building Index in Malaysia, Green Star in Australia, Green Mark in Singapore, and BEAM in Hong Kong. In addition to extensive consultations abroad, there were extensive in-country consultations, including representatives of government; research institutions; NGOs and international organizations; industries and enterprise; associations (i.e., of professionals and companies); universities and educational institutions; others (e.g., media, banking, insurance); and the core founders. GBCIndonesia worked with the Malaysia Green Building Confederation (MGBC) to design a professional development program called GREENSHIP Professional. This process also included consultations with GBCA of Australia on council development; and with HK-BEAM on rating tool assessment category details. The analysis also compared these systems to the local context, with Indonesia straddling the equator and located exclusively in the hot (and humid) tropical climate zone, for example, as well as being a nation composed of 17,000 far-flung islands.

In the development process for GREENSHIP, the GBCIndonesia signed MOUs towards opening up dialogue with the building sector community, including with the following organizations: 1) ASHRAE-Indonesia Chapter; 2) Research and Development Center for Settlement (Puskim PU); 3) Technology Policy Assessment Agency (BPPT); 4) Real Estate Indonesia (REI); 5) Architects Institute of Indonesia (IAI); 6) Indonesia Society of Construction Management (HAMKI); and 7) Malaysia Green Building Council (MGBC).

The GBCIndonesia has also established cooperation with government entities to assist in market transformation through dissemination and advocacy, including Ministries of Public Works; Environment; Energy and Mineral Resources; Culture and Tourism; Housing; Industry; and Health; the Policy Institute

for Procurement of Goods and Services (LKPP); and the National Development Planning Agency (BAPPENAS). The Ministry of Environment is assisting in the dissemination of Eco-Office Guidelines, and the Ministry of Culture and Tourism is collaborating on a national blueprint for a Green Hotel Standard, demonstrating effective sustainable management in compliance with all relevant international standards. From 2009 to 2011 GBCI conducted more than 140 seminars, workshops and training events, including with government institutions, universities, associations, private sector/industry; public seminars/workshop; monthly network events; training events; and rating service product launches.

The GREENSHIP rating tools were registered and accepted by the Ministry of the Environment on July 21, 2011, acknowledging the competence of environmentally-friendly building certification service providers in Indonesia. Basic criteria of the tools take into account the suitability and standard conditions prevailing in Indonesia, which are all based on the principle of sustainability.

Usability

Given the emerging status of both the rating system developer and the tools themselves, it is not surprising that the GBCI webpage for GREENSHIP is not well-populated at present, with few topic areas and hyperlinks, and limited availability of sections with partial translations in English. This situation will likely improve considerably by 2012.

System Maturity

GREENSHIP development was initiated in 2008, with the first pilot tool available for public use in 2010, and approval of the rating system obtained from government in mid-2011. As of early 2011, 28 projects were registered, with 17 of them New Buildings; zero projects had been certified, and four projects are expected to be complete the certification process by the end of 2011. Details of the scoring system for building certification are not yet accessible in the public domain. The path to attain professional credentials associated with GREENSHIP includes training and exams targeted at becoming credentialed as a GREENSHIP Associate (GA); a GREENSHIP Professional for NBs (i.e., GP-NB); and EBs (i.e., GP-EB). Training involves field work and associated solutions sought through development of case studies.

Communicability

Information on the communicability of building certification results is not yet available for GREENSHP, given the nascent phase of the GREENSHIP rating tool, 28 buildings registered by early 2011, and zero buildings certified as of 2011.

Technical Content, Measurement and Verification

The June 2010 pilot version Benchmark Summary document (11 pages) contains few technical details in comparison with what is available for many of the other more mature rating systems in use in the APEC region—systems with very detailed rating tool reference manuals several hundred pages long. The pilot version was replaced in late 2011 with V.1 for NB, which is not accessible in the public domain. Coverage of this aspect of GREENSHIP is brief in comparison to coverage of other APEC rating systems, due to these limitations.

The six main environmental attribute categories for GREENSHIP NB have a total of 101 points in V.1 (June 2010), distributed as follows: (1) Appropriate site development—17; (2) Energy efficiency and conservation—26; (3) Water conservation—21; (4) Material resource and cycle—14; (5) Indoor health and comfort—10; and (6) Building environmental management. All references are to national standards in the NB checklist with a few exceptions.

Conformity Assessment

All credit references are to national standards in the NB, Checklist, e.g., SNI/Decrees/other local regulations, etc., with the exception of the following: under materials, the Environmentally Friendly Processed Product earns an extra point if it references ISO 14001 certified material, or other equivalent certifications recommended by GBCIndonesia, and a minimum of 30 percent of the total budget. An extra point is earned if 30 percent of the wood is certified by the Indonesian eco-labeling body (LEI) or Forest Stewardship Council. If chemicals are marked by labels/certification recognized by GBCI (incl. external), an extra point is earned.
The building registration and certification procedure is as follows: (1) Registration is sent to GBCI; (2) Design Assessment Process, including registration, exercise and preparation of design assessment, and recognition of design assessment; and (3) Completion Assessment, including preparation of completion assessment, assessment, and award of GREENSHIP NB certification per the assessment results. This nascent system will continue to undergo testing and development and has a system for revisions.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex I.

Japan: CASBEE

Japan, a developed economy with especially tight land, energy, and other essential resource constraints, has long recognized that construction, which consumes and discards resources and energy in enormous quantities, is one field that actions are urgently required to develop and promote techniques and policies able to assist the drive towards sustainability. As a result, the seeds for Japan's currently well-developed and comprehensive sustainable building rating system, The Comprehensive Assessment System for Built Environment Efficiency (CASBEE), were being cast decades ago. These seeds have resulted in a set of four policies to guide the development of CASBEE over the past 15 years, as follows: (1) applicable to buildings in a wide range of applications; (2) takes into consideration issues and problems peculiar to Japan and Asia; (3) structured to award high assessments to superior buildings, therefore enhancing incentives to designers and others; and (4) simplicity in use and the communication of results. As in other APEC economies, CASBEE was designed to serve as a communication tool for sustainable building market transformation.

In the introduction to the current 2008 version of the primary CASBEE rating tool for New Construction that is part of the rating system comparison case study conducted by Fowler and Rauch. It is noted that climate change has begun to be recognized as an issue of extraordinary importance. The analytical framework for CASBEE NC currently includes aggregated assessment of Life Cycle CO2-equivalent (LCCO2) emissions from reduced energy use in building operations, embodied energy in the extraction

and manufacture of construction materials, such as the use of existing structural skeletons and recycled materials, and efforts to reduce LCCO2 through longer building life spans.

Overview of Broad-Based Rating System Review Criteria

Applicability

CASBEE addresses a wide range of building and project types, including commercial office buildings at all phases of the life cycle. The basic CASBEE toolkit, often referred to as the CASBEE "Family," began a major expansion process in 2010, with multiple new tools in various stages of development at present. The core family includes four basic tools, with a set of expanded tools for specific purposes. While other rating systems may make brief mention at present to "beyond building" concepts, the CASBEE family of tools is pursuing this concept in considerable detail, with a global climate change mitigation lens behind this broadening perspective of the usefulness of rating tools for the built environment, as evidenced by the design of the three Environmental Load factors in the BEE denominator for the CASBEE-City tool of the rapidly-expanding toolkit.

The basic non-housing tools in the CASBEE family follow the cycle of the building design process, as follows:

CASBEE PD for Pre-Design (Tool-0, 2003): This is the stage at which the preconditions that form the background to the plan, such as natural, social, cultural and business environment, are subjected to a multifaceted, three-dimensional investigation and analysis CASBEE NC for Design/New Construction (Tool-1, 2003): The concept and policies distilled in the pre-design stage are examined further at the design stage to define their ecological, technical, social, cultural, esthetic, and economic aspects. CASBEE EB for Existing Building (Post-Design) (Tool-2, 2004): This Post-Design/Operation Phase tool includes assessment of existing buildings, and includes the actual specification and performance realized at the time of assessment. CASBEE RN for Renovation (Post-Design) (Tool-3, 2004): This Post-Design/Renovation tool includes subcomponents of design and construction, and includes assessment of renovation improvements of specifications and performance. There is a growing demand for building stock renovation, especially in the Japanese market

Including the four basic tools, the expanded CASBEE family is projected to soon grow to a total of 17 tools. The four additional categories of tools include other non-housing tools (5), urban tools (3), housing tools (3), and auxiliary tools (2), as follows:

Other Non-Housing Tools: CASBEE-NC (BV) (Brief Version, 2003, General BV; and Regional BV). This simplified edition of CASBEE-NC was developed to meet the growing need for a tool that could make a simplified, provisional assessment possible in around two hours (excluding time for the preparation of an Energy Savings Plan), in order to handle needs such as: a) a simplified setting of the BEE level, as a tool for consensus-forming between owners, designers, and builders, etc.; (2) setting environmental design targets and assessing their attainment (e.g., as a proposal management tool etc. under ISO 14001); and (3) for regional assessments in preparation of documents for submission to regional and local government authorities that work in construction administration units. The NC BV tool can be tailored to local conditions, such as climate and other prioritized policies, typically by modifying

the weighting coefficients within the tool. Such assessment can be made mandatory, in the same way as a mandatory Energy Saving Plan, to be submitted to the authorities, together with the building approval application, as a way to improve the environmental efficiency of buildings in the region.

Flexible response to regional character is a common feature of all elements of the CASBEE family. As of 2010 seven regional government programs had adapted the NC BV tool, including Nagoya and Osaka. CASABEE Nagoya, for example, has its own scoring guidelines that instruct some criteria in relation to local contexts, such as including materials from local industry, while defining other excluding criteria; 2) CASBEE-NC/TC (Temporary Certification, 2005), a tool adapted to exhibition facilities; 3) CASBEE HI: Heat Island (Relaxation) (2005): This tool was developed to assess efforts in buildings to alleviate the heat island effect, especially in major urban areas, such as Tokyo and Osaka. Its role is to make a more detailed and quantitative assessment of the heat island-related assessment items included in the basic tools; 4) CASBEE-NC-Tenant (under development); and 5) CASBEE-Site (under development).

Urban Rating Tools: (1) CASBEE UD: Urban Development (2006). CASBEE-UD mainly assesses outer space excluding buildings in the large development area. It considers individual buildings, but it fully recognizes the importance of assessing building groups. Many recent city-center redevelopment projects have included plans taking into account the urban surroundings as one unit. For example, provision of public spaces on the site can be expected to have a positive effect on the surrounding environment, thereby improving environmental quality and performance. Common restrictions imposed on all buildings on a site, even if each one has a different owner, can be regarded as efforts to improve the environmental performance of the urban areas as a whole. CASBEE-UD was developed to assess the efforts of city-center renewable in urban districts or development of large areas including multiple buildings; (2) CASBEE-UD (Expo): Expo facilities (2005); and (3) CASBEE-City (under development).

Housing Rating Tools: CASBEE-DU (Dwelling Unit) (under development); (2) CASBEE-Home (DH): Detached House (under development); and 3) CASBEE-Existing Home (EH) (under development).

Auxiliary Tools: (1) CASBEE-Property Appraisal (PA (under development), with a CASBEE Connector to Economic Indicator; and 2) CASBEE-BIM (Building Information Modeling), with a CASBEE ICT Connector (under development). JSBC and USGBC are cooperating regarding development of the CASBEE-BIM Connector by Autodesk TM (as in LEED), including the Revit (Architecture) Extension for CASBEE (released July 2010). Since CASBEE includes assessment items of different expertise, e.g., architectural, structural, mechanical and landscape design, this application for architects within BIM will be limited in its scope.

Each tool is intended for a separate purpose and target user, and is designed to accommodate a wide range of uses (offices, schools, apartments, homes, expo facilities etc.) in the evaluated buildings and cities. With the latest tools added to the tool suite, it is possible to assess “from a home to a city,” due to the systematic development of the CASBEE DH; UD; and City tools. The three possible CASBEE analytical Frameworks are follows: 1) Building Scale (CASBEE-DH); 2) Urban Scale (CASBEE-UD); and 3) City Scale (CASBEE-City), with designated spaces respectively to calculate environmental Quality (Q) and Load (L) of a single building site. The first analytical framework calculates Q from all buildings within the UD site. In the second case, L is calculated from the entire site of the external space. The third case

evaluates Q and L in three major assessment categories of Q1 environmental quality, Q2 social quality and Q3 economic quality and L1 CO2 emissions, L2 CO2 absorption and L3 Carbon Trade.

Development

Past development of environmental performance assessment in Japan was in three stages prior to the development of the existing CASBEE toolkit, as follows: 1) In Stage 1, the oldest form of environmental assessment in Japan, performance assessment of the building environments was mainly indoors, and basically aimed at improving living amenities or enhancing convenience for occupants. At that point the local environment surrounding the building and the global environment were generally considered as open systems, and ignored with the assumption that buildings simply discharged their environmental loadings into their surroundings. At this stage the philosophical approach was clear, but opposite to today's approach; 2) In Stage 2, growth of public concern in the 1960s over air pollution problems, or the effects of wind on pedestrians etc. in urban areas such as Tokyo, led to the establishment of environmental impact assessments (EIAs). This stage brought in an initial concept of environmental loadings, and incorporated it into building environmental assessments, but only the immediate negative effects that buildings have on their surrounding environments were included as environmental loads, e.g., urban air pollution, wind damage, and daylight obstruction. Whereas in Stage 1 the environment was treated more as a private space or property, in Stage 2 it was treated more as a public (or non-private) space; and 3) Stage 3 began in the early 1990s, when an increase in the consciousness of global environmental problems accompanied an evolution of the environmental assessment of buildings, with specific methods being proposed, based on extensive research experience. The framework of assessment became clearer in Stage 3, while the framework of assumptions on which the environmental performance evaluation is based became unclear.

It is from this perspective that the development of CASBEE, i.e., Stage 4, began in 2001. CASBEE started with the perception that the above situation required a reconstruction into a new system clearly based on the perspective of sustainability. Stage 3 began with the recognition that the capacities of local environments, and the world as a whole, were reaching a limit, resulting in the concept of closed ecosystems as essential for determining environmental capacities when conducting environmental assessments. Therefore a hypothetical enclosed space, bounded by the borders of the building (up to the site boundaries on the sides, including building foundations within the ground, and above the roof of the building), was proposed for making environmental assessments of buildings. The environmental loadings could thus be defined as the negative environmental impact that extends outside to the public environment, i.e., beyond the hypothetical enclosed space. The improvement of environmental performance within the hypothetical enclosed space is defined as the improvements in living amenities for building users. Dealing with both factors, Stage 4 environmental assessment clearly defines these two factors, and distinguishes one from the other, as defined by the basic BEE equation of CASBEE. This makes the philosophy of assessment at stage 4 much clearer, and is now the basis of the CASBEE framework. The concept of Eco-efficiency, defined as "value of products and services per unit of environmental load" (e.g., by World Business Council for Sustainable Development) was next introduced for CASBEE to enable the integrated assessment of two factors, inside and outside the building site. Efficiency is commonly defined in terms of input and output quantities, so a new modeled definition was proposed for an expanded definition of Eco-Efficiency, as (beneficial output) divided by (input plus non-

beneficial output). This definition was expanded to include three groupings of beneficial output to Q numerator of BEE, i.e., Building Environmental Quality and Performance, with Building Environmental Loading categories (L) forming the denominator.

The three main systems that Japanese researchers studied were: 1) BREEAM-UK; 2) LEED ™ USA; and 3) green building Tool. The CASBEE documentation notes that building environmental performance assessment methods such as these have spread rapidly in society, particularly in developed economies, but more recently in developing economies as well. Also noted is that these methods have also come to be used for "Design for Environment" and building environmental labeling (i.e., rating), with the main issue in assessment at this stage being the negative impacts, or in other words, the environmental loadings that the buildings have on the environment, including from anLCA perspective, in evaluating the environmental loads of a building throughout its life.

This research and development phase of CASBEE has been carried out as a cooperative project between industry, government and academia, through a committee established within the Institute for Building Environment and Energy Conservation (IBEC), and under the guidance of the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT). IBEC issues the Technical Manuals associated with each rating tool. The Japan Green Build Council (JaGBC)/Japan Sustainable Building Consortium (JSBC), non-government organizations, have been involved in the development of CASBEE. JSBC and its affiliated subcommittees provide overall management of CASBEE, with its membership including primarily building and construction-related organizations from academia, industry, and government. The Research and Development Committee for CASBEE has a Case Study Working Group, and oversees four Assessment Subcommittees that focus, respectively, on 1) Energy Efficiency; 2) Resource Efficiency; 3) Local Environment; and 4) Indoor Environment. The chairs of the JSBC program units are generally professors at various universities and institutes of technology throughout the economy.

The JSBC is the national member of the WGBC. In 2002 the pilot 1st edition of CASBEE NC was launched. Since the CASBEE was officially released in 2003, nation-wide it has been promptly adopted in national government policies, as well as those of 22 major local governments in Japan (as of Oct. 2010). As noted above, the program is in a rapid development stage at present, and is more than doubling the size of its tool suite over the 2010-2011 time period. The development approach has been consensus-based, and involves life-cycle analysis and expert opinion.

Usability

Since the CASBEE was officially released in 2003, nation-wide it has been promptly adopted in national government policies, as well as those of 22 major local governments in Japan (as of Oct. 2010). The cumulative number of CASBEE accredited assessors nation-wide reached 8,400 by August 2010. On the official CASBEE webpage, details of product support, including records of inquiry, FAQs and an e-mail help desk, and membership information, are generally not accessible in English. However, as of August 2011 access to the technical manual for CASBEE NC and several other rating tools was made possible in English on a guest pass basis, once personal information is provided, whereas earlier access had been limited to those registering a building (in Japan) for assessment. The current NC technical manual (262 pp.) is especially comprehensive, and in addition to lengthy information on the assessment procedure and

scoring criteria, it also includes case studies and other additional information typically on website pull-down menus for other rating systems. Details of membership and several other aspects of usability, credit interpretations, application guides and other rating system details are still primarily available in Japanese.

System Maturity: As noted above, the CASBEE rating system was initiated in 2001; available for public use in 2002, and with the most recent version of the CASBEE NC rating tool issued in 2008. The testing and development process, and system for revisions of this rating system are extensive. By 2009 a total of 1400 buildings had registered for the certification process, and 80 had been awarded certificates.

The JBSC-managed certification program for rating system assessors has been designed primarily for participation by specialized engineers, as well as architects, with expertise and knowledge in comprehensive environmental performance evaluation, and requirements to attend special training courses and take an exam to be accredited.

Communicability

As noted in the discussion of Stage 4 of the development process for CASBEE, this rating system goes a step beyond all of the other rating systems in clearly separating the analyses of Quality (i.e., increase) vs. Harm (i.e., reduction) in the Building Environmental Efficiency (BEE) quotient, with Q (Building environmental quality and performance) as the numerator and L (Building environmental loadings) as the denominator. The use of BEE also enables simpler and clearer presentations of building environmental performance assessment results. A graphic of the analytical boundaries of the building project is produced before the assessment begins. The BEE analytical results are graphed, with the Q points on the Y axis, and the L points on the X axis. A graph showing all solution ranges radiates from the lower left corner score of zero for both Q and L. The details of the six analytical categories are provided below in the technical section.

A set of four basic types of graphical illustrations is included in each set of building project assessment results, as follows: (1) a *BEE Figure*, with L on the X axis and Q on the Y axis, illustrating BEE values (0.0 to > 3.0 on) and star ratings (i.e., 1 to 5 stars), (2) a *Radar Chart* (also referred to as a spider graph) illustrating the Assessment Results of Major Categories of BEE (i.e., six for CASBEE NC). If adjustments during the design process are made, for example, to lower energy usage and embodied energy in resources and materials, comparisons of the baseline scoring results can quickly indicate visually the relative effect of the adjustments in these two areas (3) a *Life Cycle CO2 Global Warming Impact Chart* depicting the amount of life-cycle CO2 emissions of a standard building (per energy conservation law), and 4) *Bar Charts of Assessment Results of Medium-Level Categories* (i.e., Level 3 out of the 5 Levels of assessment for each rating criterion). This latter collective display of six sets of vertical bar charts includes a bar illustrating results for each subcomponent in each of the six assessment categories graphed in the radar chart mentioned above.

BEE is designed to have ten subcomponents each in the Q and the L analyses, with Q1 and L1 each having four subcomponents, while Q2-Q3 and L2-L3 have three each. Individual scores for each of the total of 20 bars are provided, as well as average scores for each of the six scoring categories. The summary page of these four sets of graphical representations of results for each CASBEE assessment also includes a photo and basic specifications of the building project at the top. This summary snapshot can

provide the "simplicity" of understanding results that CASBEE assessment strives for in its development approach, i.e., clarity in understanding separately if quality is increasing; and if harm (i.e., environmental load) is decreasing overall, and specifically in which categories, when subject buildings are compared to baseline buildings or to other assessments of the subject building. Standing behind the simplicity of this snapshot page are also high levels of rigor, detail and comprehensiveness that relatively few rating systems aim for.

As noted earlier, widespread adaptation (primarily through weighting coefficients) and application of the CASBEE rating system is taking place by regional and local government units throughout the economy, enabling savings of energy, associated C02 emissions, water and material savings across Japan, which is precisely the reason why so much care and dedicated expertise went into the development of this rating system. While the intent has primarily been voluntary, self-assessment in the use of this rating system at national and local levels in Japan, with less emphasis on registration for certification and none on global deployment of this system, nonetheless this rating system is proving to be unique in the APEC region and the world, and may offer useful lessons learned for other rating systems in the region. The BIM Autodesk tool being piloted for use with LEED-USA, and now one of the two auxiliary tools under development for use with CASBEE, illustrates the usefulness of sharing lessons learned around the region, and globally.

The overall CASBEE framework labels the sustainability of the assessed building at one of five tiers of building certification, as follows: i.e., S (Excellent) = 5 stars; A (Very Good) = 4 stars; B+ (Good) = 3 stars; B- (Rather Poor) = 2 stars; and C (Poor)= 1 star, with (1) Scores between 1.5 and 4.5 are in the S and A categories, and represent relatively high environmental quality and low environmental loads, with all buildings in these two categories being identified as "green". The superior S category requires a minimum of 53 Q points, and a minimum of a 3.0 BEE score (quotient); (2) Scores between 0.5 and 1.5 are in the B+ and B- categories, and represent average building ratings; and (3) Scores of 0.5 or less have relatively high environmental loads and poor environmental quality, are in the C category, with the worst designated as "brown".

A BEE graph shows rating results of projects submitted to a specific targeted city in Japan (e.g., Nagoya City building rating results from 2004-2008), most of the hundreds of building scores clustered in the center yellow B+ and B- range, with a smaller cluster (<25) in the upper left green A range, and very few scores (<5 each) in both the S (highest) and C (lowest) ranges. An assessment of the Life-Cycle CO2 (LCCO2) performance of a building can also be used to distinguish the relative contribution of various solutions to reducing CO2 emissions, as illustrated in the relative lengths of composite bars representing the total percentage of CO2 reductions against a reference Case 1 (i.e., 100 percent).

Overview of Technical Content, Measurement and Verification

The Built Environment Efficiency (BEE) = Q/L represents a quotient index with the BEE value indicating the degree of sustainability of the assessed building. There are six rating system attribute categories of the CASBEE rating system, as defined in BEE, with the Q scoring target demarcated by the hypothetical boundary line of the referenced building and its assets within this boundary line; and the L scoring target being the (off-site) Environment outside of this boundary line. There are three major attribute categories within the Quality (plus) and three within the Load (negative) portions of the quotient.

Conformity Assessment

When crafting the building certification program, JSBC participated in international standardization activities through the ISO and was accredited by the Japan Industrial Standards Committee (JISC) as an independent, third-party organization to verify conformity with CASBEE's standards, and ensure that the CASBEE label conforms to potential international standards regarding environmental declarations, including the following: (1) ISO 14020 series: Environmental labeling standards data specifications; (2) ISO 14040 series: LCA methods; and (3) ISO TR 14025: Specifications of basic characteristics of Type III environmental declaration. CASBEE also promotes cooperation with similar labeling program developers abroad, to accelerate mutual recognition.

*C*ommercial buildings are rated as follows:

CASBEE PD for Pre-Design (Tool-0, 2003): The preconditions that form the background to the plan, such as natural, social, cultural and business environment, are subjected to a multifaceted, three-dimensional investigation and analysis. In the process, the parties involved identify design themes and build shared concepts and policies.

CASBEE NC for Design/New Construction (Tool-1, 2003): This is a self-assessment check system that allows architects and engineers to raise the BEE value of the building under consideration during its design process. It can also serve as a labeling tool when the building is subjected to expert third-party assessment. Remodeling and replacement construction can also be evaluated under this tool. An assessment using CASBEE-NC may take 3-7 days, including the time required to prepare documents necessary as the basis for scoring.

CASBEE EB for Existing Building (Post-Design) (Tool-2, 2004): This step includes the actual specification and performance realized at the time of assessment based on operation records for at least one year after completion. It was developed to be applicable to asset assessment as well. When a design that has been integrated through the design stage is put into practice, it is subjected to an overall verification process, followed by ongoing retrospective verification through its life-cycle, to evaluate sustainability. The results of the verification are constantly reflected in improvements to the implemented design and concept.

CASBEE RN for Renovation (Post-Design) (Tool-3, 2004): This includes assessment of renovation improvements.

During an assessment, either a self-assessment or a formal, registered assessment of a building, there is a List of Input Items, as well as a List of Output Items, with a weighting sheet (adjusted, for example, by local government units per the results of local prioritization processes) and a CO2 database sheet to assist with calculations in going from the Input to the Output sections.

The use of especially stringent conformity assessment criteria for an item, e.g., the energy efficiency of a key thermal comfort equipment item, may include citation of a standard or other reference that does not originate in the economy where the specific rating system has been developed for use. The only citation of an internationally-recognized standard in CASBEE is regarding the use of air-conditioning equipment to improve thermal comfort, i.e., ASHRAE 55-1992, which may have been more commonly cited in

developed economies before 2000, including in Japan. A total of nine relatively minor and dated references outside of Japan were cited (with several being cited multiple times). The remaining 56 references cited in the bibliography in the CASBEE NC Technical Manual are either clearly of origin in Japan or do not provide enough information as to the author or publishing location to determine that the origin is outside of Japan.

Compliance with CASBEE is ensured through a series of requirements to achieve certification, including chain of custody, site visits, metrics, and auditing/surveillance. The time required to achieve certification for CASBEE for New Construction may take 3-7 days, including the time required to prepare documents necessary as the basis for scoring. The certification program for the rating system assessors has been designed primarily for participation by specialized engineers, as well as architects, with expertise and knowledge in comprehensive environmental performance evaluation, and requirements to attend special training courses and take an exam to be accredited.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex J.

Korea: Korea Green Building Certification (KGBC)

In 2001 the South Korean government's Ministry of Land, Infrastructure and Transportation (MLIT) and the Ministry of Environment established Korea Green Building Certification (KGBC), a rating system that was further deployed by the Ministry of Construction and Transportation in 2002. Based on a September 12, 2011 presentation by Chang-U Chae of the Korea Institute of Construction Technology (KICT), titled "Korea Green Building Certification," the Ministry of the Environment and the Ministry of Land, Transportation and Maritime Affairs (MLTMA) have responsibilities to 1) provide overall management for the certification system, 2) design Certification Bodies (CBs), and 3) organize an Operating Committee (OC), which approves affairs of the system and supervise CBs. It is not clear that any CBs have been established yet. A rating tool within the KGBC rating system is referenced as Green Building Certification Criteria (GBCC). GBCCs were developed for use by either the national or local (e.g., municipal) governments. The objectives of the KGBC and its tools are to evaluate the environmental performance of buildings and promote dissemination of green building in Korea.

The Korea Green Building Council (KGBCouncil), founded in 2000, is authorized as a nonprofit organization by the South Korean government to promote the development of the allied building industries through the development and dissemination of green building technologies. The KGBCouncil conducts research on the development of new technologies and policies, and promotes the exchange of information among stakeholders from industry, academia, research institutes, professionals (e.g., architects and engineers), and the government through seminars, symposiums and lectures on new technologies. The KGBCouncil also tries to promote international cooperation with green building organizations of other countries. It is composed of an executive board and seven general committees, i.e., Activities, Editorial, Research, Personnel, Foreign Affairs, Information and Publicity. The mission of the KGBC is to promote sustainable development. Meeting this goal includes significant reduction of GHG emissions through the dissemination of green building technologies during the life cycle of the building, as one of the most important roles of the construction sector.

Per information on the KGBCouncil webpage, the Korea Sustainable Building Council (KSBC), established in 2009 as a prospective member of the WGBC, hosted the CaGBC in Korea in October 2011, and is also holding internal discussions with the KGBCouncil re: amalgamation, despite their different memberships (i.e., primarily professionals in the KGBCouncil and academics in the KSBC). A representative of the CaGBC reported that the Korean Government's system of measuring the sustainability of buildings includes incentives, although sometimes problematic, and is aiming for 100 percent net zero buildings by 2025. Initiatives include the establishment of pro-green programs in a number of cities, including Seoul and Kwangju, with the latter having an MOU with San Francisco to develop green programs. He also reported that LEED is becoming known, and large corporations such as Samsung and Hyundai are using LEED, as are the larger architectural firms. It is popular in high-end office buildings and is now beginning to be implemented in schools and commercial and residential projects, with 100 registered projects,10 certified projects, and 400 LEED Accredited Professionals in Korea.

Since the announcement in late 2008 by South Korea President Lee Myung-bak of a national strategy for accelerating green growth, he has signed numerous bilateral clean energy agreements and new laws to lay the groundwork for this sweeping strategy, while accepting multiple international awards for his leadership in the green growth area. In 2009 the government announced a 30 percent cut from business-as-usual GHG emissions by 2020, with the move toward a low-carbon economy seen as being in Korea's national interest - and in the interests of economic growth.

Broad-Based Rating System Review Criteria:

Applicability

As of mid-2011 seven rating tools were in use for the KGBC program, each focusing on a specific green building type, i.e., office, retail, hotel, school, residential, multiresidential complex, and "other" building types; with tools for existing buildings (EBs) and homes currently in the pilot phase. The addition of an EB tool will facilitate assessment of building operational and maintenance, aspects, providing a useful complementary tool the office building assessment tool in terms of assessing building performance measures once it has been commissioned and entered the occupancy stage. In terms of the existing stock of building types in Korea, dwellings represent 67 percent of total buildings, commercial buildings 17 percent, industrial buildings 4 percent, and other buildings types 12 percent of the total inventory.

Usability

Information on the KGBC rating system product support was not available.

Development

Development of the KGBC has been a cooperative effort between industry, government and academia. It was launched in 2001 by MLIT and Ministry of the Environment, and is enforced by Ministry of Construction and Transportation and Ministry of the Environment. Specific GBCCs were developed and then enforced in the following order: Multi-Residential in 2001; Office Building for Daejeon Metropolitan City in 2002, and for national use in 2003; Mixed-Use Dwellings (i.e., with residential and

non-residential components) and School Building in 2003; followed by the remaining tools. In 2010 the Ministry of Construction and Transportation conducted a study comparing and analyzing not only assessment tools, but also sustainable building design guidelines for public buildings developed around the world, especially in the United States, the United Kingdom and Germany. These guidelines integrate concepts of sustainability throughout all phases of the life cycle of a building, i.e., inception, design, construction, operation, and demolition, and result in more energy-efficient, lower-cost, and less environmentally-damaging buildings. The results of this study are being used to further integrate these concepts in the context of public buildings in Korea.

In operating the GBCS jointly between the Ministry of Construction and Transportation and the Ministry of the Environment, the KGBC established an Executive Board with nine committees, i.e., seven general committees (activities, editorial, research, personnel, foreign affairs, information and publicity) and two technical committees (i.e., Green Building Certification, and Green Building Dissemination). It has four categories of membership: Members (i.e., individual professionals), Corporate Members (i.e., company, research institute, university, or government organizations supporting the advancement of the Council's activities); Honorary members (nominated by the executive board for exemplary achievements); and Associate members (fulfilling only partial requirements as a Member).

Three building schemes developed separately in Korea are now operated jointly with the KGBC. In 1992 the Korea Eco-Labeling Program was launched to provide environmental information and promote the green products business, with Eco-Label certifying a product that emits fewer pollutants than other products in the same category. GBCS tools include evaluation of the number of Eco-Label-certified building materials used in a building. In 2001 the Building Energy Rating System was developed to promote the energy-efficiency of public buildings by specifying building design requirements, and performing a comparative assessment of the actual energy-saving rates of project buildings to those of design reference buildings. The BERS system has since been incorporated into the energy category criteria for the GBCS tools. In 2006 the Housing Performance Grading Indication System, or "Good Housing" scheme, was established to increase the confidence of buyers in the high quality of buildings sold by participating builders, and including 20 high-performance line items related to noise, structure, environment, living conditions, and fire and safety aspects. A recent ten-year review of lessons learned from these programs produced five recommendations for improving the KGBC program: (1) provide market incentives for making buildings greener; (2) the role of the government is key to expanding the market; (3) regulation and incentives need to be applied differentially by market type; (4) harmonization is necessary between government and business; and (5) in order to encourage transparency, the certification body needs to be independent. There are plans to boost KGBC by establishing a third party independent organization for certification purposes.

System maturity

By mid-2011, i.e., after one decade of operation, the program had issued a total of 1786 certificates; i.e., 589 interim certificates and 1197 final certificates, with a total of 229 certificates for office buildings contributing to this total (i.e., 60 interim and 169 final certificates).

From 2002 to 2005 the number of buildings certified was in the range of 3 to 33 per year; from 2006 to 2010 the range increased from 173 to 571 annually. The following policy incentives for building owners are attributed to moving the market forward during the latter period, i.e., a) permission in 2005 for a 3 percent increase in extra construction expenses allowed for certified government-owned housing; (2) adoption in 2007 of a KGBC obligation for schools; (3) and reduction in 2009 of property and environmental taxes for commercial buildings.

The KGBC plans to develop an international rating tool for buildings located outside Korea.

Communicability

The final Certification Report is transmitted to the Ministry of the Environment and the MLIT, which have overall certification system management responsibilities, including designation of certification bodies, and organization of an operating committee, which approves affairs of the system, and supervises the certification body. The scoring results from the assessment process are weighted, with a total of four levels of certification possible, depending on the weighted scoring outcome. The four levels are labeled "1st Class" through "4th Class, respectively. The required point range for each level of certification was not available in English on the KGBC website.

Technical Content, Measurement and Verification

Nine technical environmental attribute categories of the GBCC for Office Building have been established by the Ministry of the Environment and Ministry of Construction and Transportation (but only six categories for the GBCC for Office Building for Daejeon), including a total of 40 criteria, with a potential total of 136 points, distributed as follows: Land development 7, Commuting transportation 5, Energy 23, Materials and resources 21, Water 14, Atmosphere pollution 6, Management 10, Ecological environment 19, and Indoor environmental quality 31.

Conformity Assessment

The assessment process begins with submission by the building owner of a registration application to the KGBCouncil, which completes an initial review of the documentation and the site, and prepares an Assessment Result Report. This report is sent to the certification committee for the second review process, which includes report deliberations and produces a rating decision.

Future plans to boost the KGBC include the establishment of a third-party, independent building certification body that would administer a systematic certification process, with transparency and objectivity of the assessment results, resulting in increased adoption of new green building technologies. The proposed Green Building Center (GBC) would include a certification committee, which would designate and supervise the certification body and receive its certification reports, with the certification body receiving applications for green buildings and issuing certifications. A KGBC assessor function is planned with a certification process for Accredited Professionals (APs) who would form a pool of trained and credentialed Assessors, eligible to support assessment processes. The certification committee would provide oversight for this parallel Accredited Professional Program (APP), and be notified of pending renewals of qualifications of APs and Assessors.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex K.

Malaysia: Green Building Index

Formation of the Malaysia Green Building Confederation (MGBC) began in 2007, when a group of consultants, academia, and representatives from the building industry met to initiate a nonprofit making organization to promote sustainable buildings in Malaysia. The MGBC, an emerging member of the WGBC, coordinates closely with industry and government. By 2008 MGBC was officially registered, and joined by two organizations of professionals, i.e., PAM (Pertubuhan Akitek Malaysia), an association of architects, and members from the Association of Consulting Engineers of Malaysia (ACEM). The Malaysia Green Building Confederation, has six key roles, as follows: 1) to collaborate and support the government and industry to develop a sustainable built environment; 2) to facilitate exchange of knowledge in the field of sustainable built environment; 3) to be the reference center for sustainable building resources; 4) to be the platform for networking on sustainability matters nationally and internationally; 5) to promote and stimulate demand for sustainable buildings; and 6) to support, promote, and provide input to the Malaysia GBI. MGBC regularly hosts Green Building Seminars, Forums and Workshops, posting associated presentations and other documentation on its webpage.

From its inception, in addition to the provision by government of extensive incentives, the Green Building Index (GBI) has received the full support of Malaysia's building and property players, and has done extensive outreach to other stakeholders groups. However, as reported by the MGBC President at the September. 14, 2011 WGBC Asia Pacific Network Policy Workshop, a number of challenges have been faced by MGBC and policy-makers during the initial GBI implementation period from 2009-2011, all of which have been addressed. In this presentation other gaps hindering the acceleration of green building development were also identified, including an economic downturn, a lack of clear policies encouraging sustainability, a lack of public awareness, a lack of support from stakeholders, and administrative red tape.

The GBI Malaysia rating system, released in 2009, is Malaysia's industry-recognized green rating system for buildings to promote sustainability in the built environment and raise awareness among developers, architects, engineers, planners, designers, contractors and the public about environmental issues and responsibility to future generations. The GBI rating system provides an opportunity for developers and building owners to design and construct green, sustainable buildings that can provide energy savings, water savings, a healthier indoor environment, better connectivity to public transport, the adoption of recycling and greenery for their projects, while reducing the impact on the environment.

GBI is developed specifically for the Malaysian tropical climate, environmental and development context, and cultural and social needs. The objectives of the GBI are to: 1) Define green buildings by establishing a common language and standard of measurement; 2) Promote integrated, whole-building designs that provide a better environment for all; 3) Recognize and reward environmental leadership; 4) Transform the built environment to reduce its negative environmental impact; and 5) Ensure new buildings remain relevant in the future and existing buildings are refurbished and upgraded to improve the overall quality of the building stock.

Broad-Based Rating System Review Criteria

Applicability

The GBI rating system is a voluntary system, applicable to the following, including commercial office buildings: 1) Building types: non-residential; residential, township, and industrial; and 2) Project types: New Construction; Existing Buildings. The range of rating tools launched by GBI as of mid-2011 includes: 1) Non-Residential New Construction (NRNC, 2009); Residential New Construction (RNC, 2009); Non-Residential Existing Building (NREB, 2010); Industrial New Construction (INC (2011); Industrial Existing Building (IEB, 2011); Township (2011); and a Daylight Calculation Tool. All of the tools are in version 1, with the exception of RNC in version 2. Under development are tools for Malls, Hotels, Healthcare, and Data Centers.

Development

MGBC studied four well-known rating systems: BREEAM-UK, LEED-US, Green Star Australia, and Singapore's BCA Green Mark. There were concerns that the first three were developed for use in colder climate zones than the tropical climate zone that Malaysia is in, and while Singapore is also in the tropics, it's dense city-state context is quite different than Malaysia's urban and rural context. The development team was lead by a team of professionals from PAM and ACEM, in consultation with ARCASIA in Korea; Prof. Kazuo Iwamura from Japan, Director of the Union of International Architects of the WGBC; and NABERS rating tool representatives in Tasmania, Australia. As a result, the GBI provides an assessable differentiation to promote environmentally-friendly buildings for the future of Malaysia, while also being a benchmarking rating system that incorporates internationally recognized best practices in environmental design and performance. The GBI Malaysia rating system website provides access to additional documentation on the extensive consultative process used during GBI's development.

Usability

In terms of product support, the MGBC webpage contains sections reporting information on MGBC membership, events and news, publications, resources, FAQs and contacts. Membership consists of more than 300 individuals, in seven categories, i.e., professional; corporate, academic; associate; student, industry, and institutional categories, with nearly half in the professional category. The GBI webpage includes extensive information on registration processes for building projects and training programs, training event descriptions and schedules, and a section to download rating tool assessment criteria manuals for all of the existing rating tools. Educational partners include the North American Board of Certified Energy Professionals, the Building Performance Institute, and the American Institute of Architects Continuing Education. A third website, GBI Malaysia (gbi.malaysia.com), is still relatively nascent, but includes background on GBI and lists of providers of design and construction services, and green technology products, defined as methods, materials, and products, and including non-toxic cleaning products, systems for harvesting rainwater and greywater, and wind and solar energy resources.

System Maturity

As noted above, GBI was initiated in 2007, launched in early 2009, and issued recent revisions and additions to the rating toolkit in 2011. Soon after the launch PAM commenced one-day training sessions

for architects and engineers, with topics including the building code MS1525: Code for Energy Efficiency in Non-Residential (Buildings). In April assessment and accreditation of several pilot projects began. The assessment process involves an assessment at the design stage (Design Assessment-DA), leading to the award of a provisional GBI rating. Final award is given one year after the building is first occupied (Completion and Verification Assessment-CVA). Buildings must be re-assessed every three years in order to maintain their GBI rating to ensure that buildings are well-maintained. There is no indication from the website information that building operational performance is included in these assessments.

By mid-2011, 181 buildings in Malaysia had been registered for GBI assessment, with 30 Design Approvals (15 by NRNC, 1 by NREB), and 2 CVAs (2 by NRNC and none in other categories). Buildings have been registered in more than seven states, including 74 in Selangor and 59 in Kuala Lumpur. Prerequisites to take the GBI Facilitator and Certifier exams include, respectively, degrees or professional registration as an architect or engineer, similar to the CASBEE context in Japan. The range of training opportunities available is extensive. By mid-2011 24 courses for GBI Facilitators had been conducted, including FAQ sessions, with over 1600 people trained, and 437 qualified as GBI Facilitators. Two Certifier Forums were conducted, with 10 qualified as GBI Certifiers.

Communicability

With a total of 100 points possible, the number of points required for certification at the following levels ise: 50-65 Certified; 66-75 Silver; 76-85 Gold; and 86-100 for Platinum ratings. A certificate is issued and the result is published on the website. With only two recent certifications to date, information regarding how clearly results are defined and communicated was not publicly accessible.

Technical Content, Measurement and Verification

The structure of the five basic environmental attribute categories plus Innovation as a 6th category is very similar to that of LEED-USA, and many other rating systems in use in the Asia Pacific region. The six assessment categories, and maximum points available for each, are as follows: (1) Energy Efficiency—38; (2) Indoor Environmental Quality—21; (3) Sustainable Site Planning and Management—10; (4) Materials and Resources—9; (5) Water Efficiency—12; and (6) Innovation—10, for a total score of 100. Information on detailed points for subcategories and international standards referenced may be found in Annex L.

Conformity Assessment

In January 2009 the development team approved the setting up of the GBI Malaysia assessment and accreditation framework, including the terms of reference for the GBI Accreditation Panel (GBIAP), GBI Certifiers, and GBI Facilitators. More recently terms for GBI Commissioners have been added. GBI Malaysia was put under the management of Greenbuildingindex Sdn. Bhd. (GSB), and formed as an independent committee consisting of senior PAM and ACEM professionals to conduct reviews and award the GBI rating to qualified projects. In Feb. 2009 ACEM joined PAM as a shareholder of GSB. Though an independent committee, it is not clear that GSB is a true third party assessment organization. Additional functions of GBIAP are to (1) review appeal cases; (2) review and approve points for the innovation" category; (3) set standards and qualifications for GBI Certifiers and Facilitators; (4) approve examination syllabi (including CPD requirements) for GBI Certifiers; (5) maintain a register of GBI

Certifiers; (6) approve syllabus of training courses and examination and maintain a register of GBI Facilitators; (7) the decision of the panel on granting GBI ratings, approval or dismissal of GBI Certifiers and Facilitators shall be final; and (8) maintain a register of all certified GBI Buildings. The GBI is currently a copyright of GSB.

To register a project, building owners, developers and consultants can make an application for GBI Malaysia assessment by submitting an application form and payment of the requisite fee to the GSB. Fees vary by floor area—for example, a 30,000-square-meter building costs $7,000. Applicants may then choose to appoint a GBI accredited Facilitator to provide professional services. GBIAP appoint accredited Certifiers to assess the projects. Upon completion of the assessment process, the Certifier's report will be forwarded to GBIAP to register and award the certification.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex L.

New Zealand: Green Star NZ

The New Zealand Green Building Council (NZGBC), an established member of the WGBC, is committed to setting standards of best practice and leadership through the development of green building rating tools, so that the property industry can apply to have their projects rated according to their building type and function.

The NZGBC first adopted Green Star Australia and later adapted Green Star to develop Green Star New Zealand. Green Star NZ shares joint standards with Australia for some of the criteria assessments. The two systems have nearly identical structure, assessment categories, and criteria etc., but GS-NZ is developed to the local context. New Zealand shares the same climate zone as southern Australia, i.e., subtropical, with a temperate climate in southern NZ. The adaptation reflects the differences between the two countries' markets, building legislation and physical environments. Green Star NZ is also aligned with the other major international building rating tools, including the British BREEAM system and the North American LEED. South Africa has adopted Green Star as well.

Broad-Based Rating System Evaluation Criteria

Applicability

Green Star NZ is a comprehensive, national, voluntary environmental rating scheme that evaluates the environmental attributes and performance of New Zealand's buildings. Rating standards have been established for four building types to date, i.e., Office 2009; Industrial 2009; Education 2009; and Interiors 2009, with Office 2009 the rating tool targeted for this case study. A rating for the design phase, i.e., Green Star NZ – Office Design, is predictive of the actual completed building's environmental performance, and a rating for the built phase, i.e., a Green Star NZ – Office Built rating, is a review of the actual completed building's environmental performance. It is encouraged and expected that all buildings rated during their Design and Built stage will continue to use the tools available at each stage of the

development (i.e., design, built, fit-out, and in use) only then can the building's actual environmental performance be determined and assured.

Green Star NZ -Office 2009 assesses the environmental impact that is a direct consequence of a building's site selection, design, construction, and maintenance. There are three key stages to the Green Star rating tool suite, each corresponding to a phase in a building's lifecycle, with (1) the Design phase rating the design of a building and assessing what will be built; (2) the Built phase rating the completed construction and assessing what has been built; and (3) the In-Use phase rating the building in operation and assessing its performance on a yearly or two-yearly basis. The standard for Office 2009 combines the design and built phases, with the Office In-Use rating tool still under development. The reference manual notes that the "Aim and Credit" Criteria for each credit are the same for the design and built phases, while the compliance requirements", or types of evidence submitted, can vary between phases. The Office tool rating for the design phase is predictive of the actual completed building's environmental performance, and a rating for the Built phase will continue to use the tools available at each stage of development (i.e., design, built, fit-out, and in-use). Only then can the building's actual environmental performance be determined and assured. The manual is freely available on the NZGBC webpage for use as a guide to track and improve the environmental performance of all buildings.

Development

NZGBC has developed these tools in partnership with the building industry in order to: (1) establish a common language and standard of measurement for green buildings; (2) promote integrated, whole-building design; (3) raise awareness of green building benefits; (4) recognize environmental leadership; and (5) reduce the environmental impact of development. It is not clear, however, that stakeholders other than companies and industry associations were involved in the development process and the standard-setting norms followed are unknown. Both the GBCA and NZGBC websites note that Green Star NZ was adapted from the Australian Green Star rating system, after first adopting Green Star-Australia.

Usability

In terms of the Usability of Green Star NZ, product support is still limited, e.g., in numbers of case studies, records of inquiry, and FAQs on the website. Membership of 600 organizations is reported. The rating system checklist and credit interpretations are provided in spreadsheet format on the website as a de-facto technical manual, with a separate but relatively brief worksheet available for each environmental attribute category, and printed separately.

System Maturity

The website provided a list of 43 certified projects in mid-2011, with 4 Star status achieved b y 23 buildings; 5-star status by 18 buildings, and 6 Star status by two buildings. Further details on building certification requirements are provided in the technical section below. Ongoing education in green building practice is noted as a key component in growing the industry's green building capacity and its ability to meet the increasing demand for high-performing green buildings, and "one size doesn't fit all". Since early 2011 two pathways for attaining professional credentials related to the Green Star commercial building and construction industry have been offered, at both more general and professional levels, i.e., 1)

Green Star Practitioner – for those who are working, or plan to work, within a Green Star project; and 2) Green Star NZ Accredited Professional – for those planning to make Green Star project submissions. Delivery of a third foundation course, Fundamentals of Green Building Practice, is planned for late 2011for those who are new to green building.

Communicability

As with Green Star-Australia, the Green Star -NZ building certification system also includes a total of six levels of stars, but only the top three levels receive awards, as follows: 4 Stars – Best Practice (45-59 points); 5 Stars – New Zealand Excellence (60-74 points); and 6 Stars – World Leadership (75-100 points). In terms of communicating rating results, a framed certificate and award letter are provided, as well as promotional opportunities through an e-newsletter, joint press releases, green building tours, possible NZGBC speaking engagements and events, and other branding options. The limited information regarding the certified projects on the website is clear and easily-understood.

Technical Content, Measurement and Verification

In the credit summary for Green Star NZ - Office 2009, the structure of the eight separate environment impact categories is identical to that of Green Star – Australia v3 for Offices, with a ninth Innovation category for bonus points. Each category assesses environmental impact that is a direct consequence of a project's site selection, design, construction, and maintenance, with all of the categories containing credits that address initiatives that improve or have the potential to improve a building's environmental performance. Points are awarded in each credit section for actions that demonstrate the building has met the associated conformity assessment criteria. If a category is Not Applicable (N.A.) to a specific building project, this credit line is marked N.A. on the project's scorecard for this category, and the number of potential points associated with this credit line subtracted from the total number of points possible in the category. The weighting factor is then applied to each category to reflect the overall importance of the environmental issue addressed by the category. These weightings vary between each GS tool to reflect the different environmental impacts of each building type. In summary, assessment results in eight category scores, that are in turn multiplied by environmental weightings applied separately to each category, to derive a single score that is used in rating the whole building project, with points for innovation added in to the single score before the rating outcome is determined.

The eight categories, with the rating system checklist acronym, are as follows: (1) Management (MAN); (2) Indoor Environment Quality: (3) Energy (ENE): (4) Transport (TRA); (5) Water (WAT): (6) Materials (MAT), (7) Land Use and Ecology (ECO): (8) Emissions (EMI); and Innovation (INN), for a total potential of 146 points in the eight categories, plus 5 bonus points. GS-NZ also shares with GS-Australia four associated Calculator modules, i.e., Greenhouse Gas Emissions Calculator (ENE-2); Public Transport Calculator (TRA-4); Water Calculator (WAT-1); and Ecology Calculator (ECO-4); with the addition of a Sewerage Calculator (EMI-5) in GS-NZ.

Conformity Assessment

The NZGBC commissions at least two third-party Assessors to check and validate a project's submission and recommend a Green Star certified rating, and facilitates all assessments to ensure that projects are

assessed fairly and equally. All Assessors are reportedly industry experts with a great deal of experience in green building design and construction, but the "third-party" aspect is not clear. Achieving formal Green Star NZ certification reflects the commitment and leadership of the building owner to improve environmental performance. This building assessment process is a two-stage process. At the second stage, project teams are given the opportunity to provide further information for any credits that the NZGBC Assessors did not award at the first round of assessment, with detailed guidance provided on any further information required.

In addition to international and other globally-recognized standards, as a result of the close working relationship between Australia and New Zealand as the latter first adopted, and then adapted the Australian version of the Green Star building rating system to better fit its local context, there are multiple examples of joint Australia (AUS-New Zealand (NZ) standards and credit line items in Green Star NZ that match those in Green Star Australia.

The primary third party certification body that Green Star NZ has relied upon for testing and environmental assessments of products and materials is Environmental Choice NZ (ECNZ), but the range of their products is no longer sufficient to meet the certified product needs of the clients of the architectural and specification professionals in New Zealand. For this reason GBCA is assisting NZGBC in alignment efforts to recognize other, internationally based eco-labels within Green Star, per its Assessment Framework for Product Certification Schemes, yet acknowledge differences in the New Zealand market.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex M.

Philippines: BERDE

In March 2007 the Philippines Green Building Council (PHILGBC) was formally incorporated as a non-stock, nonprofit organization, with a Board of Trustees, Chairman and President, and 10 Founding Trustees. PHILGBC, a prospective member of World GBC, aims to introduce environmentally sensitive practices in the design, construction, and management of the built environment, working extensively to promote buildings that are environmentally responsible, profitable, and healthy places to live and work in. The organization's members are the Philippines' champions of industry's green building best practices, forming a coalition of leaders from every sector of the building industry. The PHILGBC also aims to be the premier forum where green building ideas are formulated, tested and implemented. By November 2007 a green buildings roundtable was held to launch a meaningful dialogue with the economy's captains of industry, academe, building professionals, developers, contractors and the public sector.

As noted by President Aquino III during the Nov. 17, 2010 launch of Building for Ecologically Responsive Design Excellence (BERDE) by the Philippines Green Building Council (PHILGBC), gaining further knowledge in green designs, programs, technologies, products, strategies and services is a priority for guiding and safeguarding the future of the Philippines. As he noted at the 13th ASEAN-China Summit in Oct. 29, 2010 in Hanoi, Vietnam, although contributing only one third of one percent of global GHG emissions, the Philippines is one of the most vulnerable economies in the world to climate change, increasingly experiencing severe disruption to agricultural productivity, economic livelihoods, food

security, biodiversity and ecosystems as a result. With the building and construction industry growing at a very rapid pace, and associated with alarming increases in energy use and GHG emissions, green buildings were identified as having the highest potential to significantly decrease GHG emissions with proven and commercially available technologies, while also addressing the high cost of energy, as well as the water, air pollution and solid waste crises in the Philippines. The Climate Change Commission (CCC), an independent body established by the previous President is responsible for formulating a national framework strategy on climate change, as well as action plans at the national and local levels, and collaborates with the PHILGBC.

Broad-Based Rating System Review Criteria

Applicability

BERDE is applicable to New Construction (NC) and Existing Building (EB) projects, including commercial office buildings. Additional rating tools are still in the development phase.

Development

The PHILGBC implemented many awareness campaigns, conferences, roundtables, and CEO and government forums to encourage public participation in the development of BERDE, which has now become part of the core mandate of the PHILGBC. BERDE is a consensus-driven, multisector, multidisciplinary, industry-lead, and government-supported green building rating system. It is a third party certification monitoring and measuring system that enables all market players to benchmark in a single system, thus leveling the playing field. It aims to enable the public to easily identify green buildings, and become the common language for green building in the property industry, with leading companies and organizations now beginning to utilize BERDE to pursue sustainability of building design, construction, and operations. In 2010 the Ayala Land Inc. (ALI) offered nine Existing Buildings as pilot projects, to further enhance the effectiveness of the BERDE rating system in building a more sustainable future. The launch of BERDE was not only noteworthy in including sponsorship by the President of the Philippines, but also the partnerships formed by PHILGBC with ALI, TUV Rheinland Group/ Philippines (TUV-R/P), and GHD Pty Ltd.. In 2011 additional firms registered for BERDE NC projects.

The PHILGBC Board owns the BERDE certification mark, is the highest policy-making body in the BERDE rating system structure, and also manages the appeals committee for BERDE. The BERDE Steering Committee is composed of architects, engineers, building owners and managers, and senior government officials, e.g., from the Department of Energy. Members of PHILGBC receive discounts on BERDE-related trainings, seminars and annual conferences.

Usability

The PHILGBC webpage invites new members, details membership benefits and the member logo, and lists the names of the Board of Trustees. The BERDE rating system technical manual was not available for viewing on the PHILGBC webpage during the research phase of this project. With the rating system still essentially in a pilot/emerging status, the sections of the webpage addressing usability aspects are also still largely under development in comparison to those of the more mature rating systems (e.g.,

LEED, Green Star), e.g., documentation re: product support, openness of operations and transparency of the rating system.

System Maturity

As noted in the Philippines Country Report joint presentation made on September 14, 2011 in Singapore by the President of PHILGBC and a (CCC) Presidential Advisor on Climate Change, despite executive support and multiple legislative initiatives, significant issues and challenges remain in the adoption of green building practices in the Philippines. PHILGBC has been working with its members for nearly four years to raise public awareness and understanding, increase capacity-building efforts among professionals working as financial, economic and technology experts; educate policy-makers, and train government and industry representatives in multiple aspects of transforming the built environment. The larger question of implementing this system in a mandatory vs. a voluntary manner is still being posed. For example, for a mandatory approach, is there a need to develop effective legislation? Is BERDE the new mandatory minimum? Will it be used to assess environmental impact fees? Can it help reduce market risk associated with investment in new and mostly untested technologies? If implemented as a voluntary approach, how much will it cost? Will it stimulate demand for new products and services? Will it create "green" collar jobs? Will it link with the Clean Development Mechanism (and climate finance)? PHILGBC and the Philippine government continue to conduct joint public education and awareness activities together, and foster a productive working relationship, with the President and multiple government agencies acknowledging PHILGBC's programs and endeavors. PHILGBC also values its membership in the Asia Pacific Network (APN) of the WGBC as an important platform for information exchange, for key people to meet with Philippine government officials and decision-makers in the building industry, and for intensive training by green building professionals of the Philippines.

Communicability

The five-star rating system established for BERDE is based on the following point system: 1 Star 50-59 points; 2 Stars 60-69 points; 3 Stars 70-79 points; 4 Stars 80-89 points; and 5 Stars 90 points and above. As of late 2011 more than 10 new and existing building projects had been registered with the BERDE rating system, but none had completed the certification process. The PHILGBC website for BERDE is still in a development phase in terms of establishing clarity, versatility, and results representation measures for this rating system, including details of the certification process.

Technical Content, Measurement and Verification

BERDE has ten assessment categories totaling a potential of 100 points plus 10 bonus points for innovation, as follows: (1) Management—11; (2) Land use and ecology—10; (3) Water—6; (4) Energy—8; (5) Transportation—13; (6) Indoor environmental quality—13; (7) Materials, products and equipment —12; (8) Emissions—3; (9) Waste (10) Heritage Conservation—4; and (11) Innovation—10.

As noted by the PHILGBC president during the Sept. 14, 2011 WGBC presentation, there remains an absence of national standards in the Philippines. Questions are still being asked internally as to how to measure environmental performance. Business as usual is defined as the space between meeting existing regulations and standards that define the mandatory minimum, and the floor for achieving at least a 1 Star

rating in BERDE, with the rating system measuring the space from this floor to the highest 5-star rating level. BERDE is still faced with a branding issue, at first wanting the system to be primarily locally-based, but also acknowledging that the tourism sector is willing to pay the extra cost of greenness if meeting higher standards (i.e., with the need to also be able to measure the "luxury value" in this context). The measurement of Heritage Conservation was also noted as an example of not only measuring the cultural value of a 300 year-old church, but also the sustainability of a structure that continues to keep its occupants comfortable inside at 25°C without needing an air-conditioning system, and serve as an educational example for future architects.

Conformity Assessment

For the new BERDE rating system, the forward to the NC technical manual includes a lengthy discussion of the rationale for outsourcing Assessment and Certification (A&C) activities to a Third-Party Certification Body. With the finalization and publication of the manual, the need to efficiently and effectively establish a credible, independent, impartial, and objective BERDE A&C scheme for the Philippines was prioritized, while avoiding the potential for Conflict of Interest (COI) at every turn in the A&C processes for both buildings and professionals. It was highly recommended that the PHILGBC outsource the BERDE A&C activities to a Third Party Certification Body already accredited to the relevant international ISO/IEC 17021 Standard. TUV Rheinland-Philippines Inc. (TUV-R/P) came forward and was chosen by PHILGBC, as this certification body possesses both international and local accreditations, as well as a top management commitment to impartiality in all management system certification activities. This commitment includes a legal requirement to identify, document and prevent any possible COIs from entering the A&C processes. As a result, in compliance with ISO/IEC 17021, TUV-R/P now manages the application, assessment and certification processes for buildings, as well as the training and certification of BERDE professionals and assessors associated with BERDE. Fees for performing specific A&C tasks are determined in advance.

Credits referencing international standards include the Project Team, referencing ISO, OSHA, or LEED-AP qualifications. Technical Site Assessment and Design references: ASHRAE, CIBSE; ISO 14001 and EHSMS 18000. Land Reuse references ASTM E 1903-97 Phase II and Energy Efficiency Improvement from baseline refer to ASHRAE/IESNA. In addition, the following technology efficiencies refer to various international standards including Lighting referring to the UNDP-DOE-GEF Manual of Practice on Efficient Lighting; Natural Ventilation referring to CIBSE AM10. Energy Efficiency Building Envelope references ASHRAE 189 Design for High-Performance Green Buildings and ASHRAE Standard 90.1 or ASTM E779-10 or equivalent as well as DOE Guidelines in Energy Conserving Design of Buildings. ASTM 2357 or ASTM1677 Standard Test Methods are also referenced. Energy Efficient Equipment and durable goods reference USDOE Energy Star and ASHRAE 90.1. DOLE-OSHA Standards are referenced for indoor acoustics. Indoor air quality references ASHRAE 55-2004 and ASHRAE Standard 55-2004, ASHRAE 62.1-2004 and California SCAQMD Rule # 1168. Paper products must be Forest Stewardship Council compliant paper products. A Pollution and GHG Inventory aims to provide a record of equivalent carbon emissions of the building using LCIA for criteria air pollutants per the U.S. Clean Air Act and the Montreal Protocol. The process for assessing and verifying buildings for certification was not available.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex N.[5]

Singapore: Green Mark

The vision of Singapore's Green Mark (green building rating) Scheme, launched in January 2005 by the Building and Construction Authority (BCA) of the Ministry of National Development, is to have the best built environment for Singapore, a distinctive global city-state with a population of 5 million people. With Singapore's location 2° north of the equator, BCA-Green Mark represents the 1st rating scheme globally to be designed specifically for a tropical zone. The overall BCA-GM scheme's mission is to shape a safe, high quality, sustainable, and friendly built environment. Green Mark encourages the adoption of an integrated design approach incorporating passive design and various green building technologies. The Green Mark motto is: "A Green Mark Building means better indoor environmental quality for a healthier and more productive workplace."

In 2010 the Minister of National Development, also serving as the co-chair of the Inter-Ministerial Committee on Sustainable Development, guided the strategic focusing of the second Green Building Master Plan, while also serving as the founding patron of the Singapore Green Building Council (SGBC), an established member of the World GBC. The SGBC manages the green product certification program, while the Singapore Environment Council oversees the Singapore Green Labeling Scheme.

The work of the SGBC is to complement and support the government's efforts to accelerate the greening of domestic buildings by 2030, while sharing knowledge with other countries in the same (tropical) climate zone. In September 2010 the SGBC launched the Green Building Product Certification Scheme (GPCS) as the first dedicated product scheme in support of the BCA Green Mark green building scheme. Also associated with the BCA-GM scheme is the Singapore Green Label Scheme, launched in May 1992 by the Ministry of Environment, and administered since June 1999 by the Singapore Environment Council. The Singapore Green Label Scheme aims to help the public identify environment-friendly products that meet certain eco-standards specified by the scheme to encourage eco-consumerism in Singapore and encourage manufacturers to design and manufacture with the environment in mind.

Broad-Based Rating System Review Criteria

Applicability

The specific tool for use with new commercial buildings is the BCA Green Mark for New Non-Residential Buildings (NRBs), i.e., Green Mark NRB/V. 4.0, effective on Dec. 1, 2011. The Construction Quality Assessment System (CONQUAS) is a domestic tool of BCA that is linked to Green Mark NRB/V. 4.0. Continual improvement of the BCA GM criteria for New Buildings (NBs), through ongoing revisions, are aimed at creating a more sustainable built environment through the following: a) further enhancing the building energy efficiency standard; (2) greater emphasis on passive design; and (3)

[5] The BERDE manual was available in read only format for a short period of time in the autumn of 2011. Details of the newly-established third party certification entity were available, but the criteria section of the manual was under development, with only general information available.

improvements in resource efficiency. The full BCA Green Mark Scheme toolkit targets specific types of building projects and buildings, as follows: 1) New Buildings (NBs): a) NRBs; (2) Residential Buildings (RBs); (3) Landed House (LH); and (4) Transit Station (TS); 2) Existing Buildings (EBs): a) NRBs; (2) RBs; and (3) Existing Schools (ESs); and 3) Beyond Buildings (BBs), still under development: a) BCA-New Parks (NParks) Design and Development; (2) BCA-NParks for Existing Parks; (3) BCA-LTA for Rail Transit System; (4) Office Interiors (OI); e) Infrastructure; f) Districts; g) Restaurants; and h) Overseas projects.

Development

The Singapore BCA Green Mark Scheme was launched by the Building and Construction Authority (BCA), an agency under the Ministry of National Development (MND), in January 2005. In April 2008 it became mandatory for all new buildings or works on existing buildings exceeding 2000 square meters in floor area to achieve a minimum Green Mark Certified rating in Singapore. Green Mark's parameters are within the tropical climate, its scoring priorities being customized for the current state of Singapore, where a high priority is given to energy and water efficiency scores. Singapore's public transport network is also already in place and thus little priority is given to transport in the ratings.

Usability

In terms of usability, the official BCA government website for Green Mark is significantly underdeveloped. A limited number of product support-related hyperlinks do exist for general enquiries, FAQs, and training schedules.. In the search for a technical manual for BCA-GM for New NRBs/V4.0 on this website, only a brief, 18-page "framework" document on assessment criteria was available for downloading, often lacking in the specifics of technical assessment criteria required to earn specific points towards a potential total of 192 points in seeking green building certification.

System Maturity

As of July, 2011 a total of 840 BCA-Green Mark building projects were registered, representing a gross floor area (GFA) of 25 million sq. meters (vs. 1.1 million square meters in 2005), and more than 100 buildings certified in all building and project type categories. With 12 percent of buildings being classified as "green" in 2011, the vision is to increase this target to 80 percent green buildings by 2030.

There is a professional accreditation system associated with this rating system, managed by the BCA Academy of the Built Environment. This system includes four professional accreditation levels, as follows: 1) GM Supervisory Level, with Green Mark Manager (GMM) and Green Mark Facilities Manager (GMFM) (primarily O&M, and facilities management experience); 2) Green Mark Professional (GMP) Level; and 3) GMP Associate Level, with multiple specialized academic programs, diplomas (e.g., mechanical engineering/green building technology or electrical engineering/clean energy) and degrees (e.g., BSc in Facilities & Events Management or MSc in Facilities & Environment Management); and 4) Executive Level Development Programs (e.g., CEO Breakfast Talk; Leadership in Green Building Lecture Series; EDP Leadership in Environmental Sustainability; EDP Innovations in Sustainable Design & Technology; and EDP Green Building Training for Managers/Professionals from Tianjin Eco-City in

China). The Road Map for building the capabilities of a Green Collar Workforce includes 2000 graduates of the GMM course and 120 of the GMP courses.

Communicability

The scoring system for each of the four levels of building certification, based on the percentage of total points scored, and with estimated energy savings indicated in parenthesis, is as follows: 0) Try Again 0-49; 1) Certified: 50-74 (10-15 percent EE); 2) Gold: 75-84 (15-25 percent EE); 3) Gold Plus: 85-89 (25-30 percent EE); and 4) Platinum: 90-100 (≥30 percent EE).

Technical Content, Measurement and Verification

There are five main attribute categories in the NRB 4.0 tool, with the acronym, maximum points, and percentage of the total points possible indicated for each category, as follows: 1) Energy Efficiency (EE) 116 points, 61.2 percent; 2) Water Efficiency 17 points, 8.9 percent; 3) Environmental Protection 42 points, 22.0 percent; 4) Indoor Environmental Quality 8 points, 4.2 percent; and 5) Other Green Features & Innovations (OGFI, contributing to better building performance) 7 points, 3.7 percent, for a maximum total of 190 points. There is no weighting of scores in the BCA-Green Mark Scheme.

Conformity Assessment

The certification procedure for building project applications for green building assessment and rating services is as follows: 1) Developers, building owners and government agencies submit an application form to BCA to register their interest in participating in the BCA Green Mark Scheme; 2) The BCA assessment team has a preliminary meeting with the project team to brief on the criteria and request for relevant reports and documentary proofs to substantiate the subsequent submissions. All Pre-Requisite requirements for the NRB 4.0 certification are to be complied with, as well elective requirements, i.e., a minimum of 30 points for energy-related requirements; and a minimum of 20 points for other green requirements; 3) Actual assessment is conducted on a later date, once the team is ready. The assessment includes design and documentary review, as well as site verification. Documentary evidences are to be submitted at the end of the assessment; and 4) Upon completion of the assessment, a letter of award showing the certification level of the project will be sent to the team.

Green Mark references several international standards including NRB EE 1-1 PR1-2 Air-conditioning system; ASHRAE Guide 22 and AHRI 550/590 for chilled water efficiency) . Also the developer, main builder, Monitoring & Evaluation consultant and architect are ISO 14000 certified. All other references are to Singapore Standards.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex O.

United States: Green Globes USA

While LEED is widely recognized, GreenGlobes is also used in the United States. Green Globes is North America's first interactive, web-based design guidance, environmental assessment, and green building rating system, and the first nationally recognized alternative to LEED in the USA. Green Globes is

operated by the Green Building Initiative (GBI) which acquired the rights to distribute Green Globes in the United States in 2004.

The GBI has committed to continually refining the system to ensure that it reflects ongoing advances in research and technology, and involving stakeholders in an open and transparent process. To that end in 2005, GBI became the first green building organization to be accredited as a standards developer by the American National Standards Institute (ANSI). The GBI ANSI technical committee was formed in early 2006 and the official Green Globes ANSI standard was published in 2010.

Broad-based rating system review criteria

Applicability

The Green Globes system is used by large developers and property management companies, including the Canadian federal government, which has adopted the program for its entire real estate portfolio. The Green Globes system has also been used by the Continental Association for Building Automation (CABA) to power a building intelligence tool called Building Intelligence Quotient (BiQ). It is also used for many types of commercial and government building projects, including public buildings, offices, retail, industrial, healthcare and university/school buildings. Several universities have used Green Globes to certify an entire campus.

Development

Green Globes traces its history back to BREEAM UK in 1992, a paper-based rating system with our 100,000 buildings certified by 2011. From the UK version, BREEAM Canada and BREEAM GreenLeaf then evolved to Green Globes USA. Green Globes emphasizes energy and benchmarks against Energy Star, a joint program of the US Environmental Protection Agency and the US Department of Energy. Changes originally made to adapt Green Globes for the U.S. market were non-substantive – e.g., units of measurement, U.S. versus Canadian references and incorporation of U.S. programs such as the EPA's Target Finder.

Usability

The NC and CIEB tools are proprietary, and must be purchased. As a result limited information is available on the usability of these tools, other than general remarks by GBI staff that it is web-based, interactive, and user-friendly.

System Maturity

Approximately 150 buildings have been evaluated on-line, third-party assessed and certified. Sectors include corporate offices, governments, education, healthcare, industry, retail, and multifamily buildings.

Communicability

Certification recognition levels include 1 Globe 35-54 percent, 2 Globes 55-69 percent, 3 Globes 70-84 percent, 4 Globes 85-100 percent, with the latter three ratings comparable to silver, gold and platinum ratings of LEED-USA (Nine US Federal buildings have been dual certified under both systems. Minimum

points are required for standards compliance at each of the four certification levels. A Green Globes certification plaque is awarded for each certified building.

Technical Content, Measurement and Verification:

There are seven assessment categories for the New Construction rating tool including project management (50 points), site (115 points), energy (380 points), water (85 points), resources (100 points), emissions (70 points) and indoor environment (200 points), for a total of 1000 points. CIEB does not include project management or site assessment criteria, with points shifted to the emissions and environmental management for existing buildings assessment categories and small adjustments made to the remaining categories.

The LCA credit calculator is a free tool that helps architectural design and engineering teams understand various cradle-to-grave environmental impacts of building assemblies. The LCA tool takes into consideration the following impact indicators: building material life span, embodies energy, solid waste, air and water pollution and global warming potential. The tool provides results for hundreds of common building assemblies in low and high rise categories. Based on the Athena EcoCalculator for Assemblies, it is free, downloadable and easy to use software. Design teams who use the LCA Credit Calculator as part of their evaluation process receive LCA related education credits within the Green Globes New Construction assessment protocol and rating system. The next version will fully incorporate the GG LCA Calculator.

Details of the New Construction rating tool are the same as for Canada Green Globes (see above). The detailed requirements for the US license for existing buildings are not available except for purchase as they are an ANSI standard.

Conformity Assessment

GBI launched a two-stage third-party assessment process using highly qualified third-party assessors, typically architects and engineers with more than 15 years of experience. The two stages include a review of essential documents as well as an on-site walk-through of the building. Documents reviewed include construction and analysis documents, management policies, facility records and other support materials). Staff interviews, as well as a site visit and walk-through audit, supplement the documentation submitted on-line to confirm the percentage of points indicated. New buildings are required to undergo a thorough review of construction documents prior to the onsite visit. GBI selects the appropriate assessor based on factors such as geographic proximity, qualifications, expertise with the specific building type and fair distribution of assignments. A final rating of one, two, three or four Green Globes is awarded after completion of the two-stage assessment. Post building construction, 12 months of operational data while the building is occupied is required for the CIEB assessment. General pre-assessment checklists for New Construction and CIEB, as well as specific checklists and an application guide for Healthcare may be found on the web page.

Detailed information about broad-based and technical criteria, and conformity assessment may be found in Annex P.

Vietnam: LOTUS

In partnership, Vietnam Green Building Council (VGBC), an associated group of the WGBC, and the Ministry of Construction of the Socialist Republic of Viet Nam have been hard at work creating and launching the new LOTUS green building rating system for Vietnam. The Ministry of Construction performs national management roles in urban and rural design, planning and construction, including for housing, office development, business properties, industrial parks, economic zones and technology development. It is also acts as the legal owner of state-funded enterprises that it manages. By March 2009 the Ministry of Construction officially recognized the VGBC, and also took part in the establishment of the World Green Business Council-Asia Pacific Network (WGBC-APN) in September 2009, as well as the recent APN event in Singapore. The six primary objectives of the VGBC are to: (1) enhance awareness of green building practice through workshops and online resources; (2) develop a set of green building rating tools, i.e., LOTUS; (3) define and implement an official green consultant training and examination program (i.e., LOTUS Accredited Professional (AP); (4) create a Green Database (i.e., of products and services); (5) continue long-term research on climate change resilience for the building environment; and (6) strengthen ties with its academic, government and private sector partners.

At a presentation in Singapore on September 14, 2011, the Ministry of Construction/DSTE representative mentioned an eight-year legal effort in Vietnam to establish a strong foundation for implementing an aggressive strategy to fast-track green building development. The various government entities involved include the Ministry of Science & Technology (MOST); the Ministry of Construction, and the Ministry of Finance, in collaboration with Ministry of Industry.

For the LOTUS rating system, the most important legal document cited is the 2005 Energy Efficiency Building Code (EEBC), the primary reference point for the energy assessment category of LOTUS (ref. technical section below), which is continually being updated and expanded.

Broad-Based Rating System Review Criteria

Applicability

LOTUS includes a set of market-based green building rating tools, developed by the VGBC specifically for the Vietnamese built environment. In 2011 the toolkit includes 1) Non-Residential (NR) V1; 2) Residential V1, with both tools launched in Sept. 2011, and 3) Existing Building Operations (EBO), with a large demand already existing for this tool, which is still under development. Development and deployment of free energy modeling software associated with this tool is planned, as well as further development of green building research programs with VGBC partners.

Development

In the acknowledgement section of the LOTUS Non-Residential) (NR) Rating Tool Pilot Checklist dated 31/08/2010, the Vietnam Green Business Council (VGBC) notes that after it conducted a survey of the world's significant green building rating systems, several became focal points from which it borrowed heavily during the construction of LOTUS, i.e., (1) Green Star- Australian; (2) LEED-USA; and (3) GBI-Malaysia, as well as, to a lesser extent, (4) BREEAM-UK; and 5) Green Mark- Singapore. This was a three-year research effort, including the expert advice of specialists giving particular consideration to Viet Nam's economic and environmental characteristics, and to existing Vietnamese standards and policy. As

with the other existing international green building rating systems, LOTUS shares the same goal of establishing standards and benchmarks to guide the local construction industry towards a more efficient use of natural resources and more environment-friendly practices.

In developing LOTUS, VGBC also acknowledges the importance of the assistance of green business councils in Australia (GBCA), the USA (USGBC), the WGBC (based in Canada), the Global Cities Institute of the Royal Melbourne Institute of Technology, and the support from its own founding and regular members, the many partnerships listed above, especially with the Ministry of Construction. Other useful support noted on the VGBC webpage was from two EC-funded projects: (1) the MEET-BIS (Mainstreaming Energy Efficiency through Business Innovation Support) Vietnam Switch-Asia Program; and (2) the ASEAN Management Accreditation Scheme (AEMAS), executed by the Research Center for Energy and Environment (RECC) to reduce GHG emissions through the promotion of energy efficiency and energy management systems in industry, including associated energy manager training and accreditation programs.

The survey of other rating systems included redistributing the points within each of the rating tools to match the category structure of the LOTUS NR Pilot. The intent of each credit from LEED, Green Star and GBI was analyzed, and one of the following actions was taken: (1) if the intent was analogous to the intent of a LOTUS NR Pilot credit, the points were placed within the appropriate LOTUS NR Pilot category; (2) if the intent of the credit was outside the scope of LOTUS NR Pilot, the points were not included in the survey; or (3) if the credit was an innovation credit, the points were not included in the survey. After an analysis of the global weighting for all these systems, which were summarized in graphs in the pilot NR checklist, a general weighting was established for the NR rating tool point distribution, taking into account local needs as well as local capabilities and market characteristics.

The VGBC's strategy to build stakeholder capacity is to organize workshops and conferences to raise awareness for all stakeholder groups, and to implement VGBC training programs to build private sector capacity through Green Building Basics modules (e.g., for saving water and energy); as well as professional-level LOTUS-AP training and examination systems. The VGBC strategy for advocacy presented at WGBC-APN 2011 is to target the four priority stakeholder groups with support for priority actions, as follows: 1) *Government*: promote and deploy information on green building policies and incentives; coordinate WGBC and UNEP efforts; build internal capacity; enforce the law, and raise awareness; 2) *Real-Estate Developers*: promote green valuation, build capacity, better assess project exposure and vulnerability, and record building performance; 3) *Construction Industry*: build capacity to design, build and operate buildings; and 4) *Academia*: set up sustainable construction curriculum for architects and engineers.

The VGBN is also seeking potential support from the WGBC-APN for the following: 1) capacity building for all stakeholders (i.e., government at national and municipal levels; definition of university curriculum; organization of workshops for the private sector); 2) creation of an exchange platform to share information about green building practices and feedback on the implementation of specific incentives; 3) benchmarking of building performance at the regional level; and 4) developing research at the regional level, especially with ASEAN neighbors (all of which are located in the tropical climate zone) with nascent rating systems, such as Malaysia, Indonesia and the Philippines.

Usability

The design of the VGBC webpage is similar to that of other WGBC members, and includes sections that profile VGBC and its partners, its membership, LOTUS rating system, resources, the green database, FAQs, and contact information. With the roll-out of the first rating tools in late 2011 concurrent with the writing of this report, the website remains under development, and still evolving, with some sections being populated at a faster rate than others at present.

System Maturity

While the LOTUS rating system has been under development from 2007 to 2011, with the first two modules (NR and R) graduating from a pilot to a Version 1 stage in late 2011, and four NR projects (two office buildings, two factories) already registered during the pilot phase. The third module (CIEB) is still in pilot phase, and plans for the content of new modules are still unclear. Nonetheless, several aspects of the roll-out of the LOTUS system are relatively advanced for the still emerging stage of its development, i.e., 1) development of the Vietnam Green Database of green building information, with free access to information and the ability to add a product or service, easy access on the VGBC website, continued support as the market evolves, especially to ease the work load of architects and engineers and facilitate closer cooperation; 2) development and deployment of free energy modeling software, to facilitate detailed understanding of increasingly stringent measures to achieve higher levels of ES&E in an buildings undergoing assessment; and 3) development of additional green building research programs with partners.

Communicability

The LOTUS scoring system for the three levels of green building certification possible are as follows: 1) Certified: 60-83 points; 2) Silver: 84-105 points; and 3) Gold: 106-150 points. None of the four buildings registered for NR certification has completed the assessment and certification process yet.

Technical Content, Measurement and Verification

Per the Glossary for the LOTUS NR Rating Tool Pilot Checklist, a Category is a grouping of Credits that have a similar area of focus and perceived environmental impact. Each Credit has a specific intent that, if followed and achieved, allows the user to gain points within a LOTUS Rating Tool. In addition, some Credits have mandatory Prerequisites, i.e., minimum levels of performance that can be found at the Category and Credit level. If a LOTUS Rating Tool is to be used for LOTUS Certification, all Prerequisites must be attained. The LOTUS Technical Manual is a user's guide to attaining a LOTUS Provisional and Full Certificate. It provides technical guidance for all LOTUS Credits in order for users to understand intents, requirements, approaches and implementation, calculations, and submissions. In the LOTUS NR Rating Tool Pilot Checklist introduction to the Energy assessment category, it is noted that from 2010 to 2025 overall energy demand is expected to increase 10 percent per year and triple by 2025, with the electricity portion increasing eight times due to rapid urbanization and construction rates. However, since buildings, especially in urban areas, consume a majority of the energy produced annually in Vietnam, there is potential for mitigating climate change and energy insecurity through integrating energy efficiency measures into buildings. With energy efficient designs, buildings can potentially reduce their energy consumption by up to 50 percent (Fangzhu Zhang et al, 2010, Green Buildings and Energy

Efficiency), thus climate change improvement can be realized. With this target in mind, the LOTUS NR Pilot rating tool set up a certain level of energy consumption reduction as a prerequisite for the Energy category, ensuring a minimum energy efficiency standard for all LOTUS certified green buildings. Likewise, all credits within this category encourage the reduction of a building's energy use through 1) strict controls, 2) optimization of natural conditions, 3) the use of energy efficient technologies, and 4) the use of sustainable renewable energy sources.

There are nine assessment categories for the LOTUS NR pilot rating tool, including associated point and normalized percentage allocations as follows: 1) Energy (E) 34 points, 22.7 percent; 2) Water (W) 15 points, 10.0 percent; 3) Materials (M) 20 points, 13.3 percent; 4) Ecology (Eco) 13 pts, 8.7 percent; 5) Waste & Pollution (WP) 13 points,8.7 percent; 6) Health & Comfort (H) 20 points, 13.3 percent; 7) Adaptation & Mitigation (A) 13 points, 8.7 percent; 8) Community (CY) 10 points, 6.7 percent; and 9) Management (Man) 12 points, 8.0 percent; and a 10th Innovation category for 8 bonus points. There are a total of 86 credit categories in LOTUS, worth a possible total of 150 points plus 8 bonus points.

Conformity Assessment

In LOTUS there are only three credits referenced to other than national standards, i.e., use of limited HCFCs & HFCs per the Montreal Protocol, Indoor Air Quality ventilation rates per ASHRAE Standard 62.1; and the requirement for Green management to adhere to an Energy Management System and ISO 14001 certification. Other credits reference Vietnam standards are referenced to domestic standards. LOTUS Certification is a formal process to independently validate how a project has achieved the environmental performance specified in LOTUS rating tools Documentation-based submissions are provided to the VGBC as evidence of this achievement. The project owners can also hire a LOTUS Accredited Professional who has been certified by the VGBC to advise on the likelihood of the project achieving LOTUS Certification. The LOTUS Accredited Professional (AP) has undergone training and successfully passed the LOTUS Rating Tool examination. Upon Accreditation, the LOTUS AP is then deemed qualified to work either as an internal or external resource within a LOTUS project. VGBC's role is that of a third party certification body. Therefore, the VGBC does not provide consultancy services for projects as this is the role of LOTUS Accredited Professionals.

After registration, the project will be determined to be ineligible or eligible by the VGBC. If the project is deemed eligible for LOTUS Certification, it can proceed to the next step and sign an agreement with the VGBC. There are two steps to gain a LOTUS Full Certificate: The LOTUS Provisional Certification is awarded after the completion of the design stage of the project. The Provisional Certificate certifies that the necessary requirements and strategies are in place for the building to become a "green building" and is valid for 2 years from completion of commissioning. This gives the opportunity for a project to be marketed as "green" from an early stage, before· achieving the LOTUS Full Certificate. The LOTUS Full Certification is awarded after a minimum of 18 months of operation and occupation (minimum occupancy of 50 percent of design) and is valid for 3 years. This certification demonstrates that all green building requirements and strategies of the design stage were incorporated and achieved into the final construction and operation. Where the installation differs from that specified within the LOTUS Provisional Certificate, projects must justify how these changes provide an equal or greater environmental benefit for the points to be awarded.

Detailed information about broad-based and technical criteria and conformity assessment may be found in Annex Q.

Category 3: Economies with Rating Systems Under Development

Brunei Darussalam: Advanced Planning Stage

A June 11, 2011 a Brunei Times article-*Green building drive gets German push,* reported on the June 8th, 2011 National Environment Conference 2011: *Green Brunei: New Ideas for Sustainable Country.* The National Environment Conference brought together over 250 stakeholders from government, business, academe and civil society, Markus Brunner, an international sustainability expert with Heidelberg Cement, a German firm, commented that although Brunei is in the initial stage of setting up a green business council, he is confident that things are going to work out very well. Mr. Brunner spoke, focusing on how leading companies in the Sultanate are contributing to environmental sustainability. Heidelberg Cement is a German firm producing cement in Brunei, and one of the founding members of the German Green Building Council that supports green building concepts around the world.

The first key finding reported in the official NEC conference report-out document is that Brunei intends to be part of the green building movement to rate the performance of buildings in Brunei, as this will encourage the construction industry and existing buildings to increasingly consider sustainable development. In the June 23, 2011 Brunei Times article, *Take holistic approach to "greening" buildings,* it was reported that Pehin Dato Hj Suyoi, the Minister of Development, during the recent East Asia Climate Partnership Roundtable 2011 meetings in Korea, noted that Brunei is currently aiming to reduce the energy intensity of the economy by 25 percent by 2030 through the introduction of an energy audit of buildings. 2005 is the base year for this target, set in accordance with the APEC Leaders' 2007 Sydney Declaration to reduce the energy intensity of the APEC region by 25 percent overall in 2030 compared to 2005.

In response to a question as to what Brunei is current discussing and implementing with regards to climate and energy sustainability and conservation, the reply was that the Ministry is investigating the establishment of a green building council for Brunei Darussalam, and this could not come at a more necessary or opportune time, as local and international architects are increasingly focusing on the global "green" building trend. Masri Hj Taha, a leading local architect, was also interviewed. When asked whether a government or private sector initiative should kick this movement off, he insisted that a more holistic approach is the way to go, and including an advocacy campaign to help create demand for "green" building, new in general in Brunei.. He also noted that both government and the private sector need to start investing into this initiative.

An August 12, 2011, *Brunei Times* article "Brunei to register with World Green Building Council," noted that Brunei had started the process of registering with the WGBC to keep up-to-date with green building technologies around the world and set a benchmark for green buildings in the sultanate. Dato Hj Abas, another leading architect and the president of the Association of Surveyors, Engineers and Architects (Puja), noted that becoming a WGBC member means having to comply with council requirements, so designs would be accredited and able to achieve platinum, gold or silver status, and being a member

would enable Brunei to set up a body for the green building index (Note that Brunei is associated with the WGBC)[6]. He also noted that the association had recently set up a Green Initiative Committee to form the guidelines and standards that architects, engineers and surveyors will have to follow when designing or constructing new projects in the sultanate. He also noted that Brunei hopes to establish its own green building index to categorize its designs and use as its reference. Recently the Beach Bunch, a local NGO, announced that it has proposed to build "the first true green building in Brunei," an ecologically friendly Environmental Information Center at Meragang Beach, using whatever is available locally for its "super adobe" design.

The recently formed Authority for Building Control and Construction Industry is an authority responsible for: (1) The Building Control, including issuing of occupation permits; and (2) the Construction Development, including standards, safety and quality relating to the construction industry. This economy adopts the ISO 15392:2008 Sustainability in building construction-General Principles, as a National Standard PBD. It also adopted the ISO 50001 Energy Management standard upon publication by ISO. Moving forward, the National Standard PDB12:2008 Building Guidelines and Requirements, is being reviewed for incorporation into the economy's sustainable building policies.

Papua New Guinea: Early Planning Stage

Mr. David Velyoke represented Papua New Guinea at the September 12-13, 2011, APEC and ASEAN workshop, as well as the WGBC-APN workshop on September 14, 2011 in Singapore. In multiple discussions with the author and other workshop participants, he noted a strong interest in coordinating and facilitating the formation of a green building market transformation effort in Papua New Guinea. He continued to communicate virtually after returning to Papua New Guinea.

Thailand: Advanced Rating System Development Phase

The green building movement in Thailand has been in a development phase for two years at present, with national associations of architects and engineers in the lead. Very important to this development was the establishment of the 2009 New Building Energy Code (2009 NBEC) by the Ministry of Energy, effective June 20, 2009. The BEC regulates building construction and renovation of any building that has a gross building floor area (GFA) greater than 2000 square meters, and must be designed to consume less energy. The Thai Green Building Institute (TGBI) was launched in 2010, it involves cooperation between 1) the Association of Siamese Architects under Royal Patronage (ASA); and 2) the Engineering Institute of Thailand under H.M. the King's Patronage (EIT). Additionally, multiple government agencies and professional associations support this project, i.e., 3) the Department of Alternative Energy Development and Efficiency (DEDE); 4) the Department of Public Works and Town and Country Planning (DPT); 5) the Pollution Control Department (PCD); 6) the Air Conditioning Engineering Association of Thailand (ACAT); and 7) the Illuminating Engineering Association of Thailand (TIEA).

TGBI has six categories plus innovation: (1) Building Management; (2) Site and Landscape; (3) Water Conservation; (4) Energy and Atmosphere; (5) Materials and Resources; and (6) Indoor Environmental

[6] The names of the organizations that are affiliated with the WGBC, including in Brunei, are not listed on the WGBC website.

Quality. Fourteen case studies of commercial and public buildings were presented, including seven projects achieving Gold or Platinum ratings, and seven receiving ASA Green Awards.

4. Comparison of Rating Systems in Use in the APEC Region

There are commonalities and differences for the broad-based and technical criteria, as well as conformity assessment procedures, among the various rating systems including LEED-USA and other rating systems in use in APEC economies. The various aspects of the broad-based criteria, including applicability, development, usability, system maturity and communicability are discussed below, followed by a discussion of the potential impacts on trade.

Commonalities and Differences in Broad-Based Criteria:

Applicability

Annex R Table 1: *APEC Rating Systems Applicability* provides a summary of (1) green building climate zones,(2) project types, and (3) building types and (4) aspects of voluntary vs. mandatory y applications associated with rating systems in use in the APEC region.

Rating Systems and Climate Zones

The fit of a building project's operational climate zone to the climate zone for which the rating system was primarily designed is increasingly of interest in the region. Detailed information relevant to this section is provided in Annex R. In the web pages for rating systems developed relatively recently by ASEAN economies, e.g., GBI, GREENSHIP, LOTUS and BERDE in Malaysia, Indonesia, Vietnam and the Philippines respectively, there is typically reference made to an effort to not only review well-established systems such as BREEAM and/or LEED-USA designed for economies in the temperate climate zone, but also to review systems of ASEAN neighbors in the region that share the same tropical climate zone. With the increasing allocation of points to the energy (efficiency) assessment category of most rating systems in the APEC region, given high fossil fuel energy costs to power building energy systems, attention to details as to how to best reduce the Building Energy Intensity (BEI) requires specific information and equipment to either keep the heat in the building in the temperate zone, or out of the building in the topical zone. Examples of criteria that are typically scrutinized are the envelope criteria, and the ability of specific ventilation, air-conditioning, lighting, and monitoring equipment to achieve high performance levels for the functions that they are designed for. The relative abundance of solar energy nearer the equator and relative scarcity on an annual basis in the temperate zone provide a second reason to pay attention to location, resource, and equipment details if maximum points for on-site use of renewable energy or use off-site power by the building are to be earned. The APEC region includes two fundamentally different climate zones, i.e., 1) the tropical zone (TRZ) (ranging from ± 23.5° latitudes N and S), where the fundamental green building design principle is to keep heat *out* of the building; and 2) the temperate zone (TEZ) (ranging from 23.5° to 67° N and S latitudes), where the fundamental principle is to keep heat *in* the building. In the subtropical region (STR), i.e., the warmer portion of the TEZ

(ranging from 23.5° to 40° N or S) there can be a dilemma in the design of the Building Energy System, depending on whether hot or cold extremes are more of an issue.

In the APEC region, with multiple economies straddling both major climate zones (i.e., Australia, Chile, China and USA), 15 of the 21 economies include the tropical zone (10 entirely, including all of the ASEAN economies; and five partially); while 11 economies include the temperate zone, three economies are entirely within the warmer STR). At present seven rating systems, most relatively mature (ref. Table 5: APEC Rating System Maturity), are primarily used in the TEZ, i.e., LEED-USA and LEED-Canada, Green Star-NZ, KGBC, CASBEE, Green Globes, and CGBL. Six rating systems are currently used in the TRZ, i.e., BEAM, Green Mark, GBI, GREENSHIP, BERDE, and LOTUS.

The first rating system found in the APEC region, BEAM, was launched in 1996. Designed only for use in the tropics, yet based on review of only TEZ-based rating systems, its implementation was especially challenging, requiring an unprecedented and lengthy citation of specific standards and testing procedures (ref. technical section below). Green Mark, also used in a dense urban tropical context but launched nine years later, was able to benefit from this learning curve. The four rating systems launched most recently in the APEC region, i.e., GBI, GREENSHIP, LOTUS and BERDE, are all designed to operate in the tropical zone, with three more planned or under development for use in the TRZ, i.e., in Thailand, Brunei and Papua New Guinea. The exceptions are Australia and China, both of which have significant populations in the two major climate zones. Insufficient information is available to understand how Green Star-Australia and ESGB are able to adjust to both major climate zones. More than 99 percent of the USA population lies within the TEZ, but with the STR portion significant and growing.

Project and Building Types

As detailed in Annex R Table 1, the more mature rating systems, originating primarily in the more developed economies, including Green Star, CASBEE, KGBC, Green Mark, LEED, and Green Globes, typically cover a broader range of both project and building types. *Project Types:* Not only do these more mature systems cover the most common project types, such as new construction and existing building (EB), but most also cover additional building project types, e.g., Core & Shell; Office Interior and Major Renovations; Japan's CASBEE includes separate tools to rate the pre-design and temporary new construction stages of a building project and also covers unique issues such as Temporary Construction (e.g., Exposition facilities), Site and Heat Island (Effects) and Vietnam's Lotus includes a specific tool to evaluate existing building operations. Several rating systems also include "Beyond Building" project types, e.g., Parks, Rail Transit, Urban Development, and City projects (CASBEE) and Neighborhood Development (LEED-USA, LEED-Canada and Green Star Australia. *Building Types:* The most common types of buildings covered are non-residential (NR) and residential (R), with the more advanced systems also covering additional building types, many representing more specific versions of the NR and R categories, i.e., Public Building, Education, Healthcare, Hotel, Convention, Retail, Industrial, Tenant, Community, Township, Multi-Unit Residential, Dwelling Unit, Detached Home, and Existing Home projects.

Voluntary vs. Mandatory Applications

In general, there are two basic trends in the application of rating systems, with an emphasis on either 1) promotion of primarily voluntary systems; or 2) promotion of primarily mandatory systems. In the case of rating systems developed and managed by GBCs associated with WGBC, the trend is to primarily promote use of the system on a *voluntary* basis, with specific and typically limited (albeit increasing) applications on a mandatory basis in limited contexts, such use for public buildings in the center of a city or town, e.g., museums or libraries or schools, or for buildings that are part of a larger system, either public or private, or urban or rural, e.g., health centers, school campuses or convenience stores. Rating systems in this category include LEED, Green Star, and Green Globes. Specifically, the governments of Australia and Singapore (for buildings of a certain size) have mandated rating of public buildings. Local governments in Australia have started to mandate and incentivize Green Star for new buildings with a range of incentives available. In the USA, many Federal agencies have mandated ratings for buildings they manage and many states and local governments require ratings for publicly owned buildings and buildings in which public funds are spent. Local governments in Canada's BC province have the authority to make laws related to energy and water efficiency and greenhouse gas emissions of buildings

In the case of rating systems primarily developed and managed by government authorities, the trend is to primarily promote use of the system on a mandatory basis, with initial emphasis on public buildings as experience is gained in implementing the system, and then a shift to increase the number of mandatory, rather than voluntary assessment of private sector buildings as well, both non-residential and residential, especially in dense urban areas. Rating system examples include Korea's KSGB, Japan's CASBEE, Singapore's Green Mark, China's ESGB, and Chinese Taipei's CGBL. Singapore in particular requires a Green Mark Platinum rating for buildings with air conditioning over 5,000 square meters and Gold Plus for existing buildings with A/C over 10,000 square meters. In Japan, for buildings of a certain size, local governments may require contractors for public buildings to provide a CASBEE rating. The Korean government plans to establish greenhouse gas reduction targets for buildings, though there are no current plans to require ratings of buildings.

Development

Annex R Table 2: APEC Rating System Development provides a summary of key aspects of rating system development in the APEC region, including a) rating systems reviewed during the process of designing a new rating system for an economy; (2) system management, i.e., lead and associated stakeholder groups, and (3) the development approach used, i.e., if it was consensus-based, included expert opinion of life-cycle analysis, and was a relatively open, less open or closed process. *Systems Reviewed:* Initially there were few rating systems to review during the design process, i.e., BREEAM and/or LEED-USA, but more recently up to five systems have been reviewed by multiple economies during the development of their own rating system. On the whole, the rating systems studied by the most economies were: LEED-USA (7), BREEAM-UK (6), Green Star-Australia (3), Green Mark-Singapore (3), and GBI-Malaysia (2).

System Management

In terms of system management, nine rating systems are lead by NGOs, typically WGBC members [7], as with LEED in the USA & Canada, Green Star in Australia and NZ, the GBI in Malaysia, GREENSHIP in Indonesia, BERDE in the Philippines and LOTUS in Vietnam, with the BEAM Society recently assisted in Hong Kong, China by the HKBBC. In five economies the rating systems are lead by a government agency, which works collaboratively with the domestic WGBC member (ref. Table 1) regarding implementation and/or other specialized support functions, e.g., implementation at the provincial and municipal levels in China; organization of international green building conferences in Chinese Taipei; and close coordination with industry and/or academe in China, Japan, Korea, and Singapore. One system is managed by a private sector entity, i.e., Green Globes by the GBI in the USA and ECD and BOMA in Canada.

Approach

The approach to the development of a rating system was typically consensus-based when an NGO was in the lead, with a range of other potential key stakeholder categories involved, including industry, academe, and government (ref. Annex R Table 3 for details). In the case of CASBEE and Green Mark, with government leads, academe remains closely involved. In all cases expert opinion was important. In varying degrees with CASBEE, LEED, BEAM, Green Mark, Green Globes and Green Star. In varying degrees, there is an emerging and expanding use of life-cycle analysis (LCA) associated with the use of rating systems.

Usability

In *Annex R Table 3: APEC Rating System Usability* the usability of a rating system is indicated by the availability of *product support*, especially the availability of system information and an associated training program. Seven rating systems are associated with greater product support availability, i.e., Green Star in Australia and NZ, LEED in Canada and the USA, and Green Globes, as well as GBI and BERDE, with the first five representing older systems and the final two more recent ones. Of the four systems with less availability, two are government-lead, i.e., BEAM and CASBEE, and two have been developed more recently, i.e., GREENSHIP and LOTUS. There are three systems for which product support information was not available in the public domain, i.e., ESGB, CGBL and KGBC in China, Chinese Taipei, and S. Korea respectively.

System Maturity

In *Annex R Table 4: APEC Rating System Maturity* the indicators of system maturity used are system age, the relative stability of the system, the number of buildings registered and certified for each rating system, as well as the existence of paths for professional development associated with the system.

System Age

There are seven rating systems in the 9-15 year range (BEAM-Plus, CASBEE Green Star in Australia and New Zealand, KGBC, , LEED-Canada, and LEED-USA,), five in the 4-7 year range (Green Globes –

[7] Please see Annex R Table 1 and Annex R Table 3 footnotes for details

Canada and Green Globes-USA, Green Mark, ESGB, and CGBL), and four in the 1-2 year range (GBI-Malaysia, GREENSHIP, BERDE and LOTUS).

System Stability

Systems that have had at least four years to establish themselves tend to be relatively more stable , meaning that they are not subject to as much testing, development and revisions, while those that have been established within the past 1-2 years are less stable, i.e., they are in near constant testing and development with frequent revisions The majority, twelve systems, are more stable, while the remaining four most recently developed systems in Malaysia, Indonesia, Vietnam, and the Philippines (i.e., GBI, GREENSHIP, LOTUS and BERDE), are less stable.

Numbers of Buildings Registered

Registered buildings are in the tens of thousands for one system (LEED-USA); the thousands for three systems (LEED-Canada, KGBC, CASBEE); the hundreds for three systems (Green Mark, BEAM, Malaysia), and less than a hundred for one system (GREENSHIP), with registration information not available for the remaining seven systems.

Numbers of Buildings Certified

The number of buildings certified is in the thousands for three systems (LEED-USA, CGBL, KGBC); the hundreds for five systems (Green Globes, LEED-Canada, Green Star-Australia, BEAM, CASBEE); one hundred or less for four systems (Green Mark, CASBEE, Green Star-NZ, GBI-Malaysia); and zero for three systems (GREENSHIP, BERDE and LOTUS).

Professional Paths

Multiple professional paths are available in association with eleven systems, and only one for BEAM, with no information available for ESGB, CGBL and KGBC. The most advanced professional paths are offered by the following systems: LEED-USA (i.e., specialists for specific rating tools), CASBEE (i.e., expert architects and engineers), and Green Mark (specialists at many levels, e.g., facility manager; specialized diplomas in mechanical engineering/green building technology or electrical engineering/clean energy; graduate degree in facilities and environment management; and Executive Level Development (EDP) programs, e.g., on leadership in environmental sustainability; and innovation in sustainable design and technology.

Communicability

In Annex R *Table 5: APEC Rating System Communicability,* the indicators of system communicability included the relative clarity of the results (i.e., well-defined, easily communicated), the total points possible for commercial, new construction rating tools, as well as the certification scoring system and results presentation.

Clarity of Results

CASEBEE has the highest level of clarity of the results of any system, with four detailed sets of graphics available to analyze the results at multiple levels, in terms of relative quality vs. harm of multiple categories of environmental impacts, and associated carbon metrics. Four systems provided results that

are defined at a medium level of clarity (i.e., LEED in Canada and USA; and Green Star in Australia and NZ). Not enough information was available in the public domain to understand the clarity of results for the remaining rating systems.

Total Points

Eight systems are designed to have a total of 100 points (not counting bonus points for innovation), with six systems using alternative point totals, i.e., 57 for ESGB, 101 for GREENSHIP, 143 for GS-Australia, 150 for LOTUS, 190 for Green Mark, and 1000 for Green Globes. No scoring information was available for KGBC.

Scoring System

The certification results obtained are presented in levels for the 11 systems for which information was available, with two systems awarding certificates at relatively low levels of points (ESGB, CGBL), with the others setting the lowest bar higher. Little information was available to understand the usability of rating system documentation, e.g., certificates, award letters, plaques, publication on websites, and marketing kits. No information was available re: the scoring systems for GREENSHIP, KGBC and Green Globes.

Additional detailed comparisons of broad-based criteria, including tools available for each rating system, may be found in Appendix R.

Commonalities, and Differences in Technical Characteristics of Rating Systems

As emphasized by the structure of the earliest rating systems developed in the APEC region, i.e., BEAM in Hong Kong and LEED in the United States in 1996 and 1998 respectively, there are five fundamental assessment functions that any green building rating system would logically cover, i.e., site (land), water, energy, materials, and Indoor Environmental Quality. In Annex R *Table 7: Rating System Technical Assessment Categories as Percentages of Total,* the range of assessment categories and their relative priority are summarized for the 15 rating systems in use in the APEC region that are covered by Case Study 2 for commercial building rating purposes. For these two systems as well as LEED-Canada, only these five most basic categories are included.

The average percentage of points for each of the five primary categories for all 15 rating systems, as well as the collective total for all of the “other” categories included in the remaining 12 rating systems analyzed, is as follows, in rank order: energy 29 percent, indoor environmental quality 15 percent, site 15 percent, materials 11 percent, and water 10 percent, with a total of 21 percent collectively for “other” categories. A discussion of “other” categories is included in the “differences” section below. This translates to a priority for the energy category that is essentially either two or three times greater than that of any of the other four primary categories of APEC rating systems.

Per *Table 4-1* in the illustrative case of LEED-USA, the potential number of points possible for each the five primary assessment categories is noted, per the updated 2009 version of the New Construction &

Major Renovations rating tool. With a total of 100 potential points, the eight highest priority subcategories are as follows: 19 and 9 points respectively for optimized energy performance (i.e., energy efficiency) and the use of green energy (both on-site and from off-site sources); 12 and 5 points respectively for alternative transportation; and development density and community connectivity under sustainable sites; and four points each for water efficient landscaping, water use reduction, building material reuse, and low-emitting materials in the water and materials categories. With a total of 61 percent of all points for this short list of priority categories in LEED-USA as an illustrative case, and nearly all of the priority subcategories for site, water and materials characteristics including embodied energy-efficiency implications, it is clear that energy efficiency and green energy are the predominant themes overall for the 15 most recent commercial building rating system tools in use in the APEC region.

Table 4-1. LEED-USA Primary Categories and Associated Subcategories

Sustainable Sites	Points	Water Efficiency	Points	Energy & Atmosphere (EA)	Points	Materials and Resources	Points	Indoor Environmental Quality	Points
Site selection	1	Water-efficient landscaping	4	Optimize energy performance	19	Building re-use	4	Outdoor air delivery	1
Density, connectivity	5	Innovative wastewater technology	2	On-site green energy	7	Construction waste management	2	Increased ventilation	1
Brownfield	1	Water use reduction	4	Commissioning	2	Materials reuse	2	Construction IAQ	2
Transportation	12	*Total =*	*10 points*	Refrigerant management	2	Recycled content	2	Low-emitting materials	4
Site development	2			Measurement and Verification	3	Regional materials	2	Indoor pollution	1
Storm water	2			Off-site green power	2	Rapidly renewable Materials	1	Control systems	2
Heat Island Effect	2			*Total =*	*35 points*	Certified wood	1	Thermal comfort	2
Light pollution	1					*Total =*	*14 points*	Daylight & views =	2
Total =	*26 points*							*Total*	*15 points*

Differences in Assessment Categories:

Differences in assessment categories and subcategories between other rating systems and LEED-USA above are primarily a result of 1) realignment of the same or similar subcategories between primary and or "other" categories; 2) inclusion of local priorities not found in the existing LEED-USA structure in "other" categories; or 3) inclusion of an overarching "management" category, with multiple variations thereof.

As noted in Annex R Table 7, the following "other" categories fall into the 15 APEC rating systems:

- Green Star-AUS: management, transport, and emissions
- LEED-Canada: innovation and regional as bonus categories
- ESGB: operation and maintenance category, including property management, environmental management, and intelligent systems; and prerequisites (no details provided)
- CGBL: health and waste reduction, omits materials
- BEAM: none
- GREENSHIP: building environmental management
- CASBEE: quality of service, including functionality and usability, durability and reliability, flexibility and adaptability; and outdoor environment on site
- KGBC: commuting transport, atmospheric pollution, management, and ecological environment
- GBI: innovation (for regular points, other systems include innovation for bonus points)
- Green Star-NZ: management, transport, and emissions
- BERDE: transportation, emissions, waste, and heritage conservation, with innovation bonus category
- Green Mark: environmental protection, other green features and innovation, omits materials and site
- Green Globes USA: project management, emission and hazardous materials for new construction; and environmental management for CIEB
- LEED-USA: innovation and regional as bonus categories
- LOTUS: waste and pollution, adaptation and mitigation, community, and management.

Realignment among subcategories is best illustrated by the Green Mark-Singapore rating system, which allocates 61 percent of all points to the energy efficiency, 9 percent to the water, and 4 percent to the indoor environmental quality categories, with 22 percent to Environmental Protection and 4 percent to Other Green Features and Innovation (OGFI). In this case the Environmental Protection category

essentially assumes the role that the site and materials categories assume with LEED-USA. Another example is shifting subcategories that improve indoor environmental quality but have significant energy usage implications between these two related categories, with more shifted to the indoor environmental quality category in the BEAM-Hong Kong, China case and more to the energy category in the Green Mark case, but both cases representing examples of high-density, urban contexts in tropical climate zones where indoor environmental quality is especially important.

Local priorities that are represented as a separate "other" category include the following examples: Transportation in Green-Star-Australia; Property Management in ESGB-China; Quality of Service in CASBEE-Japan; Atmosphere Pollution (i.e., essentially Global Warming and Ozone Depletion concerns) in KGBC-Korea; Heritage Conservation in BERDE-Philippines; and Adaptation and Mitigation (also in a global warming context) and Community in LOTUS-Vietnam. Under "Management," commissioning and optimization of building energy systems is entirely covered under the energy category in LEED-USA, but assumed under a separate management category by other rating systems. Some of the additional "other" categories are in general essentially subcategories of one of the primary categories in the LEED-USA system, e.g., transportation, ecology, environmental protection, and community under Site; waste under Materials; and emissions, hazardous materials and pollution under indoor environmental quality.

The major exception is broadly the "management" category, which has been added to seven of the rating systems. For Green Star and Green Globes, management is defined as building management, as well as environmental and waste management. These three aspects of management are essentially subsumed, respectively, in LEED under the energy category (e.g., the building commissioning phase, where a major focus is on energy-consuming building equipment systems such as HVAC and lighting), site, and materials categories respectively. For ESGB management is defined as environmental management, property management and intelligent systems. The Green Star and CASBEE documentation also note attention to the property management concept. The intelligent systems concept is also mentioned as a priority in the CGBL presentation, in reference to the need for intelligent product interoperability standards for international green growth cooperation that moves towards build-out of "eco-neighborhood" and "eco-city" ideas. This broader "beyond (a single) building" concept is also behind more recent tools being introduced to the CASBEE toolkit, LEED-USA's Neighborhood Development tool, and other emerging tools in general within the more mature rating systems in use in the APEC region.

Conformity Assessment, Monitoring and Verification

Illustrative Commonalities and Differences in Rating System Assessment Category Criteria: Annex R Table 8: Rating System Assessment Categories and Illustrative Criteria, and details on conformity assessment for individual rating systems are available in Annexes B-Q. Details in Annex R Table 9: Rating System Technical Criteria Measurement have been extracted from relevant rating system documentation, i.e., illustratively from checklists, program descriptions or technical manuals, etc. that have been referenced earlier in this case study.

Standards for Certification

The most frequently cited sources of internationally-recognized standards used to verify and certify that a building meets the specified criteria are ASHRAE for energy and indoor environmental quality, and ISO

for environmental management, with a total of seven APEC economy rating systems making reference to ASHRAE and/or ISO standards when citing conformity assessment details for specific subcategory criteria.

Multiple economies cite use of internationally accepted standards originally developed for use in the United States or in Britain, e.g., ASHRAE, ASTM and AHRI in the U.S., and CIBSE and BS in the U.K. These standards are typically cited when building performance levels must meet the higher levels of green building certification for a specific rating system, e.g., in energy efficiency or criteria pollutant terms, and especially when these levels exceed those typically cited by domestic standards, building codes and/or regulations otherwise cited in the technical manuals for a specific economy's rating system. All credits for LEED-USA and LEED-Canada, most for Philippines BERDE, and some for Australia's Green Star, Green Globes in Canada, Japan's CASBEE, NZ Green Star, Singapore's Green Mark, and Vietnam's LOTUS are referenced to international standards. Australia and New Zealand have developed standards used by both systems. The remaining rating systems reference only national standards (or, as in the case of Chinese Taipei and Korea, the standards referenced are unknown).

Verification (First Party vs. Third Party) and processes

Third party assessments are conducted for a majority of the rating systems. LEED-USA assessments are conducted by the Green Building Certification Institute (GBCI) which includes a network of ISO-compliant international certifying bodies. For Green Star assessments in Australia, GBCA commissions a panel of third-party Certified Assessors. In Canada, CaGBC commissions independent third-party reviewers. Hong Kong, China BEAM-Plus assessments are undertaken by the Business Environmental Council, an independent environmental information center under the guidance of the BEAM Society Executive Committee (licensed BEAM assessors are under consideration). Japan's CASBEE assessments are performed by JSBC, certified ISO-compliant by JISC Malaysia's Greenbuilding index, managers of the Green Building Index rating system, formed an independent committee which assigns certified assessors. New Zealand GS requires two third-party assessors that are industry experts and uses Environmental Choice NZ to verify products. The Philippines' BERDE assessments are performed by TUB Rheinland-Philippines, Inc. (TUB-R/P), which is ISO/IEC 17021 compliant. GBI Green Globes also uses a third party assessor. China ESGB uses local universities and research institutes with assistance from the CGBC; however, 3-star ratings must be approved by MOHURD Beijing office. In Indonesia, the Ministry of Environment registered and accepted GREENSHIP rating tools in July 2011, with the building certification process still under development. For several rating systems, the organization managing the program also conducts the assessments, including Singapore BCA for Green Mark, the VGBC for Vietnam LOTUS, and the Korea Green Building Council certification committee for the Korea GBC program (though there are future plans for third-party independent certifying body with certified assessors).Information on the party conducting the assessment of the CGBL program on behalf of the Council for Economic Planning and Development was not available.

Certification Procedures

Many of the rating systems begin with checklists, including Hong Kong China's BEAM-Plus. A few, including Australia's GS and LEED-USA, use modeling and software tools. Australia GS conducts energy and transport modeling and uses an eco-calculator. Post-construction monitoring and metering is

conducted by Australia GS, Canada Green Globes, LEED-Canada, LEED-USA, Japan CASBEE, and Vietnam's Lotus, which requires18 months of operation and occupancy monitoring (minimum 50 percent of design) plus a performance re-assessment every 3 years. Site visits are conducted for several including Australia GS, Japan CASBEE, and Korea GBI and Japan's CASBEE clearly conducts a chain of custody analysis for materials.

For example, among the listing of ASHRAE standards alone, some define what will be measured, while others define how it will be measured.

Summary of Emerging Trends for Rating System Criteria

The broad-based rating system criteria, technical criteria and conformity assessment procedures are constantly in development. Several trends can be noted as rating systems are revised or new systems are introduced in APEC economies.

Broad-based Criteria

Applicability

There are an increasing number of rating systems designed specifically for the tropics. Also, Rating systems designed for temperate climates are being made flexible enough to accommodate warmer subtropical climate considerations, e.g., energy systems and indoor environmental quality There is also an increasing range of project types being added to these rating systems, especially "beyond building" projects that go beyond a single, whole building to include off-site aspects, e.g., parks and rail transit, neighborhoods, communities, urban development and cities, as well as an increasing range of building types, e.g., for specialized working, commercial, living, educational, or recreational etc. purposes. As mentioned above, there is increase use of auxiliary tools that can facilitate specialized as well as integrated assessments covering a range of both project and building types.

Development

Newer rating systems that are designed for similar circumstances, e.g., climate zone, population density, affordability, cultural preferences etc. are being reviewed by economies as they develop new rating systems, rather than reviewing only the well-developed systems of LEED-USA and BREEAM. As these systems are developed, NGOs have increasing roles, either in partnership with lead government agencies during the implementation phase, or as the lead entity, in partnership with other key stakeholder groups in the development and/or implementation phases. Also, systems are increasingly incorporating life cycle analysis, both of building phases and building inputs and outputs.

System Maturity

There is increasing cooperation and sharing of lessons learned and harmonization of trading practices within the APEC region, as existing systems age and are updated, while new systems come of age. Both the quantity and the quality of building projects registered and certified is increasing and additional attention is being provided to developing leadership roles, and well as specialization of professional training and certification paths to emphasize multiple fields and levels of expertise, multiple skills and

functions required to achieve high-performance buildings in general, and within specific project and building type categories

Usability

A broader range of product support mechanisms, primarily on-line, are being incorporated into the rating systems, with decreasing use of paper-based support mechanisms and processes to interface with rating system personnel. There is increasing availability of on-line support mechanisms to facilitate comparisons by system users between multiple assessment criteria of varying levels of stringency targeting similar applications and associated details of achieving higher-level rating results.

Communicability

There is increasing attention to the need for well-defined and easily communicated results, moving past levels of comparison of results within a single rating system to comparability of results between rating systems that allow for more meaningful understanding of "how green?" certified buildings are, and how significant their overall contributions are to resource savings and avoided harm to the environment and humans.

Technical Criteria, Measurement and Verification

Prioritization of Energy

Increased emphasis on Energy and associated energy-using categories such as water and indoor air quality reflects the trend towards prioritization of climate change mitigation and adaptation measures in the APEC region and greater attention to the development and build-out of green building rating systems writ large. The high-priority energy category is closely linked to the indoor environmental quality category through thermal comfort, ventilation and other energy demand-related criteria. A primary example is the use of HVAC equipment for thermal comfort purposes in the tropics accounting for large percentages of building energy consumption, e.g., in the context of older air-conditioning systems still in use in urban cities of developing economies, reportedly accounting for up to 70 percent of building energy consumption in urban areas, per the September 14, 2011 WGBC-APN presentation for Vietnam.

Prioritization of Common Metrics and Smart Rating System

Common metrics associated with clarification of greenhouse gas emissions, building energy intensity, and transportation issues are increasingly a priority in most systems. Some rating systems, including Japan's CASBEE, Singapore's Green Mark, and LEED-USA, are "Smart" rating systems that maximize the use of integral tools or connections to "auxiliary" tools that enable measurement of "Building Energy Intensity," the most useful metric for measuring energy efficiency. With the increasing emphasis on reducing energy use in buildings, this becomes an extremely valuable feature for building designers. Both building information modeling and life cycle analysis allow aggregation of building energy use as well as "embodied energy" of water and building materials. Newer systems plan to use, or are already in the process of, linking to similar auxiliary tools (Malaysia, Indonesia, Vietnam and the Philippines) or may already use equivalents (e.g., Chinese Taipei). Other economies have developed simpler but less powerful "calculators" in their rating systems that do not have the three-dimensional analytical capabilities that Building Information Modeling (BIM) tools have, but can still facilitate aggregation of essential

information for greenhouse gas emissions calculations. These tools have the potential to prove powerful in many ways including providing a seamless connection between new construction and existing building tools, which is essential if monitoring of building performance after construction is included in the rating system. Some multiattribute LCA building product certification programs include direct links to BIM tools. Products certified under these programs may then be preferred when buildings are designed to be certified by rating systems that use BIM tools. Also, by providing a building energy index that includes embodied energy can clarify what energy efficiency equipment and designs and on and off-site renewable energy features will earn a higher certification under particular rating systems. The treatment of materials management in rating systems is also becoming more important. Materials category credit systems increasingly prioritize construction waste management and materials re-use and recycling, providing an opportunity for trade in used building materials. These systems also increasingly prioritize low-emitting materials or adhesives, sealants, paints, coatings, flooring systems, composite wood and agrifiber products, increasing the opportunity for sales of these products throughout the APEC region.

Prioritization of GHG Mitigation and Climate Finance

As a group, eight of the ASEAN members have been working closely with the U.N. Environment Program's Sustainable Building Climate Initiative (UNEP-SBCI), in cooperation with Singapore's BCA Center for Sustainable Buildings. Senior-level ASEAN government representatives, including the presidents of Indonesia and the Philippines, are increasingly referring to green building in public speeches, including at launches of the new domestic rating systems. In this context the building sector is frequently touted as contributing to 40 percent of GHG emissions, making this sector an important target to focus on for economies that want to be responsible for doing their part to turn this changing climate situation around.

The biggest challenge for ASEAN economies within APEC, with per capita income levels typically a fifth or less of those in nearby APEC city-states such as Singapore and Hong Kong, China (both of which now have higher per capita income than in the United States, according to APEC data released during the November 2011 APEC leaders meeting in Honolulu), is affording the initial capital to invest in greener buildings. Hence the potential to access "climate finance" on soft terms is increasingly of interest, not only to use clean energy more efficiently and save money, but also to be able to "measure, report and verify" (i.e., MRV, a term frequently used in UNFCCC global climate change mitigation forums) these savings in terms of avoided GHG emissions. Credible MRV information derived from energy savings must come from the operational stage of buildings, i.e., projected savings at the time that construction of the building is completed is not enough. This aspect of the clean energy finance world is driving greater attention to the completeness and integrated nature of the rating system toolkits of each economy. With projected energy savings available at the end of construction not being adequate to access climate finance, a greater priority is developing to allow integration of the results from building energy system commissioning data to operational data. Tools such as building information models, energy control systems, and life cycle analysis (often auxiliary to the rating system tools) are powerful in their ability to provide the MRV information that bankers will be looking for.

Prioritization of Performance-Based Rating Systems

At present most of the existing rating systems appear to be "design-based," i.e., the official certification status of a building is based on assessment results during the design and construction (or "as-built") life-cycle phases of a building, but not during the third operational/occupied or "performance" stage of a building. However, buildings often do not perform during occupancy and operation as intended by the design or as built. Therefore, assessing the performance of buildings post-construction leads to a more accurate assessment of the environmental impact of certified buildings. Also, as noted above, the lack of performance data also limits the ability to access funding for buildings from banks and other financial institutions that require proof that environmental impacts are actually reduced compared to usual practice. There are ten rating systems that appear to be "design-based" at present, including LEED-Canada and LEED-USA, Green Globes Canada and GG USA, Green Star Australia and GS New Zealand, GREENSHIP in Indonesia, KGBC in Korea, BERDE in the Philippines and LOTUS in Vietnam. The LEED-Canada and LEED-USA systems have an Existing Buildings: Operations & Maintenance (EB:O&M) tool; however, there is no requirement at present that this tool be used to obtain or maintain certification of new buildings. Although the GG on-line system allows transfer of information throughout the various stages of the building life-cycle, credits are only assigned during the first two stages and certification is provided at the end of stage two for the new construction tools used in Canada and the United States. Information is not available to clarify the certification process for EB tools used in each context. GS Australia and NZ are both in the process of developing a GS Performance (GS-P) tool; however information on the planned role of this tool in the certification process is not available. This is true also of the other four systems with EB tools under development (e.g., GREENSHIP in Indonesia, KGBC in Korea, BERDE in the Philippines and LOTUS in Vietnam). Also, although the remaining six rating systems cite the importance of both performance assessment and associated carbon metrics, more information is required to determine whether ongoing building monitoring is required for achieving or maintaining certification (i.e., whether they are performance-based systems). Annex T provides additional details on design vs. performance-based rating systems and those using BIM tools,

Prioritization of Building Component Information by Facility Managers for Performance Monitoring

As mentioned above, "Smart" building information modeling (BIM) tools are used to produce a comprehensive summary of the life-cycle assessment of buildings' environmental impacts through the design, construction and performance stages. Also, a high level of building performance is more easily achieved if the Building Component Information (BCI) is preserved throughout these building stages, especially through the use of BIM tools, for ready access and use by building owners and facility managers. The intersection of the smart" and "performance-based rating system trends that can facilitate detailed and credible understanding of environmental impacts based on the entire life-cycle of buildings (including embodied energy and water in the building products) enables acceleration of associated common MRV metrics that financial institutions increasingly demand. These trends also offer significant potential to enhance efforts to harmonize rating system conformity assessment procedures.

Prioritization of Proposals for Common Metrics and the Smart Buildings and the Energy Smart Communities Initiative by the 2010 and 2011 APEC Host Economies, Japan and the United States

On March 3, 2011 at the 1st APEC Green Buildings and Green Growth conference in Washington D.C., the U.S. Government (i.e., Dr. Yoshida of the U.S. Department of Energy) introduced a proposal for the "Smart Buildings and the Energy Smart Communities Initiative (ESCI)". In this proposal by the United States, the four integral components or "pillars" are Smart Buildings, Smart Grids, Smart Transportation, and Smart Jobs. These four components work synergistically together to respectively maximize building energy efficiency and on-site renewable energy use; increase building access to off-site green power through smarter grids; increase access by building occupants to lower-carbon transportation options; and collectively contribute to Green Job creation in each economy and the APEC region as a whole. On both Sept. 12 and Sept 13, 2011 at the 2nd APEC Green Buildings and Green Growth conference in Singapore, the representative of Japan (i.e., Dr. Ichikawa) made presentations on "Definition of Smartness or Greenness of Cities and International Standardization; and a "Proposal for Standardization on the Smart Urban Infrastructure". These presentations and proposals by representatives of Japan and the United States represent forward-looking and holistic contributions by the 2010 and 2011 host economies respectively to the Green Buildings and Green Growth theme that APEC Leaders and Ministers are collectively supporting. The proposal by Japan argues for common metrics, i.e., a measurement standard for “smart” buildings and associated infrastructure.[8].

Common metrics will be essential if standards for “intelligent equipment” are to enable information and communication technology (ICT) for control (i.e., supply-side, including green energy), telecommunications, and energy conservation (i.e., building and transportation sector low-carbon component) technologies to be able to “talk” to each other. In the APEC region, where most of these technologies originate, few are currently inter-operable. This ICT case is far more complex than the need for common metrics for building materials, such as rapidly renewable materials or timber, where the use of auxiliary tools may easily facilitate the use of common metrics for relevant criteria and conformity assessment procedures. Harmonization of these Smart Building ICTs may well require a single set of integrated, international standards that allow for inter-operability between a full set of relevant ICTs and associated equipment that can significantly contribute to an increase in the quantity and quality of certified green buildings in the APEC region, preferably based on performance-monitoring.

Experts representing key economies participating in APEC energy and transportation working groups already realize that solutions will require both significant participation by dedicated experts, as well as a consensus process that doesn’t allow any one economy (that may have a conflict of interest) to dominate the process of working out a single, international standard to publish and adopt on a global basis. There are multiple sources of internationally-recognized standards, with one source being the ISO. In Annex U: Table U-1 an overview of participation by APEC economies in key ISO technical committees relevant to green buildings is provided, with additional details of BIM technologies in the footnotes. There are several constraints to relying on ISO TCs to solve the issue of a lack of inter-operability among key Green Growth-Green Building ICTs including the fact that not all APEC economies are seated at the table, other regions of the world may have competing priorities to APEC’s, and procedures to set up effective TCs and finally produce and publish international standards can take up to a decade or more.

[8] This should be differentiated from the common management standard being promoted by France

Implications for Trade

The report on outcomes of the *Green Buildings and Green Growth: Approaches to Encouraging a Positive Green Building Climate Joint APEC-ASEAN Workshop* held in Singapore from September 12-13, 2011 emphasizes the direction that APEC Leaders and Ministers support to transition towards low carbon economies, recognizing that buildings contribute significantly to GHG emissions in the APEC region, as well as rapid urbanization trends.

Despite the rapid evolution in the number of rating systems in the APEC region from 1996 to 2011, during this 15-year period the number of green buildings certified in the region remains low, at approximately 8000 during this period, or the equivalent of one green building per quarter-million people. Variability in the stringency of energy efficiency criteria, for example, can also vary widely. The low numbers of certified buildings to date and the lack of stringent energy efficiency criteria in some rating systems decrease the likelihood of achieving the aggressive GHG mitigation goals that multiple Leaders and Ministers have set for their economies.

Harmonization of rating systems in terms of criteria and certification procedures and accessibility of information about the rating systems and tools is key to increasing the technical quality of certified buildings and simplifying the transparency of rating system requirements, especially for suppliers of green building materials and equipment and for building project design teams searching for equipment and materials to meet increasingly stringent rating system criteria.

Features of rating systems with the potential to facilitate trade include:

- Where rating system criteria for equipment and materials reference relevant international standards, this facilitates a greater understanding among building designers or suppliers with respect to the equipment or materials that will meet rating system requirements, thus facilitating trade. All credits associated with the criteria for LEED-USA and LEED-Canada, and some for Australia's Green Star, Green Globes in Canada, Japan's CASBEE, NZ Green Star, Philippines' BERDE, Singapore's Green Mark, and Vietnam's LOTUS are referenced to international standards. Since these systems fully reference international standards, certifying buildings to LEED-USA or LEED-Canada criteria will facilitate trade. Alternative pathways (comparisons to existing baseline conditions) being developed through the LEED International Roundtable and building climate sensitivity into the LEED-USA rating system (planned for 2012) will address some of the technical shortcomings of certifying buildings to LEED-USA in non-temperate climate zones.

- When rating system conformity assessments procedures refer to international systems of conformity assessment or the procedures are clearly explained in manuals, equipment and materials suppliers and designers will be able to choose appropriate tools to maximize building performance and control for variables that will be evaluated during the conformity assessment, inspiring confidence that the building as designed will meet the required criteria. This builds confidence among designers and suppliers that their buildings will meet the criteria allowing them to consider a wider variety of high performing products and materials, facilitating trade. Rating systems referencing international the conformity assessment procedures or that have clearly outlined analytical (e.g., modeling) or monitoring/metering

processes required, include Australia's GS, Green Globes Canada and United States, LEED-USA and LEED-Canada, Japan's CASBEE, Malaysia's GBI, and Vietnam's LOTUS.

- As noted in the trends section, there is variation in the types of tools and models used in rating systems with varying levels of sophistication, technical detail and rigor. Tools and models are becoming an extremely valuable feature, however, to facilitating common metrics, thus facilitating trade. Some rating systems, including Japan's CASBEE, Singapore's Green Mark, and LEED-USA, are "Smart" rating systems that maximize the use of integral tools or connections to "auxiliary" tools that enable measurement of "Building Energy Intensity" and provide greenhouse gas metrics, often over the life cycle of the building. Common metrics enable comparisons between rating systems and facilitate understanding of how green products and technologies can earn certifications under different rating systems. With the increasing emphasis of rating systems on reducing energy use, including "embodied" energy use, in buildings, these tools provide clarity on which technologies and products are most effective in minimizing building intensity and associated greenhouse gas emissions. Thus these tools facilitate increased trade in green building products..

Features of rating systems with the potential to become barriers to trade include the following:

- Performance criteria are not spelled out clearly in the manual or other documentation, necessitating a significant investment of time on the part of the equipment or materials supplier or building design team. For example, Hong Kong, China's BEAM-Plus relies on local regulations and guidance (standards, codes and guides). Where there are differences in criteria among different regulations, the client is allowed to specify what they believe is appropriate for their building. Thus it is not possible for designers or equipment and materials suppliers to know what is required to achieve a particular rating of a building. Instead, they must rely on individual client relationships. Building rating systems are intended to communicate general requirements of a "brand" in a particular market such as a "Platinum" or "Gold" rating. Relying on direct client communications almost exclusively does not take advantage of this brand and necessitates a significant investment of time not normally required when relying on a rating system certification level "brand".

- Accessibility of information on rating system credits and associated points was often not publicly available. In particular, no information on rating system levels and associated points were available for GREENSHIP Indonesia, Korea's KGBC, or Green Globes USA (in the case of GG, the criteria and points are part of an ANSI standard available for purchase). Without knowledge of how points are earned, equipment and materials suppliers and building design teams are not able to determine whether equipment, materials or design features will enable the building owner to earn required credits for a particular certification level, thus inhibiting trade.

- Varying criteria in the same climate zone is a barrier to trade. Economy specific criteria in economies with "like climates" or similar water issues can restrict or slow down the use and adoption of green building products and technology in economies because products and building designs are less easily standardized. For example, the economies of Indonesia, the Philippines, Singapore, Vietnam and Hong Kong are 100 percent in the tropical climate zone. However, the percentage of points for the Energy assessment category range from 8 percent in the Philippines to 61 percent in Singapore. And while the

Philippines and Indonesia are both island states with flooding issues, point allocations for water range from 6 percent in the Philippines to 21 percent in Indonesia. APEC economies should consider minimizing the differences between economies with similar climates or other issues by harmonizing criteria to facilitate building standardization and therefore facilitation of trade.

- Lack of availability of information on conformity assessment procedures or how to obtain access to the information is not easily available. In some cases, e.g., the rating systems in Chinese Taipei and Korea, the standards and procedures used for conformity assessment are not clear. The party conducting the assessment is not clear for Chinese Taipei. Transparency with respect to how to obtain this information from economies and NGOs that develop and implement conformity assessment systems for green building rating systems is key to minimizing trade barriers.

- With different rating systems using different standards, codes and regulations, as well as different computer modeling techniques, to verify that buildings meet the requirements of a rating system certification level, it is difficult, if not impossible, to compare the efficiency or "greenness" of buildings certified under different systems or even within a single system at different levels of certification. If standards and computer modeling techniques used for criteria conformity assessment are not harmonized, suppliers and building designers have difficulty understanding which equipment, materials or building designs will be in demand in specific economies, thus inhibiting trade.

- As mentioned above, many rating systems reference local standards when conducting conformity assessment. Australia's Green Star, Green Globes in Canada, Indonesia's GREENSHIP, Japan's CASBEE, Malaysia's GBI, NZ Green Star, Philippines BERDE, Singapore's Green Mark, and Vietnam's LOTUS reference some international standards. Information on standards referenced by ESGB in China, CGBL in Chinese Taipei and GBCS in Korea were not available. One implication of primarily using local codes and standards is that certified buildings may not be designed to be any "greener" than they would be if the local codes were simply followed. Thus, products, equipment and materials with less environmental impact or innovative building designs will not be preferred by building designers and owners. Also, the local standards are less familiar to suppliers and designers. In both cases, lower standards (in some cases) and less easy access to the details of the standards may hinder trade.

- Some rating systems favor or accept only products certified in that economy For example, NZ Green Star bases its product certification on Environmental Choice NZ certified products. In-country certification increases the cost and time, when a product may already be certified to the requirements of another APEC certification program. Acceptance of these certifications in meeting rating system criteria would facilitate trade.

Factors Contributing to Widespread Adoption of LEED-USA

As mentioned in the Background section, the LEED-USA rating system, is not yet climate-specific, and therefore is best adopted in temperate zones. Because of this, designers may make materials or design choices that garner a LEED point, even though they may not be the most site or climate-appropriate choice available. This is particularly true when it is being applied in a non-temperate climate.

Also, LEED is defined in a way that fits with standards and codes in the U.S., making it easy to define how it is better than minimum codes in the U.S. but more challenging in other economies. Because of the proliferation of LEED certifications in other countries and economies, the USGBC has developed an International Roundtable to develop global consistency, regional approaches and local outreach and support.

Despite some of the technical challenges of using LEED-USA in other economies, approximately 20 countries worldwide do not have the resources or the desire to define a unique rating system for their economy. Also, many multinational companies seek a common standard worldwide, though the standard does not have the same meaning in some economies due not only to climate considerations but also products available locally. In addition to the market pull due to economies' limited resources and multinational company demands, LEED-USA has benefitted from a strong worldwide marketing plan and the training services provided by the USGBC worldwide.

5. Recommendations

Better alignment of the many rating systems in the region could facilitate trade. This study and the discussions at the APEC-ASEAN Singapore workshop held September 12-13, 2011 identified several potential areas for forward work at the domestic, regional and international levels:

- Engage policy makers to promote understanding that the standards and conformance infrastructure -- standards, codes and conformity assessment organizations -- provide the essential tools to enable achievement of green growth related to green buildings in the region. Ensure that the policy implications of standards and conformance issues are broadly understood at all levels of responsibility.

  Many APEC region rating systems partly or wholly reference only economy-specific standards when conducting conformity assessments. Harmonization of standards will increase trade in green building products.

- In the development and adoption of mandatory codes and regulations, use transparent, evidenced-based analysis and involve stakeholder consultations as the basis for decision making. This will ensure efficient and effective green building programs that achieve real benefits.

  Though most rating systems evaluated several other existing rating systems and analyzed the appropriateness of criteria or conformity assessment procedures, improved transparency and expert consultations will improve both the quality of green buildings and facilitate greater trade among APEC economies in green building products.

- Information sharing, participation in standards development and engagement of key stakeholders are essential to developing the standards and conformance infrastructure and building capacity and understanding on how these tools can be used to advance green buildings.

  While developing their rating systems, not all rating systems in the APEC region have involved the variety of stakeholders required to ensure development of a robust and climate-appropriate rating system. Improved stakeholder engagement processes will, therefore, facilitate trade.

- Greater consistency and precision in the use of existing terms and definitions in green building schemes and programs is needed. International consensus definitions are also needed on new concepts.Focused collaboration among a broad range of stakeholders is needed to advance harmonization in this area.

  Terms for various facets of rating systems, including criteria categories, analytical methods, and conformity assessment requirements vary among APEC economy rating systems.

- Redundant or conflicting standards can cause manufacturers to need to reengineer products to enter different markets. Collaboration on common tools for assessing and benchmarking green buildings, including through models for life cycle analysis, can help to avoid unnecessary costs, and increase the availability of green products in support of green building needs.

- Recognizing that one size does not fit all, APEC economies planning to develop new or further develop rating systems should consider building on current rating systems in use in APEC economies, especially those in similar climates, and consider adopting these rating systems.

  Advanced tools have been or are being integrated into rating systems, or software connections have or are being built to link rating systems to these tools in the most mature APEC region systems. These best practices should be studied by other economies and harmonization sought to facilitate common metrics and predictability of how building designs will meet rating system certification requirements.

- Cooperation, including through reference to international systems of conformity assessment, on methods and best practices related to conformity assessment – on requirements related to product assessment and certification to enforcement of codes and ratings systems – can result in more consistent assessment and enforcement of building ratings.

  While most rating systems spell out the processes and tools used to certify buildings, some are not available, are unclear or a large amount of latitude is given to the building owner, increasing the investment of time required to understand how certain products may fare in achieving levels of rating system certification.

  Some rating systems reference or adhere to international standards of conformity assessment, whereas others do not, leading to variations in assessment methods and inconsistency in certification procedures.

- APEC, ASEAN and other international organizations should consider the need to promote greater understanding on life cycle analysis techniques, to encourage the development of comparable carbon metrics, to expand the availability of life cycle inventory data, and to collaborate on work to refine indoor air quality attributes of buildings as possible areas of focus.

  Whole building modeling and life cycle analysis techniques that provide comparable carbon metrics and information on building energy intensity are in use in a few advanced rating systems and many more are in the process of adopting them. Increased use of these tools and techniques, as well as others, will enable comparability of rating systems, expand access to data on green products and will increase understanding of how certified buildings impact the environment, thus facilitating trade of “greener” products and increased numbers of certified buildings.

- Continued collaboration across interested groups in APEC, ASEAN and international organizations, including through workshops, to develop tools and best practices on standards, codes and conformity assessment practices in support of advancing green buildings.

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Annex A. Rating System and Green Building Council Website and Contact Information

Table A-1. Rating System and Green Building Council Website and Contact Information

Rating System Green Building Council	Contact Information/Website
AUSTRALIA	
Green Business Council	
Green Star Australia	
Green Building Council Australia	http://wwww.gbca.org.au/green-star/
BRUNEI DARUSSALAM	
Early Development Stage	Minister of Development, Pehin Dato Hj Suyoi
CANADA	
Leadership in Energy and Environmental Design (LEED) Canada	
Canada Green Building Council	http://www.cagbc.org
Green Globes	http://www.greenglobes.com/about.asp
ECD Energy and Environment Canada Ltd.	info@greenglobes.com
Green Globes Design (New Building)	
Building Owners and Managers Association (BOMA)	http://www.bomacanada.ca/
Building Environmental Standards (BESt) (Existing Bldg)	http://www.bomabest.com/
CHILE	
LEED-USA	
Chile Green Building Council	http://www.chilegbc.cl
CHINA	
Evaluation Standard for Green Buildings (ESGB) (aka "Three Star" System) GB/T 50378-2006	https://docs.google.com/Doc?id=ddqxmx9_29hs74gv
China Green Building Council (CGBC) Baizhan Li, Deputy Director	baizhanli09@gmail.com
LEED-USA	http://www.usgbc.org
HONG KONG, CHINA	
Building Environmental Assessment Method (BEAM)	
The Beam Society	http://www.beamsociety.org.hk/standards/b

Rating System Green Building Council	Contact Information/Website
	eam
The Hong Kong Green Building Council	http://www.hkgbc.org.hk/eng/
INDONESIA	
GREENSHIP	
Green Building Council Indonesia	http://www.gbcindonesia.org
JAPAN	
Comprehensive Assessment System for Built	
Environment Efficiency (CASBEE)	
Japan Sustainable Building Consortium (JSBC)	http://www.ibec.or.jp
KOREA	
Korea Green Building Certification	
Ministry of Land, Infrastructure and Transportation	http://www.greenbuilding.or.kr.eng
LEED-USA	http://www.usgbc.org
Korea Sustainable Building Council	http://www.koreasbc.org/
MALAYSIA	
Green Building Index	http://www.greenbuildingindex.org
	http://gbimalaysia.com
Malaysia Green Building Confederation	http://www.mgbc.org
MEXICO	
LEED-USA	http://www.usgbc.org
Mexico Green Building Council	http://www.mexicogbc.org
NEW ZEALAND	
Green Star New Zealand	
New Zealand Green Building Council	http://www.nzgbc.org.nz
PAPUA NEW GUINEA	
Early Development Stage	velyoke.david@nisit.gov.pg
PERU	
Peru Green Building Council	http://www.perugbc.org.pe
LEED-USA	http://www.usgbc.org
PHILIPPINES	
Building for Ecologically Responsive Design Excellence (BERDE)	

Rating System Green Building Council	Contact Information/Website
Philippines Green Building Council	http://www.philgbc.org
LEED-USA	http://www.usgbc.org
RUSSIA	
Russia Green Building Council	http://rugbc.org
LEED-USA	http://www.usgbc.org
SINGAPORE	
Green Mark	
Building and Construction Authority (BCA) of the Ministry of National Development	http://www.bca.gov.sg/GreenMark
Singapore Green Building Council	http://www.sgbc.sg/
CHINESE TAIPEI	
Certified Green Building Label (CGBL)	Dr. Wan-Hsiang Hwang, Council for Economic Planning and Development (CEPD) 2011/SOM/SCSC/CON2/024
Chinese Taipei/Taiwan Green Building Council	http://www.taiwangbc.org/tw/en/
THAILAND	
Thai Green Building Institute/Association of Siamese Architects	http://asa.or.th
LEED-USA	http://www.usgbc.org
UNITED STATES OF AMERICA	
Leadership in Energy and Environmental Design (LEED) USA	
United States Green Building Council	http://www.usgbc.org
Green Building Initiative	http://www.thegbi.org
VIETNAM	
LOTUS	
Vietnam Green Building Council	http://www.vgbc.org.vn

Annex B. United States—LEED-USA

Table B-1. LEED-USA

Category	Description
BROAD-BASED ASPECTS	
Climate Zone	Temperate Zone, (Tropical Zone < 1% of population)
Project Types	New Construction, Major Renovations, Existing Building, Core & Shell, Office Interior, Neighborhood Development
Building Types	Non-Residential, Residential, Education, Retail, Hotel, Healthcare, Multi-Unit Residential, Public Building
Other systems reviewed	Building Research Establishment Environmental Assessment Method (BREEAM) (United Kingdom)
System management	United States Green Building Council (USGBC)
Other key partners	Industry, Government
Approach	Consensus-based, expert opinion, Life-Cycle Analysis, greater openness
Product support	Greater availability of information and training
Year established	1998
Buildings registered	28,000
Buildings certified	3,740
Professional paths	Green Associate, Accredited Professional, Project Review
Levels of certification	Four: Certified 40-49, Silver 50-59, Gold 60-79, Platinum 80-100
Connected auxiliary tools	Building Information Modelling (BIM) tools, e.g. AutoDesk and Revit
Technical categories or criteria	LEED for New Construction and Major Renovations v.3 (updated in May 2011)
Categories (% of 100 points)	Energy 35, Site 26, IEQ 15, Materials 14, Water 10,
Energy criteria checklist	Performance 19, On-site green energy 7 & off-site 2, Commissioning 2, Refrigerant mgt 2, M&V 3
Site criteria checklist	Location 1, Density & connectivity 5, Brownfield 1, Transportation 12, Protection 2, Stormwater 2, Heat island effect 2, Light pollution 1
IEQ criteria checklist	Outdoor air intake 1, Ventilation 1, Construction IAQ 2, Low hazmats 4, Controls for pollution 1, Lighting & thermal comfort controls 2 & verification 2, Daylighting & views 2
Materials criteria cheklist	Building reuse 4, Constr. waste management 2, Materials reuse 2, Recycled 2, Regional 2, Rapidly Renewable Materials (RRMs) 1, Timber 1

Category	Description
Water criteria checklist	Landscaping water efficiency 4, Wastewater technologies 2, Water use reduction 4
REFERENCES FOR CONFORMITY ASSESSMENT PROCEDURES	
Minimum energy performance	ANSI/IESNA/ASHRAE Std.90.1-2007 Appendix G-Whole Building Energy Simulation
Minimum energy performance	ASHRAE Advanced Energy Design Guide
Minimum energy performance	New Buildings Institute/Advanced Buildings Core Performance Guide
On-site green energy	U.S.DOE Commercial Buildings Energy Consumption Survey M&V methods
Building energy use m&v	International Performance Measurement & Verification Protocol vol.III, April 2003/Energy Savings
Measurement & verification	U.S.EPA Energy Star Portfolio Manager (tool MPR6), building energy use files shared with USGBC
Off-site green power	Center for Resource Solutions Green-e Energy Program re: green power purchase contract terms
Off-site green power	U.S.DOE Commercial Buildings Energy Consumption Survey M&V methods
Minimum iaq performance	ASHRAE 62.1-2007 Sections 4-7, Paragraph 5.1, incl. requirements for operability of windows
Ets control	ANSI/ASTM-E779-03
Outdoor aq monitoring	ASHRAE 62.1-2007 Sections 4-7, Paragraph 5.1
Increased ventilation	ASHRAE 62.1-2007 Ch. 6 or CIBSE AM 10:2005 or CTGPG or NIST COMTAM software model
Chemical & pollution control	ASHRAE Standard 52.2 re: MERV ≥13 for mechanical ventilation filter or other device
Thermal comfort controls	ASHRAE 55-2004 Paragraph 5.1 re: thermal comfort controls for natural ventilation conditions
Recycled content	ISO 14021 EPD Type II (self-declared)
Water use reduction	ASME A11218.1-2005 & 2006 standard for public faucets

Chart B-1. LEED-USA -Applicability

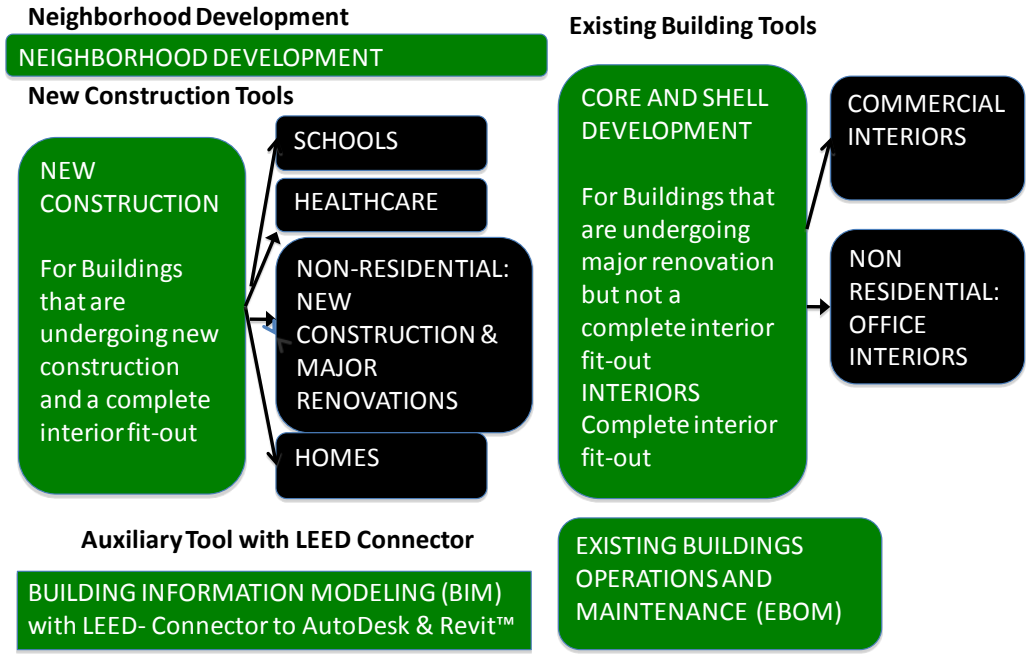
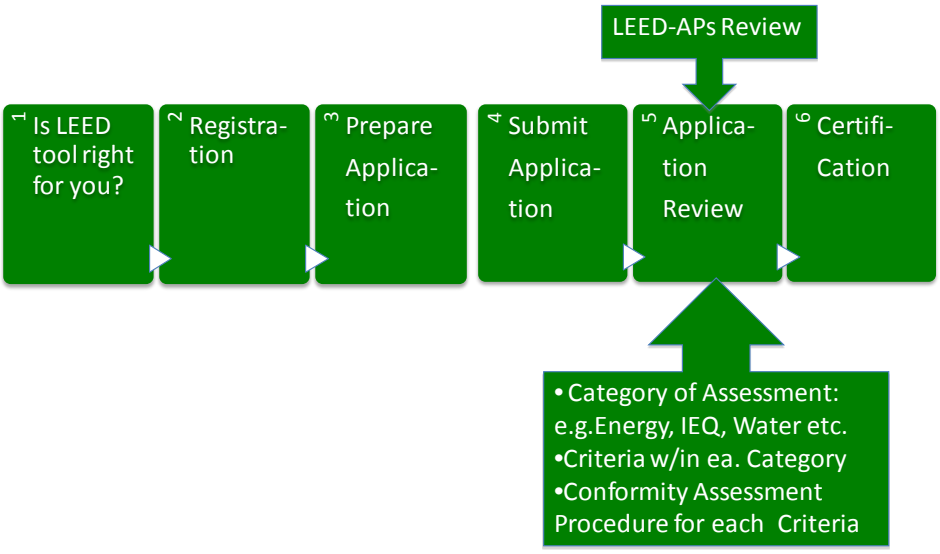


Chart B-2. GBCI Project Certification Process for LEED-USA



•Green Building Certification Institute (GBCI) certifies buildings and professionals associated with LEED-USA as an accredited, independent, third-party certification body

Chart B-3. LEED-USA Categories and Associated Credits/Points

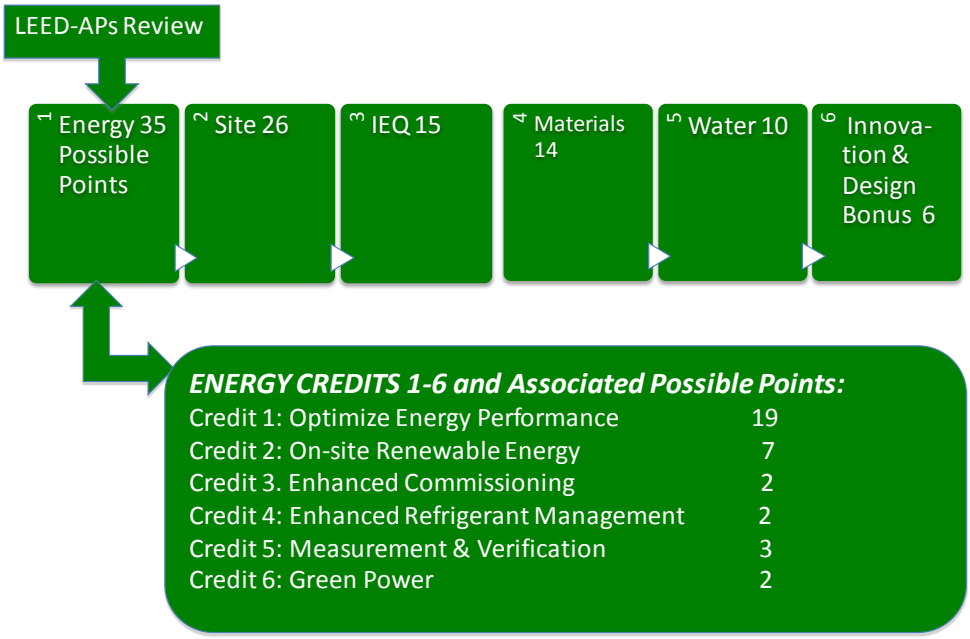


Chart B-4. LEED-USA Reference to International Standards for Optimize Energy Performance Credit

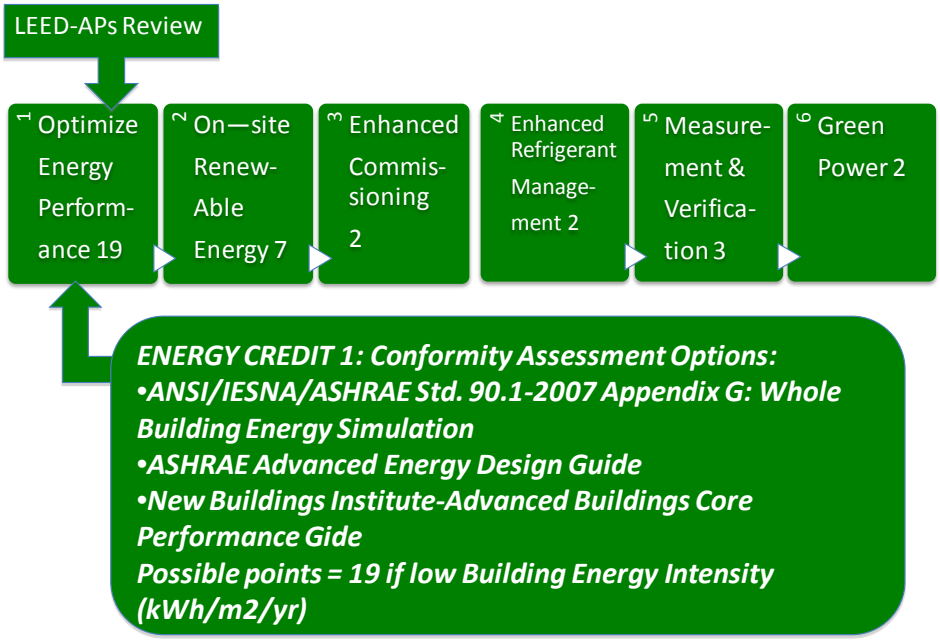


Chart B-5. LEED-USA Reference to International Standards for On-Site and Off-Site Green Energy Credits

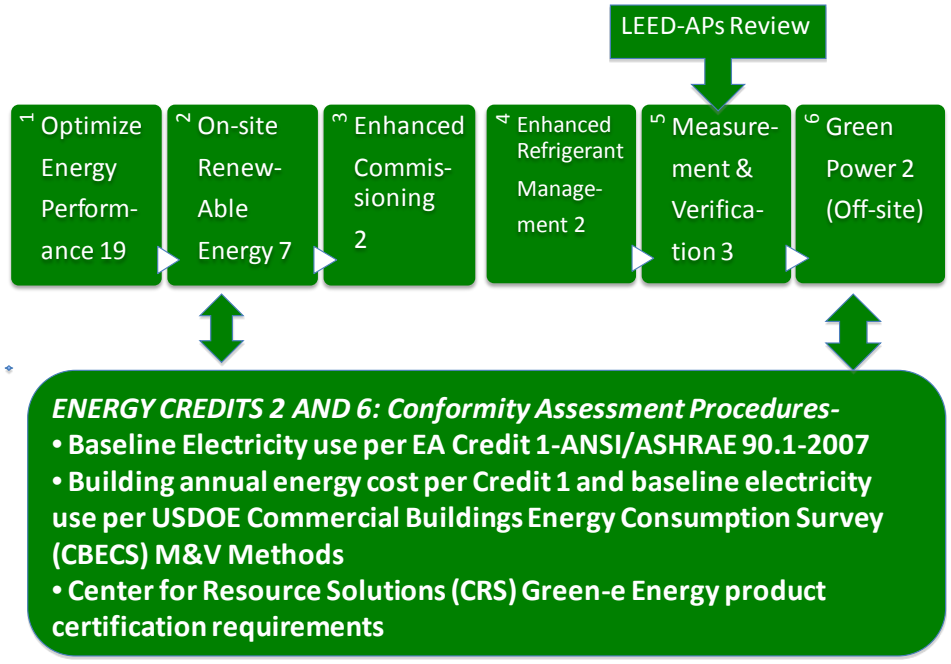
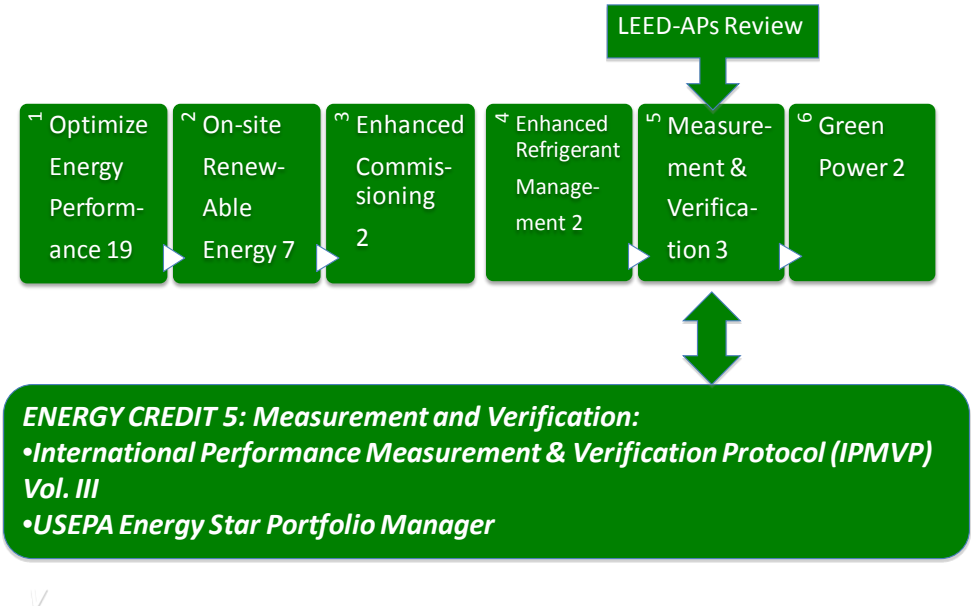


Chart B-6. LEED-USA Reference to International Standards for Measurement & Verification Credit



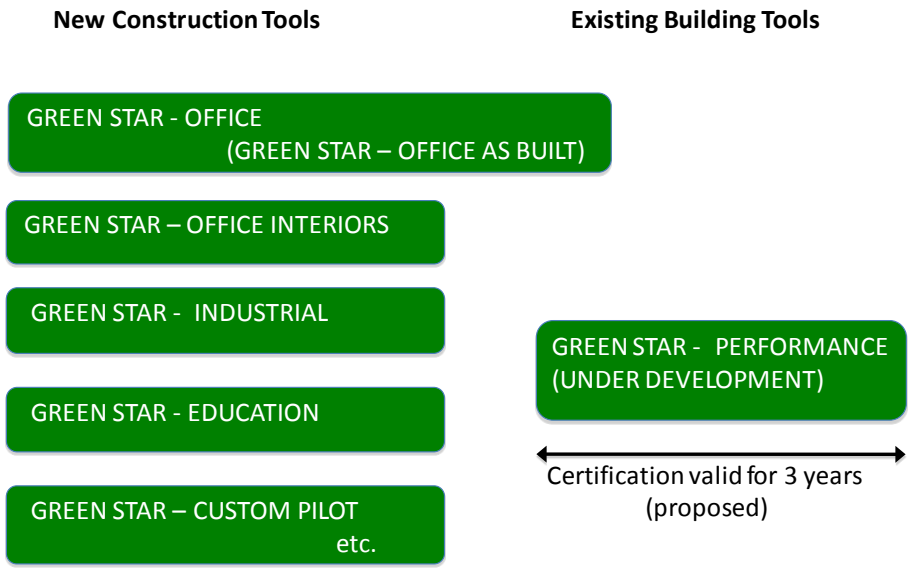
Annex C. Australia—Green Star

Table C-1. Green Star Australia

Category	Description
BROAD-BASED ASPECTS	
Climate zone	Tropical zone and sub-tropical region of temperate zone
Project types	New construction, existing building, (neighborhood development)
Building types	Non-residential, residential, retail, hotel, healthcare, multi-unit residence, public building
Other systems reviewed	LEED-USA
System management	Green Building Council of Australia (GBCA)
Other key partners	Industry, government
Approach	Consensus-based, expert opinion, life-cycle analysis, greater openness
Product support	Greater availability of information and training
Year established	2002
Buildings registered	409
Buildings certified	305
Professional paths	Practitioner, Accredited Professional
Levels of certification	Three: 4 Stars 54-59, 5 Stars 60-74, Six Stars 75-143
Connected auxiliary tools	Calculators (4) for: Energy & ABGR; Mass Transit; Potable Water; & Land Use & Ecology
Technical categories/criteria	Green Star - Office Design v3 & Office As Built v3 (2011)
Categories (% of 143 points)	Energy 20, IEQ 19, Materials 17, Emissions 13, Water 8, Transportation 8, Management 8, Site 6
Energy criteria checklist	GHG emissions reduced 20, Sub-metering 2, Lighting density 3 & zoning 2, Reduce peak power 2
IEQ criteria checklist	Ventilation rate 3, ACE 2, CO2 1, Dayllighting 3 & glare control 1, HFBs 1, Light level 1, View 2, Th.comfort 2 & controls 2, Hazmats 1, Acoustics 2, VOCs 3, Formaldehyde 1, Mold 1, Exhaust 1
Materials criteria checklist	Recycling 2, Building reuse 4, Materials reuse 1, Integrated fit-out 2, Concrete 1, Steel 2, PVC 2, Sustainable timber 2, Disassembly design 1, Dematerialization of building components 1
Emissions-criteria checklist	Emissions: Refrigerant ODP 1, GWP 2, Leaks 2, Insulant ODP 1, SW 3, Sewer 5, Light 1, Leg. 1

Category	Description
Water criteria checklist	Reduce occupant use 5, Metering 1, Landscaping 1, Heat rejection water 4, Fire system water use 1
Transportation-criteria	Transportation: Car parking 2, fuel-efficient vehicles 1, cyclists 3, mass transit 5
Management-criteria checklist	Management: GS AP 2, Building Management Services Commissioning 2, Re-commission 2,
Site criteria checklist	Topsoil 1, Reuse of land 1, Brownfield reuse 2, Preservation of ecological value 4
REFERENCES FOR CONFORMITY ASSESSMENT PROCEDURES	
BMS commissioning	CIBSE Commissioning Codes or ASHRAE Commissioning Guideline 1-1996
Environmental management	Contractor with valid ISO 14001 EMS accreditation
Mechanical ventilation	ASHRAE 129-1997 measurement protocols with Air Change Effectiveness ≥0.95
Thermal comfort-mechanical ventilation	• ASHRAE 55-2004 measurement protocols attaining 90% Accessibility Limits/ if assist natural vent. • ISO 7730 Predicted mean Vote levels between -0.5 & +0.5/ if mechanically air-conditioned spaces
Internal noise levels	AS/NZS 2107:2000 M&V procedures to confirm ≤ 40 dBeq.
GHG emissions	ABGR Validation Protocol or Energy Calculator to verify ≤ 110 kg CO2-eq./m2/yr.
Fuel-efficient transport	Minimum of 80% of preferred parking for fuel-efficient or car-pool vehicles
Sustainable timber	FSC or PEFC certification ≥ 95% (by cost) of timber product use (building & construction works)
Refrigerant ODP	GWP of ≤ 10 for all refrigerants
Stormwater	CSIRO 1999 Watercourse Pollution Guidelines or ANZECC Guidelines re: 1 in 20 yr. storm events
Legionalla	AS/NZ3666.1:2002 Risk Management Plan procedures in O&M Plan & provided to building owner

Chart C-1. Green Star Australia—Applicability



Annex D. Canada—Green Globes for New Buildings and BomaBest for Existing Buildings

Table D-1. Canada, Green Globes

Category	Description
Broad-based aspects	
Climate zone	Temperate Climate Zone
Project types	New Construction, Existing Building
Building types	Office, Public Building, Residential, Industrial, Healthcare, Education
Auxiliary tools	(Performance of Building)
Other systems reviewed	BREEAM-UK, Green Leaf
System management	New building: ECD Energy and Environment Ltd.-Green Leaf Design
	Existing building: Building Operators & Managers Association (BOMA) BESt
Other key partners	Industry, Government
Approach	Consensus-based, expert opinion, Life Cycle Analysis, greater openness
Product support	Greater availability of information and training
Year established	2004
Buildings registered	N.A.
Buildings certified	950 (Green Globes Total-Canada and USA)
Professional paths	Professional, Assessor
Levels of certification	Four: One Globe, Two Globes, Three Globes, Four Globes
Connected auxiliary tools	Online, internal connectors
Technical categories/criteria	Green Globes Design (New Building)
Categories (% of 1000 points)	Energy 30, IEQ 16, Materials 14.5, Water 13, Site12, Project Management 10, Emissions 4.5 (%)
Assessment category details	Not evaluated

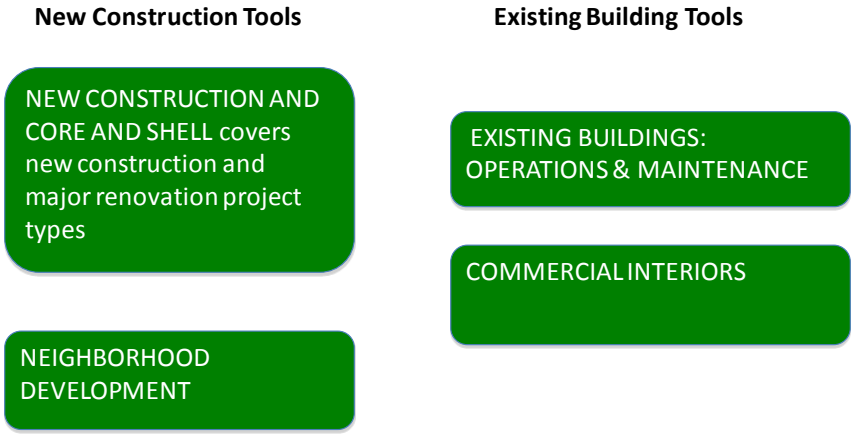
Annex E. Canada—LEED

Table E-1. LEED-Canada

Category	Description
BROAD-BASED ASPECTS	
Climate zone	Temperate zone
Project types	New construction, major renovations, existing building, core & shell, office interior, Neighborhood development
Building types	Non-residential, residential, education, retail, hotel, healthcare, multi-unit residential, Public building
Other systems reviewed	LEED-USA
System management	Canada green building council (CAGBC)
Other key partners	Industry, government
Approach	Consensus-based, expert opinion, life-cycle analysis, greater openness
Product support	Greater availability of information and training
Year established	2002
Buildings registered	2600
Buildings certified	470
Professional paths	Green associate, accredited professional, project review
Levels of certification (%)	Four: certified 40-49, silver 50-59, gold 60-79, platinum 80-100
Connected auxiliary tools	N. a.
Technical categories, criteria	LEED Canada for new construction and core & shell (updated mar. 2011)
Categories (70 points)	Energy 17, site 14, IEQ 15, resources 14, water 5, I&DP 5
Energy criteria checklist	Performance 10, on-site green energy 3 & off-site 1, commissioning 1, ODP 1, M&V 1
Site criteria checklist	Selection 1, development density 1, brownfield 1, transportation 4, protection 2, storm water 2, Heat island effect 2, light pollution 1
IEQ criteria checklist	Outdoor air intake 1, ventilation 1, construction IAQ 2, low hazmat 4, controls for pollution 1, Lighting & thermal comfort controls 2 & verification 2, daylighting & views 2
Resources-criteria checklist	Building reuse 3, constr. Waste management 2, reuse 2, recycled 2, regional 2, RRM 1, timber 1, durable 1

Category	Description
Water criteria checklist	Landscaping water efficiency 2, wastewater technologies 1, water use reduction 2
CONFORMITY ASSESSMENT PROCEDURES	
Minimum energy performance	Model national energy code for buildings or ASHRAE 90.1-2007 or ASHRAE AEDG
Refrigerants	USEPA clean air act title vi rule 608 re: refrigerant management and reporting
Building energy use M&V	IPMVP vol.iii for concepts and options for determining base building energy savings
Off-site green power	Environmental choice Ecologo program certified renewables for ≥35% power in ≥ 2 yr. Contract
Light pollution	ANSI/ASHRAE/IESNA 90.1-2007
Minimum IAQ performance	ASHRAE 62.1-2007 sections 4-7, paragraph 5.1, incl. Requirements for operability of windows
ETS control	ANSI/Astm-E779-03 standard test method for determining air leakage rate by fan pressurization
Controllability of systems	ASHRAE 62.1-2007 sections re: indoor air quality
Thermal comfort evaluation	ASHRAE 55-2004 paragraph 5.1 re: thermal comfort controls for natural ventilation conditions
Recycled content	ISO 14021 EPD type II (self-declared)
Certified wood	Forest stewardship council certification of wood used
Water use reduction	ASME 112-18.1-2005 re: public water faucet flows, ≤0.5 gpm at 60 psi per International Plumbing Code
Water use reduction	USEPA act 1992 standard baselines for toilet water flows

Chart E-1 LEED-Canada—Applicability



Annex F. China—Evaluation Standard for Green Building (ESGB) “Three Star System”

Table F-1. China ESGB, Broad-Based Aspects

CATEGORY	DESCRIPTION
Climate zone	Tropical Zone, Temperate Zone
Project types	New construction, existing building
Building types	Public building (non-residential), residential
Other systems reviewed	N.A.
System management	Ministry of Housing, Urban & Rural Development (MOHURD)
Other key partners	Universities, Green Building Councils (national, local)
Approach	Expert opinion, openness constrained
Product support	N.A.
Year established	2006
Buildings registered	N.A.
Buildings certified	113
Professional paths	N.A.
Levels of certification	Three: One Star 22-34, Two Stars 35-45, Three Stars 46-57
Connected auxiliary tools	N.A.
Technical categories/criteria	Evaluation Standard for Green Buildings (GB/T 50378-006) aka "Three Star" System
Categories (% of 57 points)	Prerequisites 23, Energy 18, Materials 14, O&M 12, Site 11, Water 11, IEQ 11
Assessment category details	Additional criteria and relevant assessment information not publicly available

Annex G. Hong Kong, China—Building Environmental Assessment Method (BEAM-Plus)

Table G-1. Hong Kong, China, BEAM-Plus

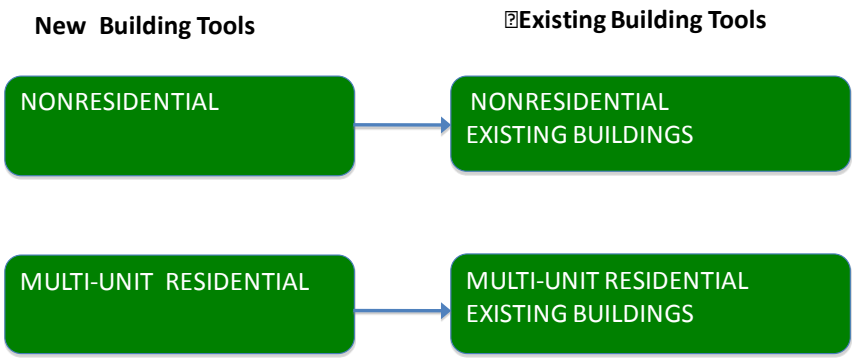
Category	Description
BROAD-BASED ASPECTS	
Climate Zone	Tropical Climate Zone
Building Types	New construction, existing building
	Non-residential, multi-unit residential
System Management	BEAM Society
Other Key Partners	Industry (Government is primary client)
Approach	Consensus-based, expert opinion, life-cycle analysis, greater openness
Product Support	Less availability of information and training
Year Established	1996
Buildings Registered	210
Buildings Certified	200
Professional Paths	BEAM Pro
Levels of Certification (%)	Four: Bronze 50-54, Silver 55-64, Gold 65-74, Platinum 75-100
Connected Auxiliary Tools	N.A.
Technical Aspects	BEAM Plus New Buildings and Existing Buildings, Version 1.1 (2010.04)
Categories (as % of 143 points.)	*Energy 31, IEQ 25, Site 17, Materials 16, Water 8, I&D 6 (B=bonus pt.), actual points below*
Energy criteria checklist	Reduced CO2 emissions 15, Reduced peak elec. demand 3, Embodied structural energy 1+1B, Car park ventilation 2 & lighting 2, On-site green energy 5, Efficient equipment 5, Energy management provisions: Testing & commissioning 4+1B, O&M 3, Metering & monitoring 1, Efficient building layout 2
IEQ criteria checklist	Security 1, Plumbing & drainage 1, Biological contamination 1, Waste disposal facilities 1, IAQ: Construction management 2, Outdoor sources of air pollution 2, & Indoor 3, In car parks 1; Ventilation: Increased 1, Background 1, Localized 2, In common areas 1+!B; Thermal Comfort: In A/C premises 2, in Naturally-ventilated premises 2; Lighting quality: Natural lighting 2, interior 2+1B, Acoustics & Noise: Room acoustics 1, Noise isolation 1+1B, Background noise 1, Indoor vibration 1, Access for persons with disability 1, Amenity features 2.

Category	Description
Site criteria checklist	Brownfield 1B, Local transport 3, Neighborhood amenities 3, Site design appraisal 1+1B, Ecological impact 1B, Cultural heritage 1, Landscaping 3, Building microclimate 4, daylight access 1, EMP 1, Construction pollution from air 1 & water 1 & noise 1, Building equip. noise 1, Light pollution. 1
Materials criteria checklist	• Efficient Use: Building reuse 2+1B, Modular design 1, Prefabrication 2, Spatial adaptability 3; • Selection: RRMs 2, Sustainable forest products 1, Recycled 3, Ozone depleting substances 2, • Regionally manufactured materials 2; Waste Reduction: Demolition waste 2, Construction waste 2
Water criteria checklist	• Water Conservation: Annual water use 3, Monitoring & control 1, Water-efficient irrigation 1,
	• Water recycling 2+1B, Water-efficient appliances 1; Effluent discharge to foul sewers 1
Innovations & additions	Innovative techniques & performance enhancements 5B, BEAM Professional 1
CONFORMITY ASSESSMENT PROCEDURES REFERENCES	
Reduce CO2 emissions	ASHRAE 90.1-2007 Appendix G-energy analysis requirements
Annual building energy use	• ASHRAE 90.1-2007 Energy Std. for Buildings Except Low-Rise Residential Buildings - Appendices: 8.1.3 min. requirements of EE building design; Appendix G approaches exceed Section 11 EE designs, incl. requirements, assumptions & modeling methodology to calculate proposed & baseline building performance
Embodied structural energy	ISO 14040: 1997 (Energy) LCA Principles & framework; or ASTM: E1991-98 Standard Guide for Environmental LCA of Building Materials/Products
Ventilation system-car parks	HVCA-UK DW143A-2000; or SMACNA IAQ Guideline for Occupied Buildings. Under Construction
Lighting system in car parks	CIBSE Code for Interior Lighting
Energy efficient appliances	USEPA Energy Star certified products or equivalent labeling scheme
Testing & commissioning	ASHAE New Buildings Commissioning; or CIBSE Commissioning Code C for A/C distribution system
Operations & maintenance	• ASHRAE Guideline 4, Preparation of O&M Documentation for Building Systems • BSRIA O&M Manuals Application Guide 1/87:1990
Metering & monitoring	ASHRAE 114-1996 Energy Management Control Systems Instrumentation; or BS EN 60521:1995
Security	ASTM International Designation E 1665-05a-Standard Classification for Office Facility Protection
Security	ASTM 1693-95a for Occupant Assets; or BS 8220 Standard Guide for Security of Buildings

Category	Description
Construction IAQ Management	• ANSI/ASHRAE 52.2-1999 Method of Testing General Ventilation-A/C Devices (per particle size) • USEPA Controlling Pollutants and Sources flush-out procedures guide
Outdoor sources, air pollution	ASHRAE 62.1-2007 re: airborne contaminants in occupied spaces (incl. CO2, NO2, O3, RSP, PM10)
Indoor sources, air pollution	ASHRAE 62.1-2007 Ventilation for Acceptable IAQ (incl. VOCs, formaldehyde, radon)
Increased ventilation	• ASHRAE 62.1-2007 Effective air delivery as a code-minimum standard, points if exceed • ASHRAE 111. Practices for Measurement, Testing, Adjusting & Balancing of HVAC & Refrigeration Systems • ASTM E 741-00-1998 Standard Test Methods for Determining Refrigeration Systems w/ tracer gas
Localized ventilation	ASHRAE 62.2-2003 Ventilation for Acceptable IAQ in domestic kitchens incl. fans
Background ventilation	• ASHRAE Fundamentals Handbook Chapter 2 (2001) • ASTM E 2267-03 re: flow estimates through habitable areas • ASTM E 741-00-2000 Test Methods for Determining Air Change in Single Zone w/ tracer gas dilution • BS 5925:1991 w/ Amendment No. 1, Code of Practice for design w/ natural ventilation practices
Ventilation in common areas	ASHRAE 62.2007; ASHRAE Fundamental Handbook Ch. 26; ASTM E 741-00 or equivalent
Thermal comfort in A/C area	ASHRAE 55-1992; ISO 7726 Ergonomics & instruments for measuring physical quantities
Thermal comfort w/ natural ventilation	ASHRAE 55-2004: ANSI/ASHRAE 140-2001 Test for Evaluation of Building Energy Analysis Models
	ISO 7726 Accuracy of sensors to test thermal environmental conditions for human occupancy
	ISO 7730: Indices & specifications for purposes of testing PMV & PPD
Natural lighting	CIBSE Lighting guide LG 10 for daylighting and window design
Interior lighting/occupied	IESNA Lighting Handbook, Reference & Applications 9th ed.; or CIBSE Code for interior lighting; or CIE Std. S 008/E Lighting of indoor work places; CIE Tech. Report No. 97 Indoor system maintenance.
Interior lighting/unoccupied	IESNA Lighting Handbook; CIE S 008/E; CIE 117-1995; or CIBSE Code for interior lighting
Room acoustics/audible speech	ISO 3382 Measurement of reverberation times; ANSI S12.60-2002; ASTM E 1130-02 Std. Test Methods; BS8233

Category	Description
Noise isolation testing	• ISO-140-4: 1998 Measurement of building airborne sound insulation; ISO 140-7 Floors insulation; • ISO 717-1. 1996 Part 1 -Airborne sound insulation & Part 2 Impact sound insulation; BS 8233; or • ASTM E336-97 Testing Standards -Airborne; ASTM 413-04 Rating sound insulation classification; • ASTM 989-89 Impact insulation Class IIC testing; ASTM E 1007-97 Testing tapping noises
Background noise	IEC 60804:2000 Integrating - averaging sound levels to type 2 or better; BS 8233; CEN EN 12354;
Indoor vibration	ISO 2631-2 Evaluation of human exposure-whole-body vibration, continuous & shock-induced(1-80 Hz)
Building microclimate	British Building Research Station: Wind Beaufort Number < 17.1 to prevent harm to humans
Noise from building equipment	ISO 9613-2 Calculating attenuation of sound propagation outdoors & BS 4142:1997 compliance methods
Light pollution	CIE 150:2003 & 126-1997: ILE Tech Report 5: 2001;CIBSE Fact File No. 7
Modular/standardized design	ISO 1006:1983 Building construction-modular coordination basics; ISO 2828 rules; BS 6750
Spatial adaptability	ASTM E1692-95a; ASTM E1697-95; ASTM E1334-95; IEA Annex 31 Energy analysis of changes
Sustainable forest products	FSC; AFPA; CFPC; or WWF certification
Recycled materials	BS 883:1992 or BS 6543: 1985
Ozone depleting substances	• USEPA ref. tradeoffs in reducing ODS vs. GWP with specific compounds; CIBSE 0900953993 • ASHRAE Guideline 3-1996 Reducing emissions of halogenated refrigerants
Water quality testing	ISO 5667-5:1991 Systematic sampling techniques
Water recycling	BSRIA Final Report 13034/1:1997 - Systems for recycling of gray water & harvesting of rainwater

Chart G-1. Hong Kong, China BEAM-Plus—Applicability



Annex H. Chinese Taipei—Certified Green Building Label (CGBL)

Table H-1. Chinese Taipei CGBL, Broad-Based Aspects

Category	Description
Climate zone	Sub-Tropical Region of Temperate Zone
Project types	New Construction, Existing Building
Building types	Non-Residential, Residential
Other systems reviewed	N.A.
System management	Green Building Chapter of Chinese Taipei Building Code
Other key partners	Chinese Taipei Green Building Council (TGBC)
Approach	Expert opinion, openness constrained
Product support	N.A.
Year established	2007
Buildings registered	N.A.
Buildings certified	2749
Professional paths	N.A.
Levels of certification	Five: Certified 12-25, Bronze 26-33, Silver 34-41, Gold 42-52, Diamond 53-100
Connected auxiliary tools	N.A.
Technical aspects	Certified Green Building Label (CGBL)
Categories (% of 100 points)	Energy 28, Site 27, Health 15, IEQ 12, Water 9, Waste Reduction 9
Assessment category details	Additional criteria and relevant assessment information not publicly available

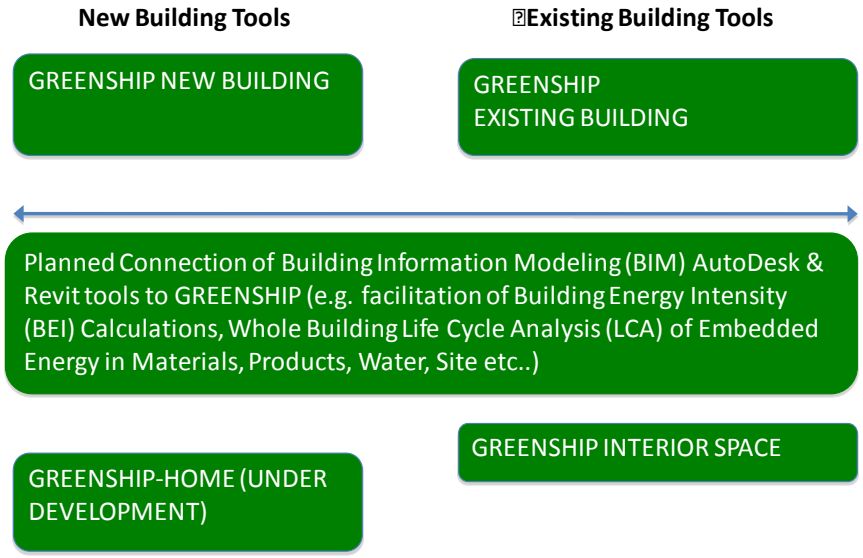
Annex I. Indonesia—Greenship

Table I-1. GREENSHIP

Category	Description
BROAD-BASED ASPECTS	
Climate zone	Tropical Climate Zone
Project types	New Building, (Existing Building, Interior Space, Neighborhood Development)
Building types	Non-Residential, (Residential)
Other systems reviewed	LEED-USA, GBI-Malaysia, Green Star-Australia, Green Mark-Singapore, BEAM-HK, China
System management	Green Building Council Indonesia
Other key partners	Industry, Government
Approach	Consensus-based, expert opinion, greater openness
Product support	Less availability of information and training
Year established	2010
Buildings registered	28
Buildings certified	0
Professional paths	Associate, Specialized
Levels of certification	N.A.
Connected auxiliary tools	Planned connection of BIM tools to GREENSHIP
Technical categories/criteria	GREENSHIP New Building Version 1.0 (June 2010 pilot) (Jan. 2011 v.2 not accessible)
Categories (%, 101 points)	Energy 26, Water 21, Site 17, Materials 14, Building Environmental Management 13, IEQ 10
Categories (% of 101 points)	Energy 26, Building Energy Management 13, Water 21, Site 17, Materials 14, Indoor Health & Comfort 10
Assessment category details	Note: additional criteria and relevant conformity assessment information are not available

Category	Description
Energy criteria checklist	Energy modeling software simulation of Building Energy Intensity (BEI) comparisons between baseline & designed building 20; Calculations of energy savings using standardized worksheet 15; Conducting prescriptive energy-saving measures: Building envelope 5, Non-natural lighting 4, Vertical transportation 2, Chiller Coefficient of Performance 2
Building energy management	GP as member of project team 1, Pollution of construction activity 2, Waste management 2, Proper commissioning 3, Submission of green building database form & implementation data 2, Fit-out compliance re: certified wood, building management training and post-construction IAQ management plan 1, Submit LOI to do occupant survey on thermal & humidity comfort at least 12 mo.post certification date, with existing building certification denied if non-compliance when ≥ 20% dissatisfied and building management does not conduct improvements 2
Water criteria checklist	Water use reduction 8, Water fixtures 3, Water recycling 3, Alternative water resource 2, Rainwater harvesting 3, Water efficiency landscaping 2
Site criteria checklist	Site selection 2, Community accessibility 2, Public transportation 2, Bicycle 2, Site landscaping 3,Microclimate 3, Storm water management 3
Materials criteria checklist	Building & material reuse 2, Environmentally friendly processed product 3, Non-ODS usage 2, Certified wood 2, Modular design 3, Regional material 2
Indoor health & comfort criteria checklist	CO2 monitoring 1, Environmental tobacco smoke control 2, Chemical pollutants 3, Outside view 1, Visual comfort 1, Thermal comfort 1, Acoustic level 1
CONFORMITY ASSESSMENT PROCEDURES—REFERENCES	
Energy modeling software	Every 2.5% reduction of BEI after 10% minimum reduction is reached earns 1 pt.
Standardized worksheet	Every 2% reduction after 10% minimum reduction is reached earns 1 pt.
Building envelope	Every reduction of 3W/m2 from 45W/m2 OTTV (i.e. SNI 03-6389-2000 as baseline) earns 1 pt.
Non-natural lighting	Minimum reduction of energy use for lighting of 30% below SNI 03-6197-2000 baseline
Chiller COP	Using chiller with COP minimum of 10% higher than SNI 03-6390-2000 baseline
On-site renewable energy	For every 0.5% of electrical power substituted by renewable energy earns 1 pt. (5 pt. ceiling)

Chart I-1. Indonesia Greenship—Applicability



Annex J. Japan—Comprehensive Assessment System for Built Environment Efficiency (CASBEE)

Table J-1. Japan—CASBEE, Broad-Based Aspects

Category	Description
Climate zone	Temperate climate zone
Project type	Predesign, new construction, existing building, renovation, NC brief version, heat island, NC-temporary construction, urban development, UD expo, (Site, City)
Building types	Non-residential, (township, dwelling unit, detached home, existing home)
Other systems reviewed	BREEAM-UK, LEED-USA, GB Tool
System management	Ministry of Land, Infrastructure, Transport & Tourism (MLIT)
Other key partners	Japan Sustainable Building Consortium (JSBC)
Approach	Consensus-based, expert opinion, Life Cycle Analysis, less openness
Product support	Less availability of information and training
Year established	2002
Buildings registered	1400
Buildings certified	80
Professional paths	Specialized (Expert Architects and Engineers)
Levels of certification	N.A.
Other - broad-based	Certification data: BEE figure, radar chart, life cycle CO2 global warming impact chart, and bar charts of assessment results of medium-level (i.e. Level=3) categories
Connected auxiliary tools	BIM tools, e.g. AutoDesk & Revit; and tool for property appraisal
Technical categories, criteria	CASBEE New Construction 2008 Edition (Tool 1)
Categories (%)	Other 30, Energy 20, IEQ 20, Site 15, Materials 13, Water 2
Assessment category details	Additional criteria and assessment information are not provided in this table because of the unique structure of CASBEE. Information for Japan relates to environmental assessment categories, criteria for these categories and their prioritization, and samples of conformity assessment procedures. The reader is encouraged to read the CASBEE technical manual to understand the extraordinary complexity and usefulness of the reporting formats that the CASBEE rating system provides.

Chart J-1. Japan—CASBEE Applicability: Basic Design Process Tools

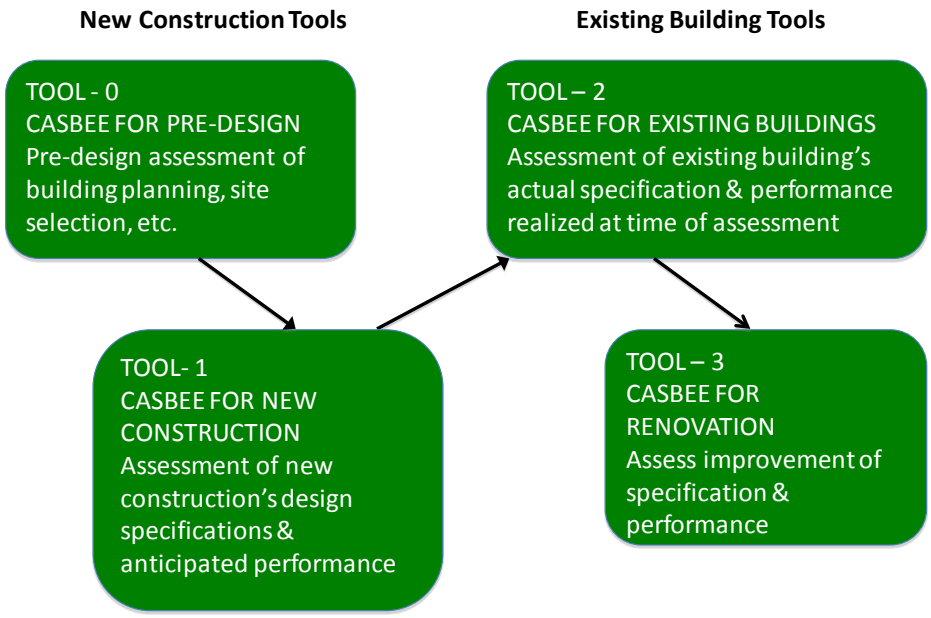
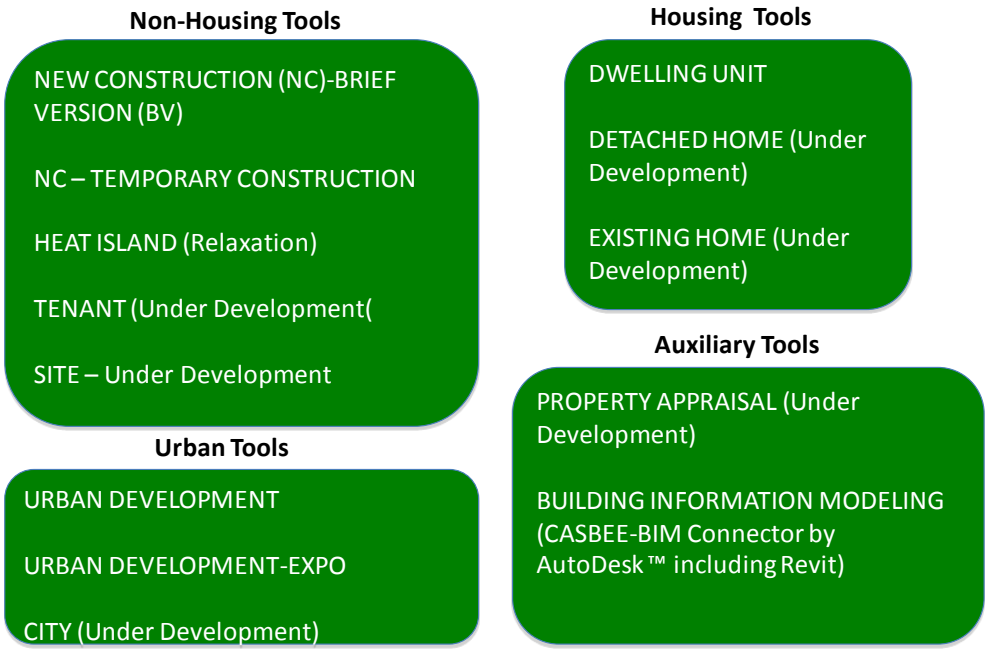


Chart J-2. Japan—CASBEE – Applicability: Additional Tool Categories



Annex K. Korea—Green Building Certification System (GBCS)

Table K-1 Korea GBCS, Broad-based Aspects

Category	Description
Climate zone	Sub-Tropical Region of Temperate Zone
Project types	New Construction, (Existing Building)
Building types	Office, Multi-Residential, Retail, Hotel, Education, Residential, Other
Other systems reviewed	N.A.
System management	Korea Green Building Certification (KGBC) (coordination of key Government agencies, MOCT & MOE)
Other key partners	Industry, Academia
Approach	Expert opinion, openness constrained
Product support	N.A.
Year established	2001
Buildings registered, certified	R=589 (partial certification), C=1197
Professional paths	N.A.
Levels of certification (%)	Two: Excellent 65-84, Best 85-100
Connected auxiliary tools	N.A.
Technical categories, criteria	GBCC (MOE, MOCT) Office Building
Categories (% of 136 points)	IEQ 23, Energy 17, Materials 15, Ecological Environment 14, Water 10, Management 7, Site 5, Commuting Transportation 4, Atmospheric Pollution 4 (%, total points. = 136)
IEQ criteria checklist	Low VOCs 6, No ETS 3, Outdoor/indoor ventilation 3, Occupancy air flush 2, No hazmats 1, Natural ventilation IAQ plan 3, temperature control 2, acoustics 2, rest space 4, comfort 4, disabled access 1
Energy criteria checklist	Annual consumption 15, On-site green energy use 2, Reduction of lighting energy 6
Materials criteria checklist	Use green construction methods 3, Reduced product use in toilets 1, Product recycling rate 2. Certified salvaged product use 3, On-site recycling 3, Reuse of EB support 7 and non-support 2

Category	Description
EcologicalEcological Environment checklist	Landscaping 6, Green space area ratio 7, creation of aquatic biotope 3 & of terrestrial biotope 3
Water criteria checklist	Reduce runoff (porous) 3, Reduce city water use 4, Use rainwater 3, Install greywater system 4
Management checklist	On-site construction management Plan 2, O&M documentation 4, Ease of occupant space change 4
Site criteria checklist	Ecological value 2, Land development 3, Interference w/ daylight to adjacent properties 2
Transport criteria checklist	Distance to public station 2, On-site bicycle rack 1, Information access 2
Atmospheric pollution criteria checklist	Emission of CO2 during building operation 3, Protect ozone layer avoiding ODP substances 3
Assessment category details	Note: additional criteria and relevant assessment information not available

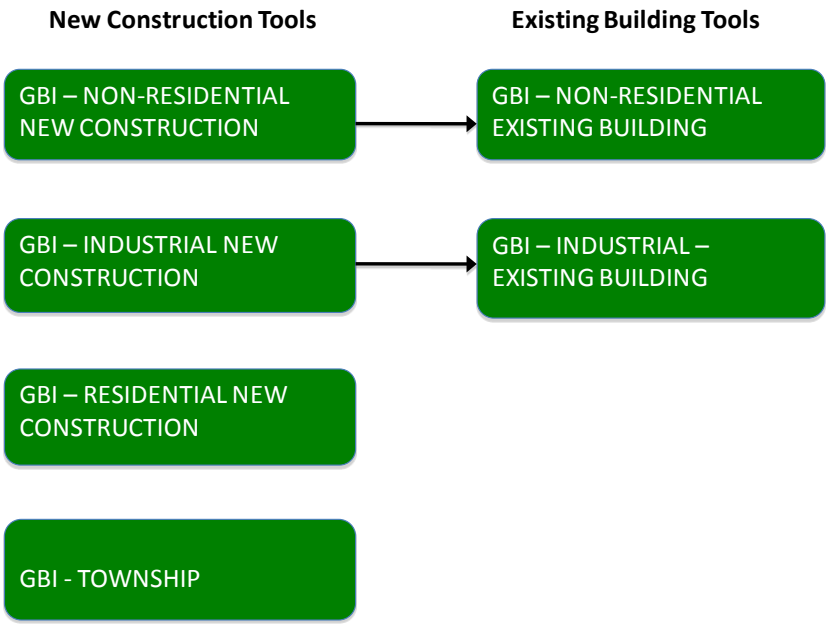
Annex L. Malaysia—Green Building Index (GBI)

Table L-1. Malaysia GBI, Broad-Based Aspects

Category	Description
Climate Zone	Tropical Climate Zone
Project Types	New Building, Existing Building
Building Types	Non-Residential, Residential, Industrial, Tenant
Other systems reviewed	BREEAM-UK, LEED-USA, Green Star-Australia, Green Mark-Singapore
System management	Malaysia Green Building Confederation (MGBC)
Other key partners	Academia, Industry, Government
Approach	Consensus-based, expert opinion, greater openness
Product support	Greater availability of information and training
Year established	2009
Buildings registered	181
Buildings certified	32 (30 partial)
Professional paths	Certifier, Facilitator, Commissioner
Levels of certification (%)	Four: Certified 50-65, Silver 66-74, Gold 76-85, Platinum 86-100
Connected auxiliary tools	N.A.
Technical categories, criteria	GBI for NRNC v1.0 2009
Categories (prioritized/points)	Energy 35, IEQ 21, Site 16, Materials 11, Water 10, Innovation 7
Energy criteria checklist	Min. EE Performance 1, Lighting 3, Elec. Sub-metering 1, Renewable energy 5, Advanced EE Performance-BEI 15, Commissioning enhanced 3 & Post-occupancy 2, EE Verification 2, Sustainable maintenance 3
IEQ criteria checklist	Min. IAQ performance 1, ETS control 1, CO2 control 1, IA pollution. 2, prevent mold 1, control thermal comfort 2, ACE 1, Daylighting 2 & glare control 1, Elec. Lighting 1 & HFBs 1, Ext. views 2,
Site criteria checklist	Select 1, Brownfield 1, Connectivity 2, EMS 2, Constr.mgt. E, transport 3, BUM 1, SW 1, Roof 2
Materials criteria checklist	Materials reuse 2, recycled 2, regional 1, Sustainable Timber 1, recycling on-site 1, CWM 2, ODP 2

Category	Description
Water criteria Checklist+IEQ	Rainwater harvest 2 & recycle 2, Efficient landscape 2, Fittings 2, Meter 2, Acoustic 1, IAQ 2, POCS 2
Innovation-Criteria Checklist	Innovation in Design & Environmental Design Initiatives 6, GBI Accredited Facilitator 1
CONFORMITY ASSESSMENT PROCEDURES - REFERENCES	
Building envelope EE	EE performance of building envelope meets building code MS 1525:2007 requirements of OTTV≤50, RTTV≤25
Lighting controls	Flexible lighting controls provided to optimize energy savings, with max. 100m2 for 90% of NLA for size of individually switched lighting zone; auto-sensors for perimeter zones and daylit areas; and motion sensors in at least 25% NLA
Electrical sub-metering	Provide sub-metering for all energy use ≥100 kVa for both lighting & power for each floor/tenant
On-site renewable energy	At percentage levels of 0.25, 0.5, 1.0, 1.5 or 2.0 of the maximum electricity demand (MD); or kWp levels of 2, 5, 10, 20 or 40 is supplied by Renewable Energy (RE), whichever is greater
Building energy intensity	BEI energy efficiency performance better than baseline of ≤150 kWh/m2-yr. (use GBI and BEIT Software or equivalent used to define for specific building type), at BEI levels of ≤150, 140, 130, 120, 110, 100, or 90 respectively; or demonstrate energy savings over the last three years from historical BEI baseline, to improve by percentages of 20, 25, 30, 40, 50, 60, or 70% respectively and with associated resultant BEIs ≤200, 180, 150, 140, 130, 120, or 110 respectively
BES commissioning	Enhanced (Re-)(Retro-)Commissioning of Building Energy Systems, including appointment of Commissioning Specialist (CxS) to perform the commissioning for all of the building's energy related needs per ASHRAE Commissioning Guidance or other GBI approved equivalent standard, including equipment improvements, a commissioning plan, training for system managers, and an updated building operating plan; EE6 (2 points): on-going post occupancy commissioning
Energy management system	Annual submission of BEI sub-metering, fuel & water monitoring data for 3yr. GBI re-certification

Chart L-1. Malaysia GBI—Applicability



Annex M. New Zealand—Green Star

Table M-1 Green Star New Zealand

Category	Description
Broad-Based Aspects	
Climate zone	Temperate Zone
Project types	New Construction, Existing Building
Building types	Office, Industrial, Education,
Auxiliary tools	Five Calculators: GHG Emissions, Public Transport, Water, Ecology, Sewerage
System management	New Zealand Green Building Council (NZGBC)
Other key partners	Industry, Government
Approach	Consensus-based, expert opinion, greater openness
Product support	Greater availability of information and training
Year established	2002
Buildings registered	N.A.
Buildings certified	43
Professional paths	Practitioner, Accredited Professional
Levels of certification (%)	Three: 4 Stars 54-49, 5 Stars 60-74, Six Stars 75-100
Connected auxiliary tools	Calculators (5) for: GHG Emissions; Public Transit; Water; Ecology, Sewerage
Technical categories/criteria	Green Star NZ - Office 2009 (New and Existing Buildings)
Categories (% of 151 points)	Energy 25, IEQ 20, Emissions 13, Materials 10, Water 10, Site 10, Transport 10, Management 10, Inn. 5
Energy criteria checklist	GHG emissions reduction 20, CO control 1, Lighting power density & illuminance management 3, Lighting controls to save energy 3, Electrical sub-metering 2, Peak energy demand reduction 2
IEQ criteria checklist	Ventilation rates 3, IAQ: VOC2 4 & Formaldehyde 1; ACE 2, Tenant exhaust riser 1, Thermal control assessments 3 & control 2, Daylight 3 & glare control 1, External views 2, Electric lighting levels 3, High frequency ballasts 1, Internal noise levels 2

Category	Description
Emissions-criteria checklist	Refrigerant ODP 1 & GWP 1, Insulant ODP 1, Watercourse pollution 3, Reduced flow to sewer 4, Light pollution 1, Purge control 1, Legionella 1
Materials criteria checklist	Integrated fit-out waste reduction 3, Building reuse 6, Applied coatings 1, PVC 3, Insulation 1, Sustainable timber 2, Disassembly design 1, Dematerialization of building components 1
Water criteria checklist	Reduce occupant use 7, Metering 2, Landscaping 1, Heat rejection water 2
Land use criteria checklist	Topsoil 1, Reuse of land 1, Brownfield reuse 2, Preservation of ecological value 4
Transport criteria checklist	Car park minimization 2, Fuel-efficient transport 2, Cyclist facilities 3, Mass transit 4
Management criteria checklist	GS AP on project team 3, Building Management Services Commissioning 3, Building tuning 2, Independent commissioning agent 1, Waste management 3, Building users' guide 2, Environmental Management Plan 2
Innovation criteria checklist	Innovative strategies & technologies, Exceeding GS benchmarks, Environmental Design initiatives: 5
CONFORMITY ASSESSMENT PROCEDURES REFERENCES	
GHG emissions reduction	Significant BEI reduction < 105 kW/m2/yr. baseline, at least 5% on-site renewable energy
ACE-natural ventilation	AS 1668.2-2002 Air Change Effectiveness compliance for 90% of accessible area naturally
Mechanical ventilation	ASHRAE 129-1997 measurement protocols with Air Change Effectiveness ≥0.95
Thermal comfort mechanical ventilation	ASHRAE 55-2004 measurement protocols attaining 90% Accessibility Limits/ if assist natural vent. ISO 7730 Predicted Mean Vote levels between -0.75 & +0.75/ if mechanical A/C spaces
Electric lighting levels	AS/NZS 1680.1:2006 1.4.4 Office lighting avg. luminance ≤400 Lux & ≥0.6 uniformity, 95% area
Internal noise levels	AS/NZS 2107:2000 M&V procedures to confirm ≤ 43 dBeq
Refrigerant GWP	All refrigerants GWP < 10
Light pollution	AS 4282 Outdoor lighting avg. luminance ≤ 20% above minimum levels in AS/NZS 1680
Commissioning clause	CIBSE Commissioning Codes or ASHRAE Commissioning Guideline 1-1996
Fuel efficient transport	Minimum of 10% of preferred parking spaces for use by car-poolers or fuel-efficient vehicles

Annex N. Philippines—Building for Ecologically Responsive Design Excellence (BERDE)

Table N-1. Philippines' BERDE, Broad-Based Aspects

Category	Description
Climate zone	Tropical Climate Zone
Project types	New Construction, Existing Building
Building types	Nonresidential
Auxiliary tools	(Performance of Building)
System management	Philippines Green Building Council (PHILGBC)
Other key partners	Government, academia, industry
Approach	Consensus-based, expert opinion, greater openness
Product support	Greater availability of information and training
Year established	2010
Buildings registered	N.A.
Buildings certified	0
Professional paths	Project Review, Professional
Levels of certification (%)	Five: One Star 50-59, Two Stars 60-69, Three Stars 70-79, Four Stars 80-89, Five Stars 90-100
Connected auxiliary tools	N.A.
Technical categories, criteria	BERDE 1.0
Categories (prioritized points)	IEQ 13, Transport 13, Materials 12, Management 11, Site 10, Waste 10, Energy 8, Water 6, HC 4, EM 3
IEQ criteria checklist	Thermal comfort, Noise level, Indoor air pollution, High frequency ballasts, Green innovations
Materials criteria checklist	Recyclables, construction waste, reuse, recycle, regional, rapidly renewable, certified wood
Site criteria checklist	Sustainable construction, building reuse, greenery, EMP, public transport, refrigerants, SW, less disturbed
Energy criteria checklist	Envelope, A/C system, natural ventilation, vertical lift, EE features, renewable energy

Category	Description
Water criteria checklist	Efficient fittings, metering and leak detection, use reduction, consumption and cooling tower
Heritage conservation criteria	Heritage buildings, building facades, architectural elements, Cultural interpretation, indigenous materials
Assessment category details	

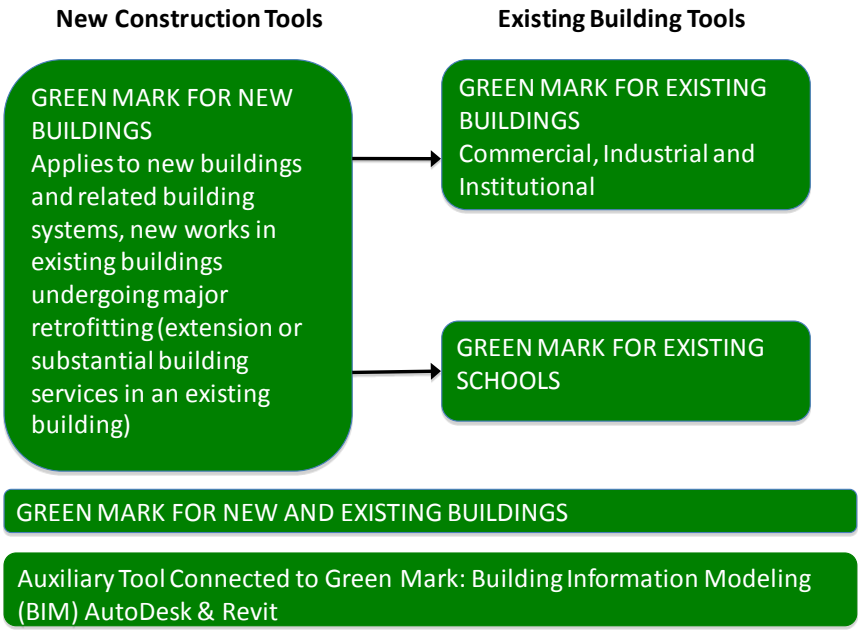
Annex O. Singapore—Green Mark

Table O-1. Green Mark

Category	Description
BROAD-BASED ASPECTS	
Climate zone	Tropical Climate Zone
Project types	New construction, existing building
Building types	Non-residential, multi-unit residential, residential, education, office interior, public building, retail
Other systems reviewed	N.A.
System management	Building and Construction Authority (BCA), Ministry of National Development
Other key partners	Academia, Industry, Singapore Green Building Council (NGO)
Approach	Expert opinion, Life Cycle Analysis, less openness
Product support	Greater availability of information and training
Year established	2005
Buildings registered	840
Buildings certified	100 (GFA=15M m2)
Professional paths	Facility Manager, Professional, Specialized, Advanced
Levels of certification (%)	Four: Certified 50-74, Gold 75-84, Gold Plus 85-94, Platinum 90-100
Connected auxiliary tools	Building Information Modeling, e.g. AutoDesk, Revit
Technical categories/criteria	BCA Green Mark for New Non-Residential Buildings Version NRB/4.0
Categories (% of 190 points)	Energy 61, Environmental Protection 22, Water 9, IEQ 4, Other Green Features and Innov's 4 (%)
Energy efficiency criteria checklist	Thermal performance of building envelope-ETTV 12, Air-conditioning system 30, Building envelope-design/thermal parameter 35, Natural ventilation/mechanical ventilation 20, Daylighting 6, Artificial lighting 12, Ventilation in carparks 4, Ventilation in common areas 5, Lifts & escalators 2, Energy efficient practices & features 12, Renewable energy 20
Water efficiency criteria checklist	Water efficient fittings 10, Water usage & leak detection 2, Irrigation system & landscaping 3, Water consumption of cooling towers 2

Category	Description
Environmental protection criteria checklist	Sustainable construction 10, Sustainable products 8, Greenery provision 8, Environmental management practice 7, Green transport 4, Refrigerants 2, Storm water management 3
IEQ criteria checklist	Thermal comfort 1, Noise level 1, Indoor air pollutants 2, IAQ management 2, High freq. ballasts 2, management practice 7, Green transport 4, Refrigerants 2, Storm water management 3
CONFORMITY ASSESSMENT PROCEDURES - REFERENCES	
Building envelope-ETTV	Envelope Thermal Transfer Values per building code and GM Standard prerequisites of baseline of 50 and ≤42 vs. 40 W/m2 and ≥ 25-30% energy savings required for Gold Plus vs. Platinum rating
Building envelope design	Thermal parameters, incl. reduced percentages from baseline values of U-values (better thermal transmittance (W/m2K) of roofs of different weights, and external walls facing different directions
Air conditioning system	Peak building cooling loads (RT) in specific ranges (≤ or ≥ 500) for efficiency (kW/RT) values within specific ranges (0.65 to 0.9) per type chilled water or air-conditioning equipment used
Natural, mechanical ventilation	Simulation modeling and analysis a prerequisite to calculate percentage improvements in air distribution system efficiency (kW/m3/s)
Daylighting	Points per distance from façade perimeter (m)
Artificial lighting	Points per percentage improvement in lighting power budget
Ventilation	Points per mode of mechanical ventilation provided in carparks or common areas
Energy efficiency practices and features	Points per percentage energy savings over the total building energy consumption
Renewable energy	Points on expected energy efficiency index (EEI, ≤ or ≥ 30 kWh/m2/yr)) and percentage replacement of electricity by RE source, and including vs. excluding the tenant's usage
Water efficient fittings	Per weighted points. scored based on number and water efficiency rating of specific fitting types used

Chart O-1 Singapore Green Mark - Applicability



Annex P. United States—Green Globes

Table P-1. Green Globes USA Broad-Based Aspects

Category	Description
Climate zone	Temperate Climate Zone (Tropical Climate Zone relevant to less than 1% of population)
Project types	New construction, existing building
Building types	Office, public building, residential, industrial, healthcare, education
Other systems reviewed	BREEAM-UK, Green Leaf
System management	Green Building Initiative (GBI) (Private, non-profit)
Other key partners	Industry, Government
Approach	Consensus-based, expert opinion, life cycle analysis, greater openness
Product support	Greater availability of information and training
Year established	2004
Buildings registered	N.A.
Buildings certified	950
Professional paths	Professional, Assessor
Levels of certification (%)	Four: 35-43 One Globe, 55-69 Two Globes, 70-84 Three Globes, 85-100 Four Globes
Other - broad-based	N.A.
Connected auxiliary tools	Online, internal connectors
Technical categories, criteria	Green Globes Design (New Building) ANSI/GBI 01-2010 Standard
Categories (% of 1000 points)	Energy 30, IEQ 16, Materials 14.5, Water 13, Site12, Project Management 10, Emissions 4.5 (%)
Assessment category details	Note: additional criteria and relevant assessment information not available

Annex Q. Vietnam—LOTUS

Table Q-1. Vietnam's LOTUS

Category	Description
BROAD-BASED ASPECTS	
Climate zone	Tropical Climate Zone
Project types	New Construction, Existing Building
Building types	Non-Residential, Residential
Other systems reviewed	Green Star-Australia, LEED-USA, GBI-Malaysia, BREEAM-UK, Green Mark-Singapore
System management	Vietnam Green Building Council (VGBC)
Other key partners	Government
Approach	Consensus-based, expert opinion, greater openness
Product support	Greater availability of information and training
Year established	2010
Buildings registered, certified	N.A./0
Professional paths	Basic, Accredited Professional
Levels of certification (points)	Three: Certified 60-83, Silver 84-115, Gold 106-150
Connected auxiliary tools	N.A.
Technical categories/criteria	LOTUS Non-Residential New Building 2010 Pilot
Categories (% of 150 points)	Energy 23, Materials 13, Health & Comfort 13, Water 10, Management 10, Ecology 9, Waste & Pollution 9, Adaptation & Mitigation 9, Community 7, Innovation 6 Bonus points.
Energy criteria checklist	Total building energy use (kWh/M2/yr) 15 points., Building envelope (OTTV) per EEBC 4, Natural ventilation 2, HVAC (COP of HVAC) per EEBC 2, Artificial lighting per EEBC 2, Hot water per EEBC 2, Transformer eff. per EEBC 2, Energy monitoring 2, Renewable energy (up to 5%) 3
Materials criteria checklist	Structural reuse 2, Non-structural reuse 2, Recycled (non-structural) 2, Recycled(steel) 3, Recycled concrete 2, Prefabrication 2, RRM 2, Timber 2, Low energy embodied materials 3
Health & comfort-criteria	Indoor air quality (meets ASHRAE Standard 62.1) 2, CO2 monitoring 2, Hazardous materials report 4, Daylight control 3, Visual comfort 1, External views 2, Individual thermal comfort 3, Thermal comfort 2, Acoustic comfort 1

Category	Description
Water criteria checklist	Water use intensity 3, Fixtures 2, Gray water recycling/reuse 2, Rainwater harvesting 2, Water eff. landscaping 2, HVAC (equipment water consumption, per EEBC) 2, Monitoring (centrally) 2
Management-criteria checklist	Design stage 2, Construction stage 1, Commissioning 4, Maintenance 2, Green management (EMS & ISO 14001) 3
Ecology-criteria checklist	Environment 1, Top soil preservation 3, Biodiversity 2, Site selection 3, Vegetation 2, Green roof 2
Waste & pollution-criteria	Sewer discharge reduction 3, A/C system refrigerants (prerequisite of GWP ≤1700 & ODP ≤0.05) w/ use of limited HCFCs & HFCs per Montreal Protocol 3, Demolition and construction waste 4, Dedicated recycling storage area 2, Light pollution minimization 1
Adaptation & mitigation-criteria	Flooding resistance 2, Storm water runoff 3, Disaster resilience 2, Heat Island Effect (Solar Reflectance Index-SRI) 2, Public transport 1, Bicycle friendly 1, Local materials 2
Community-criteria checklist	Community connectivity 2, Public space 3, Local jobs 2, Access for people with disabilities 3
Innovation-criteria checklist	Exceptional performance enhancement; and/or Innovative techniques/initiative, total 8 Bonus points.
CONFORMITY ASSESSMENT PROCEDURES REFERENCES	
Building energy use	Total building energy consumption (kWh/M2/Yr). 25% less vs. baseline model
Building envelope	OTTV of wall or roof surpasses the EEBC requirements by 60%
Natural ventilation	50% of regularly occupied spaces are naturally ventilated
HVAC COP	COP of HVAC equipment surpasses EEBC requirements by 30%
Artificial lighting	Lighting power density surpasses EEBC requirements by 10%
Hot water	Thermal efficiency of water heating systems surpasses the EEBC requirements by 5%
Transformer	Efficiency of transformers surpasses EEBC requirements by 5%
Energy monitoring	Provide energy metering for major energy uses
Renewable energy	5% of the total energy used is produced from a renewable source
Reuse of building materials	Reuse 50% of existing structural components & 30% of non-structural components
Recycled content	Recycled content of steel 30%; 25% of concrete volume contains 10% recycled cement
Prefabrication	305 of materials are prefabricated off-site
Rapidly renewable material	2% of all building materials are from a rapidly renewable source

Category	Description
Timber	70% of all timber used is from a sustainable source
Low energy embodied materials	80% of non-structural walls are made of low energy embodied materials
Hazardous materials	Low VOC & formaldehydes from all flooring systems, all paint & coatings, all adhesives & sealants, all composite wood products
Daylight control	80% of net occupied area illuminated by daylight
Visual comfort	Color temperature (TC) of all artificial lighting is > 300K & color rendition index (CRI) is > 80
External views	50% of net occupyable area achieves direct line of sight to the outdoor environ. via vision glazing
Individual thermal comfort	Demonstrate acceptable PMV values -1 to +1 for mechanically conditioned spaces & 80% ASHRAE acceptability limits for naturally ventilated spaces or occupied space per TCSDVN 306:2004
Acoustic comfort	Open areas meet T 60 <0.6s and closed areas meet T60 <0.7s requirements
Water use intensity	Reduce total building water consumption by 30% in comparison to baseline model
Fixtures	At least 90% of all fixtures in the building are water efficient
Grey water recycling/reuse	10% of the buildings total water consumption is recycled/reused grey water
Rainwater harvesting	10% of the buildings total water consumption is harvested rainwater
Water efficient landscaping	No potable water used for irrigation
HVAC water	Water consumption of HVAC equipment exceeds the EEBC requirements by 60%
Water monitoring	Provide water meters for all major water uses or a central water monitoring system
Project management	Design state involve a green coordinator of LOTUS AP as a member of the design team
Construction state	Project management is performed in accordance with internationally recognized systems
Commissioning	Appoint a commissioning team and conduct commissioning for construction and during occupancy
Maintenance	Produce a preventive maintenance plan & involve the technical team before commissioning
Green management	Adhere to an Environment Management System and achieve ISO 14001 certification
Green roof	50% of the roof area is green roof
Sewer discharge reduction	Reduce building total sewer discharge by 50%

Category	Description
Shading coefficient	Shading coefficient of window glass not less than 0.25
No indoor smoking	Complies with Decree 45/2005/ND-CP and Decision 1315/QD-TTg
Ventilation rates	ASHRAE Std. 62.1 ventilation rates are met
Hazardous materials	Produce hazardous materials report
Daylight control	30% of the net occupied area illuminated by daylight
External views	50% of net occupyable area achieves a direct line of sight to the outdoor environment via window glazing
Heat island effect	50% of the site's paved area has Solar Reflectance Index (SRI) higher than 29
Local materials	30% of all materials produced within a 500 km radius
Community connectivity	Locate site within a 0.5 km radius to at least 10 basic services
Public space	20% of the site area is open or recreational space
Local jobs	Within & city fill positions for permanent building staff with workers from a 5 km radius; from outside a city from a 10 km radius

Annex R. Comparison of Green Building Rating Systems

Table R-1. APEC Rating Systems Applicability

Economy	Rating System	Year Est	Last Update	Climate Zone	Project Type	Building Type	Auxiliary Tools
Australia	Green Star	2002	Office V 3 2011	TRZ & STR	NC, EB, (ND)	NR,E,H, I, MR	CAL
Canada	LEED	NC 2.0 2004	2009 relaunch. NC & CS 2011 update	TEZ	NC,MR,EB,CS,OI,ND	NR, R, E, Rt, H, Ho, MUR, PB	PER
Canada	Green Globes	2000	2002, 2004 added EB	TEZ	NC, EB	Nr, R, (Rt, I)	BEMA, Fit-Up, (ESC, OAR, LI)
China	ESGB	2006	N.A.	TRZ & TEZ	NC, EB	NR, PB, R	PER
Hong Kong, China	BEAM-Plus	1996	2010	TRZ	NC, EB	NR,MR	PER
Indonesia	GREENSHIP	2010 NB	2011	TRZ	NB, (EB,IS,ND)	NR, (R)	(BIM)
Japan	CASBEE	2002	2008	TEZ	PD,NC,EB,RN,NCBV,HI, NC/TC,UD,UDE,(S,C)	NR, (T, DU, DH, EH) ATs: PA	BIM
Korea	KGBC	2001	Office, MU & Schools 2003, 2010 in process	STR	NC,(EB)	OF, R, Rt, Ho, E, MR, O	PER
Malaysia	GBI	2009	NREB 2010, IEB INC 2011	TRZ	NC,EB	NR, R,I,T	(BIM)
New Zealand	Green Star	2009	N/A	TEZ	NC,EB	Of, I, E, IS	CAL
Philippines	BERDE	2010	2011	TRZ	NC, EB	NR	(PER)
Singapore	Green Mark	2005 NRB	NRB v4 2011	TRZ	NC,EB	NR,MUR,R,E,OI,P,RT	BIM
Chinese Taipei	GGBL	2007	N.A.	STR	NC, EB	NR, R	PER
USA	Green Globes	2006	N.A.	(TRZ*) & TEZ	NC,EB	Of, PB, R, I, H, E	PER
USA	LEED-USA	1998	2009 v3 & May 2011	(TRZ*) & TEZ	NC,MR,EB,CS,OI,ND	NR, R, E, Rt, H, Ho, MUR, PB	BIM
Vietnam	LOTUS	2010 NR	2011	TRZ	NC,EBO	NR, R	(PER)

Climate Zone definitions: *TRZ=Tropical Zone (1) is from equator to Tropic of Cancer (23.5°N) & to Tropic of Capricorn (23°.5 S),: TEZ=Temperate Zone (2), from boundaries of tropical zone to boundaries of frigid zones, i.e. to Arctic Circle (67° N) and Antarctic Circle (67° S); STR=Sub-Tropical Region (2) is the warmer region of the TEZs, i.e. from 23.5° to 40° latitudes in the N & in the S respectively. Climate Zones of other economies not listed above: Brunei=TRZ; Chile=TRZ & TEZ; Mexico=TRZ & STR; Peru=TRZ; PNG=TRZ; Russia=TEZ; Thailand=TRZ. TRZ* in USA ≤ 1% population*

Note: Parenthesis=under development

Project Type: *NB = New Buildings, NC=New Construction, EB=Existing Building, CS=Core & Shell Development, OI=Office Interior, Of=Office, ND=Neighborhood Development, MR=Major Renovations, IS=Interior Space, NC/TC=NC/Temporary Construction, O=Other, HI=Heat Island, UD=Urban Development, UDE=UDExpo, S=Site, C=City, NCBV=NC Brief Version, P=Parks, RT=Rail Transit, EBO=EB Operations, C=City, PD=Pre-Design, RN=Renovation, T-Tenant*

Building Types: *NR=Non-Residential, R=Residential, E=Education, Rt=Retail, H=Healthcare, I=Industrial, Ho=Hotel, MUR=Multi-Unit Residential, T-Tenant, DU=Dwelling Unit, DH=Detached Home, EH=Existing Home, EH=Existing Home, PB=Public Building, CV=Convention, CM=Community, To=Township*

Auxiliary Tools: *BIM=Building Information Modeling (e.g. Autodesk and Revit); CAL=Calculators (specialized, e.g. GHG emissions, Leaf Area Index etc.); PER=Performance of Building through life-cycle stages, i.e. planning, design, construction, commissioning, operation, management and maintenance of building systems). Note: Examples provided above are for illustrative purposes. BEMA= Building Emergency management Assessment, Fit-UP - New or Remodeling commercial interiors BIQ - Building Intelligence Quotient, ranking tools to increase penetrability of Intelligent Building Technologies (ESC) = Enclosed Shopping Center, (OAR) = Open Air Retail, (LI) = Light Industrial*

Table R-2. Rating System Development

Rating System—Economy	Systems Reviewed	System Mngt.	Approach
Green Star—Australia	LEED-USA	NGO, (I,G)	CB, EO, LCA, >O
Green Globes—Canada	BREEAM-UK	NGO (I,G)	EO, LCA, PO, <O
LEED—Canada	LEED-USA	NGO, (I,G)	CB, EO, LCA, >O
ESGB—China	BREEAM, LEED-USA	G (NGO)	EO, ≤≤O
BEAM—Hong Kong,China	BREEAM	NGO, (I)	CB, EO, LCA, >O
GREENSHIP—Indonesia	LEED-USA, GBI-MAL ,GS-AUS, GM-SIN, BEAM-UK	NGO, (I,G)	CB, EO, >O
CASBEE—Japan	BREEAM, LEED-USA, GB Tool	G (A,I,NGO)	CB, EO, LCA, <O
KGBC—Korea	N.A.	G (I,A,NGO)	EO, <O
GBI—Malaysia	BREEAM, LEED-USA,GS-AUS,GM-SIN	NGO, (A,I,G)	CB, EO, >O
Green Star—New Zealand	GS-AUS	NGO, (I,G)	CB, EO, >O
BERDE—Philippines	N.A.	NGO, (G,A,I)	CB, EO, >O
Green Mark—Singapore	N.A.	G (A,I,NGO)	EO, LCA, <O
CGBL—Chinese Taipei	N.A.	G (NGO)	EO, ≤≤O
Green Globes—USA	BREEAM, GreenLeaf	PS, (I,G)	EO, LCA, PO, <O
LEED—USA	BREEAM	NGO, (I,G)	CB, EO, LCA, >O
LOTUS—Vietnam	GS-AUS, LEED-USA, GBI-MAL, BREEAM, GM-SIN	NGO (G)	CB, EO, >O

Key: N.A.=Not Available,, NGO=Non-Government Organization, G=Government, PS=Private Sector, I=Industry, A=Academe, parenthesis indicate a collaborative partner role. Approach: CB=Consensus-Based, EO=Expert Opinion, LCA=Life Cycle Analysis, O=Openness of rating system relatively, i.e.>≈ more open; <≈less open; <<≈relatively closed. PO: Proprietary Online <O (purchased)

Status of APEC Economy World GBC Affiliates: 1) Established Members (9): Australia; Canada; Japan; Mexico; New Zealand; Peru; Singapore (BCA); Chinese Taipei; USA; 2) Associates (3): China; Thailand; Vietnam; 3) Emerging (4): Chile; Indonesia; Malaysia; and Russia; and 4) Prospective (5): Brunei; Hong Kong, China; Korea, and the Philippines. Papua New Guinea is seeking prospective status with WGBC, as a result of attending the APEC-ASEAN Green Buildings, Green Growth Workshop from Sept. 12-13, 2011 and the Sept. 14, 2011 WGBC-APN Workshop in Singapore.

Table R-3. APEC Rating System Usability

Rating System-Economy	Product Support
Green Star-Australia	I: >A T: >A
Green Globes-Canada	I: <A T: <A
LEED-Canada	I: >A T: >A
ESGB-China	I: N.A. T: N.A.
BEAM-Hong Kong, China	I: <A T: <A
GREENSHIP-Indonesia	I: <A T: <A
CASBEE-Japan	I: <A T: <A
KGBC-Korea	I: N.A. T: N.A.
GBI-Malaysia	I: >A T: >A
Green Star-New Zealand	I: >A T: >A
BERDE-Philippines	I: >A T: >A
Green Mark-Singapore	I: <A T: <A
CGBL-Chinese Taipei	I: N.A. T: N.A.
Green Globes-USA	I: <A T: <A
LEED-USA	I: >A T: >A
LOTUS-Vietnam	I: <A T: <A

Products (illustrative): helpdesk, FAQs, case studies
Key: I=Information; T=Training; N.A.=Not Available:<A=Less Availability; >A=Greater Availability

Table R-4. APEC Rating System Maturity

Rating System—Economy	Rating System Age, Stability, Results	Professional Paths
Green Star—Australia	SA=9 >SS R=409 C=305	Pr, AP
LEED—Canada	SA=9 >SS R=2600 C=470	GA, AP, PR
ESGB—China	SA=5 >SS C=113 (2010)	N.A.
BEAM—Hong Kong, China	SA=15 >SS R=210 C=200	Pro
GREENSHIP—Indonesia	SA=1 <SS R=28 C=0	A, S
CASBEE—Japan	SA=9 >SS R=1400 C=80 (2009)	S (Ar, En)
KGBC—Korea	SA=10 >SS C= 1786 (589 partial)	N.A.
GBI—Malaysia	SA=2 <SS R=181 C=32 (30 partial)	C, F, Co
Green Star—New Zealand	SA=9 >SS C=43	Pr, PA
BERDE—Philippines	SA=1 <SS C=0	PB, P
Green Mark—Singapore	SA=6 >SS R=840 C=100 GFA=15M m2	FM, P, S, Ad
CGBL—Chinese Taipei	SA=4 >SS C=2749	N.A.
Green Globes—USA	SA=7 >SS C=950	P, As
LEED—USA	SA=13 >SS R=28000 C=3740	GA, AP, PR, S
LOTUS—Vietnam	SA=1 <SS C=0	B, AP

Key: SA=System Age = years since launch as of 2011; SS=System Stability, i.e.Testing & Development, & System for Revision; N.A.=Not Available; <=Less stable; >=More stable. Professional Paths: F=Facilitator, Fe=Fellow, A=Associate, AP=Accredited Professional, P=Professional, Pr=Practitioner, Ad=Advanced (e.g. graduate degree), GA=Green Associate, PR=Project Review, S=Specialized, C=Certifier, Co=Commissioner, As=Assessor, FM=Facility Manager; B=Basic, S=Specialized (e.g. type of project, technical focus),e.g. Ar=Architect, En=Engineer.

Buildings: R= No. Registered; C= No. Certified GFA=Gross Floor Area registered in m2 as alternative data on registered buildings

Table R-5. APEC Rating System Communicability

Rating System-Economy	Clarity	Total Points	Certification Scoring (Level/Points or % Required)
Green Star-Australia	M	143	4S: 54-59, 5S: 60-74, 6S: 75-143
Green Globes-Canada	N.A.	1000	1G:15-34%, 2G:35-54%, 3G:55-69%, 4G:70-84%, 5G:85-100%
LEED-Canada	M	100	C: 40-49, S: 50-59, G: 60-79, P: 80-110
ESGB-China	N.A.	57	1 S: 22-34, 2S: 35--45, 3S: 46-57
BEAM-Hong Kong, China	N.A.	100	B: 50-54, S: 55-64; G=65-74; P=75-100
GREENSHIP-Indonesia	N.A.	101	N.A.
CASBEE-Japan	H	100	BF, RC, LCOO2 GWID, BCARML
KGBC-Korea	N.A.	136	Excellent: ≥65, Best: ≥85
GBI-Malaysia	N.A.	100	C: 50-65, S: 66-75, G: 76-85, P: 86-100
Green Star-New Zealand	M	100	4S: 54-59, 5S: 60-74, 6S: 75-100
BERDE-Philippines	N.A.	100	1 S: 50--59, 2S: 60-69, 3S: 70-79, 4S: 80-89, 5S: 90-100
Green Mark-Singapore	N.A.	190	C: 50-74, G: 75-84, G+: 85-89, P: 90-190
CGBL-Chinese Taipei	N.A.	100	C: 12-25, B: 26-33, S: 34-41, G: 42-52, D: 53-100
Green Globes-USA	N.A.	1000	1 Gl: 35-54%, 2GL: 55-69%, 3GL: 70-84%, 4GL: 85-100%
LEED-USA	M	100	C: 40-49, S: 50-59, G: 60-79, P: 80-110
LOTUS-Vietnam	N.A.	150	C: 60-83, S: 84-105, G: 106-150

Key: N.A.=Not Available, Clarity of Results (well-defined, easily communicated) H=High, M=Medium, L=Low; Certification Result Tiers: C=Certified, B=Bronze, S=Silver, G=Gold, P=Platinum, D=Diamond, S=Star, Green Star: 4=Best Practice, 5=Australia or NZ Excellence, 6=World Leadership; CASBEE: BF=BEE Figure, RC=Radar Chart (or Spider Graph), LCCO2 GWIC=Life Cycle CO2 Global Warming Impact Chart, and BCARMLCs: Bar Charts of Assessment Results of Medium-Level (i.e. Level=3) Categories.

Range of Result Products offered by APEC rating systems includes a framed certificate, award letter, plaque, website-published result, relevant logos, and/or a marketing kit.

Table R-6. Rating System Technical Assessment Categories as Percentages of Total

Rating System—Economy	Site	Water	Energy	Materials	IEQ	Other	Other	Certification Results
Green Star—Australia	6	8	20	17	19	29	Man=8, Tra=8, Emi=13	4S: 54-59, 5S: 60-74, 6S: 75-143
Green Globes—Canada	11.5	8.5	38	10	20	12	Project management=5, Emissions=7	
LEED—Canada	26	10	35	14	15	0	None	C: 40-49, S: 50-59, G: 60-79, P: 80-110
ESGB—China	11	11	18	14	11	35	O&M=12, Pre=23	1S: 22-34, 2S: 35-45, 3S: 46-57
BEAM—Hong Kong China	25	12	35	8	20	0	None	B: 50-54; S=55-64
GREENSHIP—Indonesia	17	21	26	14	10	13	Building Environmental Management=13	N.A.
CASBEE—Japan	15	2	20	13	20	30	Other = 30	BF, RC, LCCO2 GWIC, BCARML
KGBC—Korea	5	10	17	15	23	29	CT=4, AP=4, M=7, EE=14	N.A.
GBI—Malaysia	10	12	38	9	21	10	Innovation=10	C: 50-65, S: 66-75, G: 76-85, P: 86-100
Green Star—New Zealand	10	10	25	10	20	33	Man=10, Tra=10, Emi=13	4S: 54-59, 5S: 60-74, 6S: 75-100
BERDE—Philippines	10	6	8	12	13	41	MS=11, TR=13, EM=3,WS=10, HC=4	1S: 50-59, 2S: 60-69, 3S: 70-79, 4S: 80-89, 5S: 90-100
Green Mark—Singapore	0	9	61	0	4	26	EP=22, OGF&I=4	C: 50-74, G: 75-84, G+: 85-89, P: 90-190
CGBL—Chinese Taipei	27	9	28	0	12	24	Health=15, Waste Reduction=9	C: 12-25, B: 26-33, S: 34-41, G: 42-52, D: 53-100
Green Globes—USA	12	13	30	14.5	16	14.5	Project Management=10, Emissions=4.5	N.A.

Rating System—Economy	Site	Water	Energy	Materials	IEQ	Other	Other	Certification Results
LEED—USA	26	10	35	14	15	0	None	C: 40-49, S: 50-59, G: 60-79, P: 80-110
LOTUS—Vietnam	9	10	23	13	13	33	WP=9, A=9, CY=7, Man=8	C: 60-83, S: 84-105, G: 106-150
Average % of Total	14	10	29	11	16	21		

Key: N.A.=Not Available

Percentage values total 100% per rating system

Certification Results, i.e. Tiers and Associated Points Scored: Tiers: C=Certified; B=Bronze; S=Silver; G=Gold; P=Platinum; D=Diamond; S=Star; Green Star: 4=Best Practice; 5=Australia or NZ Excellence; 6=World Leadership; CASBEE: BF=BEE Figure; RC=Radar Chart (or Spider Graph), LCCO2 GWIC: Life Cycle CO2 Global Warming Impact Chart; and BCARMLCs: Bar Charts of Assessment Results of Medium-Level (i.e. Level=3) Categories for CASBEE. Other Categories: BEM=Building Environmental Management (INO); MS=Management (PHI), Man=Management (AUS, NZ); O&M=Operation & Management (CGBL); Tra=Transport (AUS, NZ), TR=Transportation (PHI); WS=Waste (PHI), WP=Waste & Pollution (LOTUS); WR=Waste Reduction (CGBL); WS=Waste (BERDE); Emi=Emissions (AUS, NZ); EP=Environmental Protection (SIN); A=Adaptation & Mitigation (LOTUS); CY=Community (LOTUS); HC=Heritage Conservation (HC); OGF&I=Other Green Features & Innovations; Pre=Preferences (CHI).

CT=Commuting Transportation (KGBC); AP=Atmospheric Pollution; M=Management; EE=Ecological Environment

Table R-7. Rating System Assessment Categories and Illustrative Criteria

Illustrative Assessment Categories and Criteria	Rating System Citation
Site: site selection; stormwater, Heat Island Effect (HIE), light pollution,	LEED-USA
Water: water efficient landscaping, wastewater reuse, water use reduction	LEED-USA
Energy: commissioning, efficient performance, on-site & off-site green power	LEED-USA
Materials: construction, re-use, recycle, rapidly renewable, certified, regional	LEED-USA
IEQ: controls, ventilation, thermal comfort, indoor pollution, lighting, daylighting	LEED-USA
Energy/Efficiency: A/C EE (kW/RT) range= 0.65-0.9 for water & equipment use	Green Mark-Singapore
Energy/Efficiency: Building Energy Intensity (BEI) ≤150kWh/m2-yr.	GBI-Malaysia
Energy/Efficiency: Building Energy System (BES) commissioning by ≥75% maintenance staff	GBI-Malaysia
Energy/Efficiency: Building User Manual for owner mandatory at commissioning	GBI-Malaysia
Energy/Efficiency: Energy Management (policy, audits, targets, metering,schedules)	Green Globes
Energy/Efficiency: Green Plot Ratio per m3 of plants using Leaf Area Index (LAI)	Green Mark-Singapore
Energy/Efficiency: Heat Recover System (HRS) ≥10% capacity	GBI-Malaysia
Energy/Efficiency: Operations manual, preventive maintenance to reduce GHGs	Green Globes
Energy/Efficiency: Reduced CO2eq. Emissions (lighting/HVAC equipment/controls	Green Globes
Energy/Efficiency: Simulation modeling of air distribution (kW/m3/s)	Green Mark-Singapore
Energy/Efficiency: Variable Speed Drive (VSD) ventilation fans	GBI-Malaysia
Energy/Envelope: Envelope Thermal Transfer Value (ETTV)≤40 W/m2 Platinum	BERDE-Philippines
Energy/Envelope: Overall Thermal Transfer Value (OTTV) ≤45 W/m2	BERDE-Philippines
Energy/GHGs: Min. 5% on-site green energy to reduce Greenhouse Gas Emissions	Green Star-NZ
Energy/Lighting: individual lighting zones ≤ 100 m2 for 95% NLA	Green Star-NZ
Energy/Lighting: Lighting Power Density (LPD) ≤2.5W/m2 per 100 Lux maximum	Green Star-NZ
Energy/On-Site Green: Displacement equivalent of ≥ 30kWh/m2/yr.	Green Mark-Singapore
Energy/On-Site Green: solar thermal cooling/concentrated solar power ≥10% cap.	GBI-Malaysia
Energy/Sub-metering: all energy uses ≤100kVA provided with sub-metering	Green Star-Australia
IEA/GHGs: Max. 110kgCO2eq./m2/yr. GHG emissions per ABGR Simulation	Green Star-Australia
IEQ/Acoustics: ≤40dBAeq.overall in ≥95% NLA	Green Star-Australia
IEQ/CO air testing, max. 9 parts per million	LEED-Canada
IEQ/CO2: Install monitoring equipment, maintain CO2 level ≤1000ppm	GBI-Malaysia
IEQ/Formaldehyde air testing max. 26 parts per billion	LEED-Canada
IEQ/Lighting: Daylight Factor (DF) ≥2% at desk height or D Luminance ≥250 Lux	Green Star-Australia

Illustrative Assessment Categories and Criteria	Rating System Citation
IEQ/Lighting: Daylight glare control w/Visual Light Transmittance (VLT) of ≤10%	Green Star-NZ
IEQ/Lighting: High Frequency Ballasts (HFBs) installed in ≥90% NLA	GBI-Malaysia
IEQ/Pollution: Air HazMat, cadmium, lead, formaldehyde per Montreal Protocol	BERDE-Philippines
IEQ/Refrigerants: None or ODP=0 and Global Warming Potential (GWP) ≤100	Green Mark-Singapore
IEQ/Refrigerants: None or Ozone Depletion Potential (ODP)=0 and GWP≤10	Green Star-NZ
IEQ/Refrigerants/cleaning agents: Zero ODP/CFC/HCFC and GWP ≤10	GBI-Malaysia
IEQ/Ventilation: Air Change Effectiveness (ACE) ≥0.95	Green Star-Australia
IEQ/VOCs: TVOCs air testing max. 500 micrograms per m3	Green Star-Australia
Materials/Insulation: ≥90% insulation with certified eco-label w/ NZGBC approval	Green Star-NZ
Materials/LCA: Effect of product on environment (air & water emissions, land)	Green Globes
Materials/LCA: Embedded resources in product (raw materials, energy & water)	Green Globes
Materials/VOCs etc.: ≥90% of new floor coverings certified	Green Star-NZ
Site/HIE: Combined slope/Solar Reflectance Index (SRI) of ≤2.12-78 or≥2.12-29	GBI-Malaysia
Site/Stormwater: Up to 90% stormwater quantity reduction	Green Star-NZ
Transport/Fuel-efficient: ≥80% preferred parking spaces for fuel-eff./pooled vehicles	Green Star-Australia

Table R-8. APEC Rating System Technical Criteria Measurement

Category, Criteria	Measurement Reference	Rating System and Economy
Energy-A/C chiller	AHRI 550/590: plant efficiency permanent M&V	Green Mark-Singapore
Energy-A/C chiller	ASHRAE Guide 22: provision instruments to measure efficiency	Green Mark-Singapore
Energy-BES	ASHRAE Commissioning Guidelines (Advanced) Building Energy System	GBI-Malaysia
Energy-BES analysis	ASHRAE 90.1-2007 Appendix G BES MEP baseline modeling	BEAM, BERDE, LEED-USA
Energy-CO2	ASHRAE 90.1-2007 Appendix G-energy analysis compliance	BEAM-HK, China
Energy-commission	ASHRAE New Building Commissioning	BEAM-HK, China
Energy-commission	CIBSE Air distribution systems, Commissioning Code A	BEAM-HK, China
Energy-controls	CIBSE automatic controls, Code C	BEAM-HK, China
Energy-efficiency	ASHRAE 189 Design for High-Performance Buildings	BERDE-Philippines (PHI)
Energy-efficiency	ASHRAE Advanced Energy Design Guide-prescriptive.	LEED-USA
Energy-efficiency	ASHRAE/IESNA 90.1-2004 A/C min. efficiency exceeded	BERDE-PHI
Energy-efficiency	Energy Star Portfolio Manager IPMVP v.3 or MPR6	LEED-USA & Canada, BEAM
Energy-embodied	ASTM E1991-98 Standard Guide for Env'al LCA-Building MR	BEAM-HK, China
Energy-embodied	ISO 14040:1997 Life cycle analysis-EM principles & framework	BEAM-HK, China
Energy-envelope	ASHRAE 189 Design for High-Performance Buildings	BERDE-PHI
Energy-envelope	ASHRAE 90.1-2007 Appendix G-energy analysis compliance	BERDE-PHI
Energy-envelope	ASTM 2357 or ASTM 1677 Test Methods OTTV ≤ 45 W/m2	BERDE-PHI
Energy-envelope	DOE OTTV Guidelines-Energy Conserving Design of Buildings	BERDE-PHI
Energy-lighting	AS/NZS1680.1:2006 max. 600 Lux; LPD ≤ 2.5W/m2	Green Star-NZ & Australia
Energy-lighting	CIBSE Code for interior lighting-car parks	BEAM-HK, China
Energy-lighting	UNDP-DOE-GEF Manual of Practice on Efficient Lighting	BERDE-PHI
Energy-MEP	ASHRAE Advanced Energy Design Guide-prescriptive.	LEED-Canada
Energy-MEP	ASHRAE/IESNA 90.1-2007 Appendix G/BES performance	LEED-Canada
Energy-MEP	MEP Simulated for project vs. ref. whole building baseline	LEED-Canada
Energy-metering	ASHRAE 114-1996: EnMngtControl Systems Instruments 1987	BEAM-HK, China
Energy-O&M	ASHRAE Guideline 4-Prep. of O&M Building System Documents	BEAM-HK, China
Energy-O&M	BSRIA Guide 1/87:1990 Building Service Res. & Info. Assn.	BEAM-HK, China

Category, Criteria	Measurement Reference	Rating System and Economy
Energy-ventilation	CIBSE AM10 or equivalent	BERDE-PHI
Energy-ventilation	SMACNA Sheet Metal & A/C Contractors Assn IAQ	BEAM-HK,China
Energy-water system	CIBSE water distribution systems, Code W	BEAM-HK,China
IEQ acoustic	ANSI S12.60-2002 ref. accousstical patterns of rooms	BEAM-HK,China
IEQ acoustic	AS/NZS 2107:2000 levels ≤ 95% of NLA/i.e./40dBAeq. overall	Green Star-Australia & NZ
IEQ acoustic	ASTM E 336-97 Airborne sound insulation test method in building	BEAM-HK,China
IEQ acoustic	ASTM E 989-89. Impact insulation Class (IIC)	BEAM-HK,China
IEQ acoustic	CEN EN 12354 Building Acoustics	BEAM-HK,China
IEQ acoustic	DOLE-OSHA Standards	BERDE-PHI
IEQ acoustic	IEC 6080:2004 Integrating-averaging sound level meters≥Type2	BEAM-HK,China
IEQ acoustic	ISO 140-4: 1998 Acoustics-measurement of sound insulation	BEAM-HK,China
IEQ acoustic	ISO 140-7. Tapping machine impact sound transmission testing	BEAM-HK,China
IEQ acoustic	ISO 3382. Acoustics-Measurement of reverberation time	BEAM-HK,China
IEQ acoustic	ISO 717-1. 1996 Part 1 - Airborne sound insulation	BEAM-HK,China
IEQ acoustics	ASTM E 1130-02. Speech privacy test method in open places	BEAM-HK,China
IEQ CO2	ASHRAE 62.1 Outdoor airflow delivery CO2 monitoring	LOTUS-Vietnam
IEQ CO2	ASHRAE 62.1Outdoor airflow delivery CO2 monitoring per	LEED-Canada
IEQ CO2	USGBC, LEED v.2, June 2001 re: conformance at levels 3-5	CASBEE-Japan
IEQ ETS	ASHRAE 62.1-2007Environmental Tobacco Smoke control-	LEED-USA
IEQ ETS	ASTM E779-03Environmental Tobacco Smoke control per	LEED-Canada
IEQ formaldehyde	ISO method 16000-3 Formaldehyde-Air testing per	LEED-USA
IEQ IAQ construction	ASHRAE 52.2-1999 MERV testing ventilation equipment filter	LEED-USA & Canada, BEAM
IEQ IAQ construction	SMACNA IAQ Guidelines 2nd ed. 2007 or 008-2008 Chap. 3	LEED-USA & Canada
IEQ IAQ construction	USEPA Controlling pollutants & sources-Ventilation techniques	BEAM-HK,China
IEQ lighting	AS/NZS 1680 Illuminance/AS 4282 Outdoor Lighting controls	Green Star-NZ
IEQ lighting	AS/NZS1680.1:2006 1.4.4 with Illuminance Level ≤ 400 Lux	Green Star-NZ
IEQ lighting	ASTM D 1003 testing methods for skylight diffuser daylight	LEED-USA & Canada
IEQ lighting	CIBSE Code for interior lighting-(not) normally occupied areas	BEAM-HK,China
IEQ lighting	CIBSE Lighting Guide LG10 Daylighting and window design	BEAM-HK,China

Category, Criteria	Measurement Reference	Rating System and Economy
IEQ lighting	CIE 117-1995 Code for interior lighting-(not)-occupied)	BEAM-HK,China
IEQ lighting	CIE Standard S 008/E Lighting-Indoor Work Places-(un)occupied	BEAM-HK,China
IEQ lighting	CIE Tech. Report-No. 97 Mntc indoor (not)occupied lighting system	BEAM-HK,China
IEQ lighting	IESNA Lighting Handbook, 9th Edition, common rm/plant areas	BEAM-HK,China
IEQ lighting	IESNA Std. 90.1-2007 section 9.4.1.2 for shared occupancy	LEED-Canada
IEQ pollution sensors	ASHRAE 62.1-2004 CO;CO2& NO2 sensors/ @ min. levels	BERDE-PHI
IEQ pollution sensors	ASHRAE 62.1-2007 Testing for NO2, O3, RSP, PM10 Indoors	BEAM-HK,China
IEQ pollution sensors	ASHRAE 62.1-2007 VOC testing- formaldehyde (HCFC), radon	BEAM-HK,China
IEQ security	ASTM E 1665-05a. Office facility protection standard	BEAM-HK,China
IEQ thermal comfort	ASHRAE 55-1992 re: achieving A/C stated design conditions	BEAM-HK,China
IEQ thermal comfort	ASHRAE 55-1992 re: comfort zone control-perimeter, humidity	CASBEE-Japan
IEQ thermal comfort	ASHRAE 55-2004 & ASHRAE RP864 Final report-TC controls	Green Star-NZ &Canada
IEQ thermal comfort	ASHRAE 55-2004 Thermal Conditions for Human Occupancy	LEED-USA & Canada, BERDE
IEQ thermal comfort	ASHRAE 55-2004 Thermal ECs for Human Occupancy	BERDE-PHI, BEAM-HK,China
IEQ thermal comfort	ASHRAE 55-2007 as a basic performance specification	BEAM-HK,China
IEQ thermal comfort	BSRIA Building Research Institute, Indoor Environment Forum 1994	CASBEE-Japan
IEQ thermal comfort	ISO 7726 Ergonomics-thermal environment-measurements 1998	BEAM-HK,China
IEQ thermal comfort	ISO 7730 A/C PMV & PPD indices for thermal comfort, 1995	BEAM-HK,China
IEQ thermal comfort	POEM-O Post-Occupancy Evaluation Method for Office 1994	CASBEE-Japan
IEQ ventilation	ASHRAE 111-Practices for Measurement, testing etc. HVAC sys.	BEAM-HK,China
IEQ ventilation	ASHRAE 129-1997 Air Change Effectiveness (ACE) ≥0.95	Green Star-AUS, GBI-Malaysia

Category, Criteria	Measurement Reference	Rating System and Economy
IEQ ventilation	ASHRAE 140-2001 Testing Building Energy Analysis model	BEAM-HK,China
IEQ ventilation	ASHRAE 62.1-2007 Ventilation for Acceptable IAQ & OAQ	LEED-USA&Canada,BEAM,GBI-M
IEQ ventilation	ASHRAE 62.2-2003 for acceptable IAQ in kitchens-w/ fans	BEAM-HK,China
IEQ ventilation	ASHRAE Fundamentals Handbook Chap. 26:2001	BEAM-HK,China
IEQ ventilation	ASTM E 2267-03 Estimation of flows through habitable areas	BEAM-HK,China
IEQ ventilation	ASTM E 741-00 Tracer gas testing method-Air change-one zone	BEAM-HK,China
IEQ ventilation	ASTM E779-03 Std. Test Methods for Air Leakage	LEED-USA & Canada
IEQ ventilation	CIBSE Applications Manual 10:2005 or AM 13:2000	LEED-USA & Canada
IEQ ventilation	Cole, R.J. et al, GBC'98 Building Assessment Manual	CASBEE-Japan
IEQ ventilation	Cole, R.J., IT Building Environmental Performance Assessment Criteria v.1	CASBEE-Japan
IEQ ventilation	ISO 7726 re: sensor compliance	BEAM-HK,China
IEQ ventilation	ISO 7730 re: PM & PPD indices & specifications	BEAM-HK,China
IEQ ventilation	NIST CONTAM Multi-zone Modeling Software	LEED-USA & Canada
IEQ vibration	ISO 2631-2. Evaluation of human exposure to building shock vibrations	BEAM-HK,China
IEQ VOCs	SCAQMD Rule #1168 & 1113-2005 VOC limits per application	LEED-USA & Canada, BERDE-PHI
IEQ windows	CIBSE Applications Manual-Window Design Principles	BEAM-HK,China
M&R-carpets	CRI green label-certified for carpeting	BERDE-PHI
Table 9: APEC Rating System Technical Criteria Measurement (p.3)		
Category/Criteria	Measurement Reference (esp. if internationally recognized)	Rating System/Economy
M&R-forest	ABGR Australian Building Greenhouse Rating Protocol	Green Star-AUS
M&R-forest	AFPA American Forest & Paper Association; CFPC, or WWF	BEAM-HK,China
M&R-forest	FSC Forest Stewardship Council wood certification-new, recycled	BEAM-HKC, GREENSHIP, BERDE
M&R-forest	FSC Re-used or post consumer recycled or FSC Certified Timber	Green Star-AUS&NZ,LEED-US/CAN
M&R-forest	WWF World Wildlife Fund Compliance	BEAM-HK,China
M&R-hazmats	Montrial Protocol-Air HazMats: Cadmium/lead/formaldehyde per Montreal Protocol	BERDE-PHI
M&R-labels	ISO 14001 certification requirements	GREENSHIP-Indonesia
M&R-recycled	ISO 14021 EPD Type II	LEED-USA & Canada

Category, Criteria	Measurement Reference	Rating System and Economy
M&R-refrigerants	ASHRAE Guideline 3-1996, Halogenated refrigerant emissions	BEAM-HK,China
M&R-refrigerants	CIBSE 2000 ISBN 0900953993	BEAM-HK,China
M&R-refrigerants	USEPA re: tradeoffs involved to reduce ODS vs. GWP	BEAM-HK,China
M&R-spatial	ASTM E 1334-95 Serviceability of Office Occupant Changes	BEAM-HK,China
M&R-spatial	ASTM E 1692-95	BEAM-HK,China
M&R-spatial	ASTM E 1697-95 Standard Classification & Practice-Offices	BEAM-HK,China
M&R-spatial	CFPC Certified Forest Products Council Project Toolkit	BEAM-HK,China
M&R-spatial	IEA International Energy Agency (IEA) Annex 31 Buildings	BEAM-HK,China
M&R-spatial	ISO 1006 Building in construction-modular construction 1983	BEAM-HK,China
M&R-spatial	ISO 2828 Modular coordination-principles & rules	BEAM-HK,China
M&R-waste	Athena Eco-Calculator for assemblies, demolition waste	Green Globes-US
Management-building	ASHRAE Commissioning Guideline 1-1996 (mech. Services)	Green Star-AUS & NZ
Management-building	CIBSE Commissioning Codes (BMS/mechanic/electric/hydraulic	Green Star-AUS
Management-building	CIBSE Commissioning Codes incl.report, O&M manual, training	Green Star-NZ
Management-design	ASHRAE & CIBSE (unspecific) to establish design basis	BERDE-PHI
Management-envir.	CSIRO 1999 Urban Stormwater Best Practice EnvMgt Guidelines	Green Star-AUS
Management-envir.	ISO 14000 certification, Staff with GM-professional certification	Green Mark-Singpaore
Management-envir.	ISO 14000 certification: developer, main builder, M&E, architect	Green Mark-Singpaore
Management-envir.	ISO 14000 certification: Envir. Management practices	Green Mark-SING, LOTUS-Vietnam
Management-envir.	ISO 14001, EHSMS 18000 references	BERDE-PHI
Management-envir.	ISO EMS accreditation of EMP provided and Contractor is valid	Green Star-AUS & NZ
Management-project	ISO, OSHA, or LEED-AP Team qualifications	BERDE-PHI
Management-site	ASHRAE (no number provided): technical site assessment	BERDE-PHI
Quality of Service Q2	NPO 2005 Optical Fiber Promotion Council-IT equip. installation	CASBEE-Japan

Category, Criteria	Measurement Reference	Rating System and Economy
Quality of Service Q2	NPO 2006 re: levels 3-5 office IT equipment installation	CASBEE-Japan
Site-land reuse	ASTM E 1903-97 Phase II	BERDE-PHI
Site-light pollution	ASHRAE/IESNA Standard 90.1-2007-exterior classified zoning	LEED-Canada
Site-light pollution	CIBSE 126:2007 Environmental Considerations External Lighting	BEAM-HK,China
Site-light pollution	CIBSE Chartered Institution of Building Services Engineers2003	BEAM-HK,China
Site-light pollution	CIE International Commission on Illumination CIE 150:2003	BEAM-HK,China
Site-light pollution	IESNA RP-33 per exterior zone requirements	LEED-Canada
Site-light pollution	ILE Institution of Lighting Engineers Obtrusive Light Guide	BEAM-HK,China
Site-light pollution	ILE Technical report No. 5, 2001	BEAM-HK,China
Site-microclimate	British Building Research Station 1972 Wind-Beaufort Number	BEAM-HK,China
Site-pollution	USEPA 2003 Construction General Permit/Pollution Discharges	LEED-Canada
Site-watershed	ISO EMS Site ecology enhancement, site assessment	Green Globes-US
Waste & Pollution	Montreal Protocol GWP≤1700 & ODP≤0.05, low HCFCs & HFCs	LOTUS-Vietnam
Water-efficiency	ASME A112.18.1-2005-fixture, fitting & appliance specs	LEED-USA & Canada
Water-efficiency	BSRIA Greywater and rainwater systems report 13034/1:1997	BEAM-HK,China

Chart R-1. Commercial Green Building Trends in APEC, 1

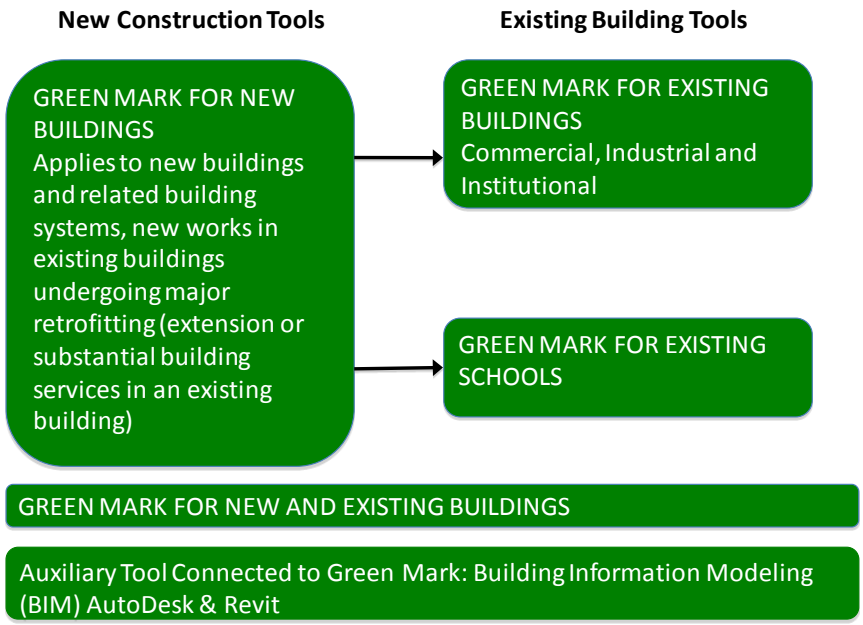


Chart R-2. Commercial Green Building Trends in APEC, 2

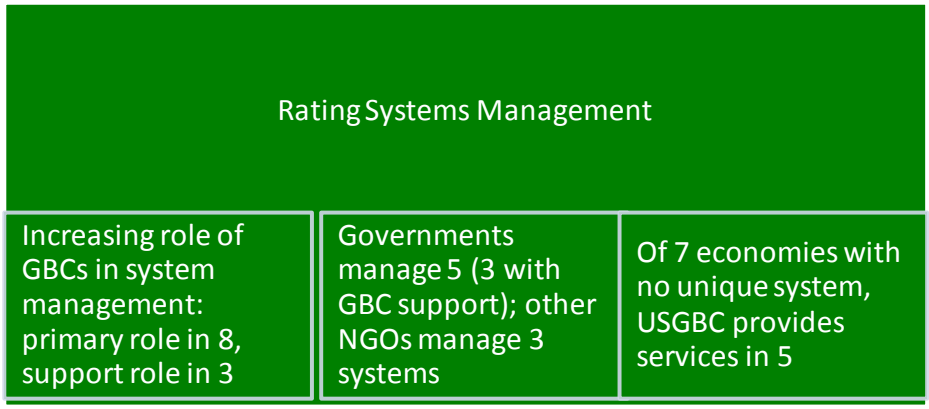


Chart R-3. Commercial Green Building Trends in APEC, 3

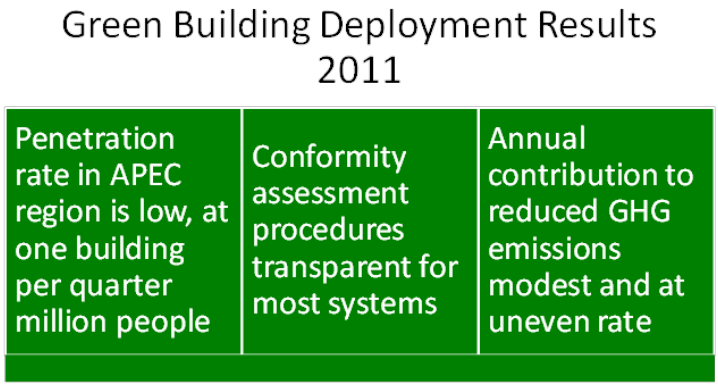
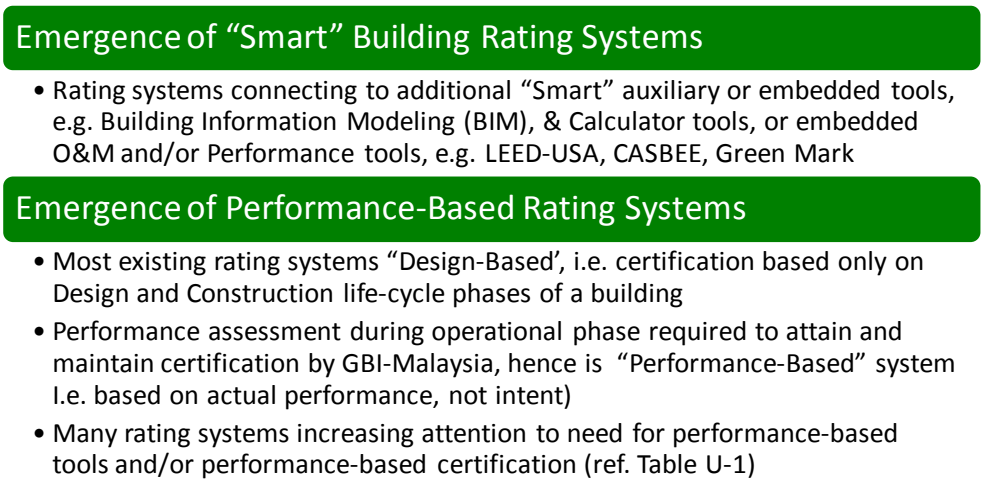


Chart R-4. Commercial Green Building Trends in APEC, 4



Annex S. APEC Economy Profiles

Table S-1. APEC Economy Profiles: Five Key APEC Economies

Data Category Basic Profile	Australia	Canada	Japan	Singapore*	United States
Total GDP (US$B, 2009)	795	1262	4200	181	14100
GDP/capita/year (US$K)	37383	37087	32700	38955	46000
GDP growth (%, 2010)	1.3	-2.5	-5.3	-1.3	-2.6
Population (M)	21.5	33.8	126.8	4.7	310.2
Urban population (%)	88.9	80.5	66.6	100	82
Total area (sq. miles/sq. km, millions)	3.0/7.4	3.9/10	0.15/0.38	.27K/.7K	3.8/9.8
Population density (per sq. mi/sq. km)	7.3/2.8	9.6/3.7	901/348	17.7K/6.8K	88/34
Range of Latitudes (S or N of equator)	10-40° S	42-75° N	26-46° N	2° N	25-48° N
Climate zone(s)	Tropic/Sub-Tropic	Temperate	Sub-Tropic/Temperate	Tropic	Sub-Tropic/Temperate
Capital city	Canberra	Ottawa	Tokyo	Singapore	Washington D.C.
Total exports (US$B)	150	314	205	205	1050
Key export destinations	CHI, JAP, KOR, IND	USA, UK, CHI	CHI, USA, KOR, THAI	HKO, MAL, CHI, INO	CAN, JAP, MEX
Primary export	Minerals, metals	Transport equip.	Motor vehicles	Metal products	Motor vehicles
Total Imports (US$)	153	318	179	179	1600
Key import economies	CHI, USA,JAP, THA	USA, CHI, MEX	CHI, USA, AUS	USA, MAL, CHI, JAP	CHI, CAN, JAP, MEX
Major international organization memberships	APEC, UN, OECD	APEC, UN, OECD, NAFTA	APEC, UN, OECD	APEC, ASEAN, UN, WTO	APEC, UN, OECD, WTO

Source: World Almanac Books, 2010. World Almanac and Book of Facts 2011, New York

**ASEAN Member*

Table S-2. Profiles of Other Large APEC Economies

Data Category	China	Chinese Taipei	Hong Kong, China	Korea	New Zealand	Russia
Total GDP (US$B, 2009)	8700	735	300	1400	115	2100
GDP/capita/year (US$)	6600	32000	42800	28100	27400	15100
GDP growth (%, 2010)	9.1	-1.9	N.A.	0.2	-1.6	-7.9
Population (M)	1330	23	7	49	4.3	139
Urban population (%)	46	N.A.	N.A.	83	86	73
Total area (sq. miles/sq. km, millions)	3.7	13.9K/36K	0.4K/1.08	38.5K/0.1M	0.1/0.27	6.6
Population density (per sq. mi/sq. km)	360/139	1848/714	N.A.	1300/502	41/16	22/8.5
Range of Latitudes (S or N of equator)	18-53° N	23-26° N	23° N	32-38° N	34-57° S	50-80° N
Climate zone(s)	Tropic-Temperate	Sub-Tropic	Tropic	Sub-Tropic	Sub-Tropic/Temperate	Temperate
Capital city	Beijing	Taipei	Hong Kong	Seoul	Auckland	Moscow
Total exports (US$B)	1200	203	N.A.	374	25	303
Key export destinations	USA/HKO/JAP/KOR	CHI/HKO/USA/JAP	N.A.	N.A.	AUS/USA/CHI/JAP	NET/ITA/GER/CHI
Primary export	metals	garments	garments	electronics	wood/paper	fossil fuels
Total imports (US$B)	954	173	N.A.	318	24	192
Key import economies	JAP/HKO/KOR/USA	JAP/CHI/USA/KOR	N.A.	N.A.	AUS/CHI/USA/JAP	GER/CHI/UKR
International organization memberships	APEC/UN/WTO	APEC	APEC	APEC/OECD/UN/WTO	APEC/OECD/UN/WTO	APEC/UN/CIS
Source: World Almanac Books, 2010. The World Almanac and Book of Facts 2011, New York, USA						

Table S-3. APEC Economy Profiles: APEC Economies with ASEAN Membership (6)

Data Category	BRU	INO	MAL	PHI	THA	VNM
Total GDP (US$B, 2009)	15	963	384	324	540	257
GDP/capita/year (US$)	38209	4000	14900	3240	8200	2900
GDP growth (%, 2010)	0.5	-2.6	-1.7	-2.6	-2.2	5.3
Population (M)	0.4	243	28.3	99.9	67	89.6
Urban population (%)	75	44	71	49	34	30
Total area (sq. miles/sq. km, millions)	2.2K/5.8K	0.7/1.9	0.13/0.33	3.8/9.8	0.2/0.5	0.13/0.33
Population density (per sq. mi/sq. km)	193/75	374/134	223/86	88/34	340/131	748/289
Range of Latitudes (S or N of equator)	4-5° N	12° S - 6° N	7-15° N	6-19° N	6-21°	8-23° N
Climate zone(s)	Tropic	Tropic	Tropic	Tropic	Tropic	Tropic
Capital city	Bandar Seri Begawan	Jakarta	Kuala Lumpur	Manila	Bangkok	Hanoi
Total exports (US$B)	8	120	158	1050	154	57
Key export destinations	CAN/MEX/JAP	JAP/SIN/USA/CHI	SIN/USA/CHI/JAP	CAN/MEX/JAP	USA/CHI/JAP/HKC	USA/JAP/CHI/AUS
Primary export	oil	oil and gas	rubber/palm oil	electronics	textiles/garments	garments
Total imports (US$B)	2	84	119	1600	119	65
Key import economies	CHI/CAN/MEX/JAP	SIN/CHI/JAP/MAL	SIN/CHI/JAP/USA	CHI/CAN/MEX/JAP	JAP/CHI/MAL/USA	CHI/SIN/JAP/TAI
Major international organization memberships	APEC/ASEAN/UN	APEC/ASEAN/UN	APEC/ASEAN/UN/WTO	APEC/ASEAN/UN/WTO	APEC/ASEAN/UN/WTO	APEC/ASEAN/UN/WTO

Table S-4. APEC Economy Profiles: Other APEC Economies (4)

Data Category, Basic Profile	Chile	Mexico	Peru	Papua New Guinea
Total GDP (US$B, 2009)	242	1500	251	14
GDP, capita, year (US$K)	14600	13200	8500	2300
GDP growth (%, 2010)	-1.7	-6.5	0.9	4.5
Population (M)	16.7	112.5	29.9	6.1
Urban population (%)	89	78	77	13
Total area (sq. miles, sq. km, millions)	0.3	0.8	0.5	0.2
Population density (per sq. mi/sq. km)	58/22	159/58	61/23	35/13
Range of Latitudes (S or N of equator)	18-55° S	14-32° N	0-18° S	3-12° S
Climate zone(s)	Tropic/Temperate	Tropic/Sub-Tropic	Tropic	Tropic
Capital city	Santiago	Mexico City	Lima	Port Moresby
Total exports (US$B)	54	230	27	4
Key export destinations	CHI/JAP/KOR/BRA	USA/CAN/GER	CHI/CAN/JAP/CHL	AUS/JAP
Primary export	minerals	minerals	minerals	minerals
Total Imports (US$)	40	235	21	3
Key import economies	CHI/ARG/BRA/KOR	USA/CHI/KOR	USA/CHI/MEX	AUS/CHI/SIN/USA
Major international organization memberships	APEC/UN/OAS	APEC/UN/WTO/NAFTA	APEC/UN/OAS	APEC/UN/WTO

Source: World Almanac Books, 2010. The World Almanac and Book of Facts 2011, New York, USA

Annex T. Design-Based vs. Performance-Based Rating Systems

Table T-1. Building Life Cycle Phases in APEC Rating Systems: Design, Construction and Operation

Member Economy	Name of System	Design	Opera-tions	Description
Australia	Green Star	NC	(GS-P)	3-stage GS tools clearly linked, complementary, track 9 categories e.g. EWM . Cite carbon metrics. Though performance tool is under development, no information on how this tool may be used to monitor building performance, and in particular whether performance monitoring will be required to obtain or maintain certification.
Canada	Green Globes	GG-D	GG-BB	RS initial design for online data transfer from D&C to O analysis, EWM LCA. Credits assigned at design and commencing construction. Performance monitoring not required for certification.
Canada	LEED	NC	EB:O&M	Design-based system, EB tool added. EB measures O&M & improvements on NC consistent scale. Recertification not required to maintain certification status of building.
China	ESGB	NC	EB	Cite carbon metrics, which requires monitoring. Performance a high priority, though not clear whether ongoing monitoring is required for certification. Details of tools not available.
Hong Kong China	BEAM-Plus	NB	EB	BEAM Plus integrates D, C, O&M, renovation & decommissioning of bldgs. Unknown whether ongoing performance monitoring is done and/or required for certification.
Indonesia	GREENSHIP	NC	(EB)	EB to be integrated with NC, emphasis on efficiency, occupants, GCC metrics. Citation of carbon metrics requires monitoring. Performance a high priority, though not clear whether ongoing monitoring will be required for certification.
Japan	CASBEE*	NC Tool-1	EB Tool-2	Initial design of system for seamless interface of life-cycle tools, increasingly online, includes EWM LCA. Cite Life Cycle CO2-equivalent (LCCO2) statistics for operational buildings, which requires ongoing performance monitoring, although not clear if required to maintain certification.
Korea	KGBC	NC	(EB)	Design of EB tool to be complementary to office building assessment tool . Unknown whether performance data will be collected and/or required for certification.
Malaysia	GBI	NRNC	NREB	Only clearly performance-based system. Recertification every 3 yrs. to encourage sustainable building life-cycle O&M.

Member Economy	Name of System	Design	Opera-tions	Description
New Zealand	Green Star	NC	(GS-P)	3-stage GS tools clearly linked. GS-P critical to increased efficiency of sector. Cite carbon metrics. Though performance tool is under development, no information on how this tool may be used to monitor building performance, and in particular whether performance monitoring will be required to obtain or maintain certification.
Philippines	BERDE	NC	(EB)	EB to provide owners & operators entry to (re-)certification process. No information as to whether performance monitoring will be required for certification of new or existing buildings.
Singapore	Green Mark*	NRB	EB	Initial design of system integrates environmental design and performance best practices, esp. facilities management. Cite carbon metrics, which requires monitoring. Performance a high priority, though not clear whether ongoing monitoring is required for certification.
Chinese Taipei	CGBL	N.A.	N.A.	Cite carbon metrics, which requires monitoring. Performance a high priority, though not clear whether ongoing monitoring is required for certification. Details of tools not available.
USA	Green Globes	GG-NC	GG-EB	RS initial design for online data transfer from D&C to O analysis, EWM LCA. Credits assigned at design and commencing construction. Performance monitoring not required for certification.
USA	LEED-USA* [a]	NC	EB:O&M	Design-based system, EB tool added. EB measures O&M & improvements on NC consistent scale. Recertification not required to maintain certification status of building.
Vietnam	LOTUS	NC	(EB)	EB tool development linked to certification validation, efficiency & carbon metrics.

Key: Parentheses indicates that EB-equivalent tool is UD (under development). RS=Rating System; NC=New Construction; NB=New Building; NRNC=Non-Residential NC; NRB=Non-Residential Building; EB=Existing Building; GS-P=Green Star-Performance; BB=BOMA BESt; EB:OM=EB: Operations & Maintenance; NREB=Non-Residential Existing Building; TWG=Technical Working Group; BM=Building Management; BO=Building Operator; D=Design; C=Construction; AB=As Built; O=Operations; M=Management' P=Performance; FM=Facility Management; EWM=Energy, Water & Materials; LCA= Life Cycle Analysis

Note: Key Stakeholders in Building Life Cycle Phases: Design & Construction: Building Owner, Design Team, Contractor Operations & Maintenance/Performance Assessment: Building Owner, Building Manager, Facility Manager

**RS management encourages use of connected BIM (Building Information Modeling e.g. Autodesk) tools as a "Smart" RS. The BIM context includes BCI=Building Component Information (e.g. manufacturer, model, serial number, specifications, maintenance history), VDC=Virtual Design & Construction Project Manager; PLM=Product Lifecycle Management, FCI=Facility Condition Index; BIM Definition: The process of generating and managing building data during its life-cycle. BIM covers geometry, spatial relationships, light analysis, geographic information, quantities and properties of building components (e.g. manufacturers' details). BIM can be used to demonstrate the entire building life cycle, including the processes of design, construction and facility operation. Quantities and shared*

properties of materials can be extracted easily. Scopes of work can be isolated and defined. Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. Dynamic information of the building, such as sensor measurements and control signals from the building systems, can also be incorporated within BIM to support analysis of building operation and maintenance. Components can carry attributes for selecting and ordering them automatically providing cost estimates and well as materials tracking and ordering. This method of management is more practical and efficient. Uncertainties in the design phase can be fixed so that they do not occur during the actual construction phase, with details also available to facility managers during the operational phase. Modern BIM tools may also be referred to 4-D CAD, with roots in three-dimensional (3-D) computer assisted drawing (CAD), augmented by definition of objects parametrically, i.e. the objects are defined as parameters and relations to other objects, so that if a related object changes, this one will too. The 3-D version has its roots in the 1980s as a "virtual building" tool developed initially by architects. The integrated information concept can also extend past the pre-design, design, construction, and operational stages to the demolition of a building, including materials recycling.

References: www.todaysfacilitymanager.com; www.en.wikipedia.org/BIM; www.vgbc.org/ LOTUS EB Consultation Paper-Scope.

[a]*LEED-USA has a Building Performance Partnership pilot program to obtain building performance data after buildings are built or retrofitted. In 2012, LEED will request performance data for some attributes from its certified buildings but has no plans to require performance data for the certification process for new or existing buildings.*

Blue—Design-based only
Green—Definitely Performance-based
Orange—Moving towards performance-based
Purple—carbon metrics, have performance data, but not clear if used in certification process
Turquoise—No information on whether performance data is collected and/or whether it is used in the certification process

Annex U. APEC Membership in ISO Building-Related Technical Committees

Table U-1:APEC Member Roles in ISO Green Building-Related Technical Committees

Economy	TC59	TC146	TC180	TC203	YC205	TC207	TC235	TC242	JTC2	TC257
Australia	P	O	S		P	P		P	O	
Brunei Dar.										
Canada	O	P				S		P	P	
Chile		O		O	O	P	P			
China	P	P	P	P	P	P	P	P	P	S
Hong Kong China	O	O	O		O	O		O	O	O
Indonesia	O	O	O			O	O			
Japan	P	P	O	P	P	P	O	P		P
Korea	P	P	O	P	P	P	P	P	P	
Malaysia		O		O	O	P	P	O		
Mexico	O		O			P	O	P		
New Zealand	O		O		O	P				
PNG										
Peru						P	P			
Philippines		P	O	O		P				
Russia	P	P	P	P	P	P		P	P	
Singapore	O	O			O	P		P	O	
Chinese Taipei										
Thailand		O	O		O	P	P		O	
United States	P	P	P	O	S	P		S	P	P
Vietnam	O	O			O	P				
Total by Status	6P, 7O	7P, 8O	1S, 3P, 8O	4P, 4O	1S, 5P, 7O	1S, 15P, 2O	6P, 3O	1S, 8P, 2O	5P, 4O	1S, 2P, 1O
Total	13	15	12	8	13	18	9	11	9	4

Key: ISO=International Organization for Standardization; JTC=Joint Technical Committee; TC=Technical Committee; S=Secretariat; P=Participant membership; O=Observer membership

Technical Committee No.	*Committee Title and/or Scope*	*Year Established*
TC59	*Buildings and civil engineering works (LCA-related)*	*1947*
TC146	*Air quality-measurement tools for pollutants and meteorological parameters*	*1971*
TC180	*Solar energy*	*1980*
TC203	*Technical energy systems and energyware balances—basic concepts and methods*	*1991*
TC205	*Building environment design for acceptable indoor environmental quality and practicable energy efficiency*	*1992*
TC207	*Environmental management*	*1993*
TC235	*Project Committee: Standardization in the field of rating services*	*2007*
TC242	*Energy management-measurement system validating continual energy usage*	*2008*
JTC2	*Energy efficiency and renewable energy sources*	*2009*
TC257	*General technical rules for determination of energy savings (regions, projects etc.)*	*2010*

Note: Membership Status of APEC Economies in ISO: Member Body: 18 APEC Economies, Correspondent Member: Brunei Darussalam and Papua New Guinea, Nonmember: Chinese Taipei