Informal notice 4

ENGLISH ONLY

Economic Commission for Europe

Committee on Housing and Land Management

Seventy-fourth session
Geneva, 7 and 9 October 2013
Item 5(a) of the provisional agenda
Review of the implementation of the programme of work 2012-2013
Sustainable housing and real estate markets

Greening the real estate market: An analysis of green building certification systems

Note by the Real Estate Market Advisory Group

Summary

This report presents an analysis of systems used around the world to certify a building as green, or environmentally sustainable. It compares 30 such certification systems and compares them using the criteria of the United Nations Global Compact Cities Programme.

The report includes proposals for the creation of guidelines for the certification of green buildings. The report was prepared by the Real Estate Market Advisory Group at the request of the Committee during its seventy-third session (ECE/HBP/170, para. 53).

The Committee is invited to take note of the information contained in this draft report.

List of Abbreviations

REM	UNECE Real Estate Market Advisory Group
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNGCCP	United Nations Global Compact Cities Programme

NOTE

This report was prepared by the United Nations Economic Commission for Europe (UNECE) Real Estate Market Advisory Group, based on work done by Mr. Michele Melchiorri at the Politecnico di Milano.

I. Introduction

This paper provides a comparison of 30 international certification systems for sustainable buildings. It assesses how the criteria listed in these systems relate to the ecology circle of the United Nations Global Compact Cities Programme (UNGCCP), which is part of the United Nations Global Compact. The purpose of the document is to help Governments to understand and use these certification systems, in line with *Policy Framework for Real Estate Markets* (UNECE 2010), which recommends "to promote the greening of real estate markets, through developing innovative solutions for the sector.

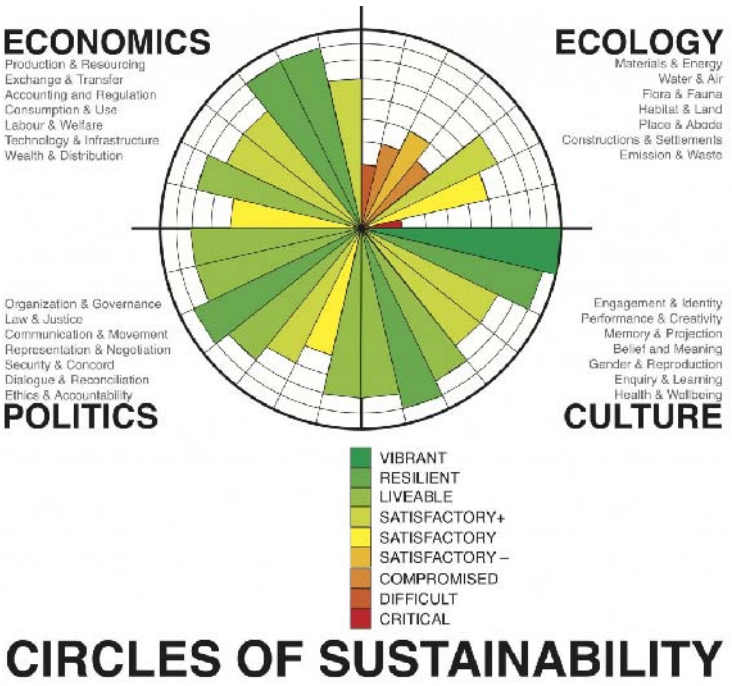
The United Nations Global Compact is a framework which encourages businesses worldwide to adopt sustainable and socially responsible policies. It has two main goals: to provide guidance to achieve the Millennium Development Goals and to propose ten core principles businesses can follow to promote sustainable cities. These principles are structured around four broad topics: human rights, labour, environment and corruption.

The United Nations Global Compact Cities Programme (UNGCCP) was launched in 2002. The UNGCCP is a programme under which cities can join the Global Compact in order to promote the promotion and implementation of Global Compact principles. The UNGCCP currently has more than 70 participants including local, regional and state governments in 29 countries[1] (United Nations Global Compact Office 2013).

The UNGCCP evaluates urban sustainability with the "Urban Profile Process", an "interpretative description of the sustainability of an urban region". The resulting urban profile is built upon several qualitative criteria based on the four circles of sustainability, with each circle divided into components. Figure 1, taken from UNGCCP (2013), shows the results of this process applied to Melbourne, Australia.

[1] Argentina, Brazil, Canada, Chile, China, Columbia, France, Germany, India, Israel, Italy, Japan, Jordan, Malta, Mexico, Mongolia, the Netherlands, Nigeria, Peru, Poland, the Republic of Korea, Serbia, South Africa, Spain, Sweden, Turkey, the United Kingdom and the United States of America.

Figure 1: The UNGCCP Urban Profile Process (applied to Melbourne)



This study compares the different indicators for green building certification systems worldwide. It divides these indicators into categories which correspond to the components of the "ecology" circle of the global compact. The study thus compares green building certification systems using, as a framework to group and categorize the indicators, the components of the UNGCCP ecology circle.

II. Certifying building sustainability

Buildings account for about 40% of global energy consumption, 40% of global resource consumption and 25% of global water consumption and emit approximately one-third of greenhouse gasses (UNEP, 2013). Buildings are both generators of greenhouse gas emissions and end-users of energy, goods and services, the production of which generates emissions elsewhere, primarily from fossil fuel combustion. Just as buildings contribute to climate change, they can offer a solution to climate change problems. In their Fourth Assessment Report, the Intergovernmental Panel for Climate Change (2007) identified the building sector as the sector where the greatest improvements for climate change mitigation could be made.

Policy tools to make new and existing buildings more energy efficient are being developed by international institutions and national governments. These tools include regulations, policy guidelines and building performance rating systems.

Since the 1990s, numerous systems to evaluate sustainable performance of buildings have been developed worldwide. The United Nations Environment Programme (UNEP) recently counted over 60 different such systems (Labbé, 2012). Many systems are regional or national, while only a few are internationally recognized and applied.

Certification systems for green buildings are a family of assessment tools based on multi-criteria analyses. These systems assess a number of indicators that are organized by topic. Typically, a score is assigned to each indicator or criterion; the weighted sum of these scores yields rates the sustainability of the building.

Table 1 shows the systems analysed and the countries where they are the most prevalent. Of the 30 systems assessed here, 17 are prevalent in the UNECE region.

Table 1: Certification systems applied worldwide

Name of system	Country/countries where system is prevalent	Note
Green building certification systems prevalent in the UNECE region		
BREEAM	Austria, Belgium, Czech Republic, Finland, France, Germany Ireland, Hungary, Italy, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Russia, Serbia, Spain, Sweden, Turkey, United Kingdom	
BREEAM-NOR	Norway	Based on BREEAM
Build it Green	United States	
DGNB	Austria, Bulgaria, Czech Republic, Denmark, Germany, Luxembourg, Montenegro, Poland, Serbia, Slovakia, Ukraine	
Green Globes	Australia, Canada, Ireland, China, United Kingdom, United States	
HQE	Algeria, Belgium, France, Italy, Luxembourg	
ITACA	Italy	
ITACA Piedmont	Italy	Based on ITACA
Labs21	United States	
LEED	Austria, Belgium, Brazil, Czech Republic, Finland, France, Germany, Hungary, India, Ireland, Italy, Luxembourg, Mexico, Montenegro, Netherlands, Norway, Poland, Portugal, Russia, Serbia, Spain, Sweden, United Kingdom, United States, Turkey	
LEnSE	Austria, Belgium, Czech Republic, Germany, Italy, Switzerland, United Kingdom	
LiderA	Portugal	
Miljöbyggnad	Sweden	
Minergie	Switzerland	
PromisE	Finland	
SB-TOOL	Argentina, Australia, Austria, Brazil, Canada, Chile, China,	

	Czech Republic, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Malaysia, Mexico, New Zealand, Norway, Poland, South Africa, Spain, United Kingdom, United States	
TQB	Austria	
Other green building certification systems		
BASE Tool	New Zealand	Based on Green Star
BCA Green MarkV2	Singapore	
BCA Green MarkV3	Singapore	
BERDE	Philippines	
CASBEE	Japan	
Estidama	Jordan, United Arab Emirates	
GBI Malaysia	Malaysia	Based on GBI
Green Star Australia	Australia	Based on Green Star
HK-BEAM	China (including Hong Kong)	
IGBC Green Homes	India	
QSAS	Qatar	
SBAT	South Africa	
TERI GRIHA	India	

III. Research methods

This study compares 30 certification systems in use worldwide to rate multifamily residential buildings or, for some systems for which specific criteria for multifamily residential buildings were not freely available, for office buildings; these systems use various indicators to assess sustainability. For each certification system, indicators have been organized into thematic subgroups. This organization is based on the system as introduced by Liu et al (2010). Not all methods have indicators which fall into every subgroup.

These subgroups have been linked to components of the ecology circle of the UNGCCP Urban Profile Process. Table 2 two shows the link between subgroups of indicators and the components of the UNGCCP. (The UNGCCP ecology component “flora and fauna” is not considered in this study, as it does not directly relate to commonly used building certification system indicators.)

Table 2: UNGCCP ecology components and subgroups

UNGCCP Component	Subgroups of indicators for green certification systems
Materials & Energy	Material & resources
	Energy & atmosphere; renewable energy
Water & Air	Water efficiency
	Indoor environmental quality, health & wellbeing
Habitat & Land	Location & linkages, transport
	Sustainable sites, land use & ecology
Place & Abode	Management, maintainance, operation & ownership
Construction & Settlements	Innovation & design process, green features and regional relevance
	Awareness & education of users
Emission & waste	Pollution, emissions, waste & recycling

Materials & Energy

This component covers materials and energy use, with a focus on renewable energy. Considerations related to "materials and resources" may include, for example: materials use, recycle and reuse; source, quality and performance of insulation and other materials; and lifecycle costs (with a specific set of parameters in the case of wooden constructions). Considerations related to "energy and atmosphere" and "renewable energy" may include: summer and winter energy sources; energy impact: heating and cooling primary energy sources; energy metering: on-site energy generation; optimized energy performance; climate-responsive building design; energy baseline management; peak-load management; energy efficient features; district heating; natural ventilation; solar gains; and energy used in construction.

Water & Air

This component covers water and air use and treatment; many of these factors relate to user comfort. Considerations related to "water efficiency" may include: water efficiency in landscaping and the provision of potable water; water use, reduction and saving; the use and treatment of rainwater; related technologies and device; the efficiency of water equipment; and water quality and access. Considerations related to "indoor environmental quality" and "health and wellbeing" may include: the quality of air and views; the amount of perceivable sunlight; the level of glare and shade; the level of indoor hazardous pollutants; noise levels; thermal comfort; ventilation; ventilation devices; space per resident; room acoustics and vibrations; access for the disabled; safety and security; moisture levels; and volatile compounds and smoke control.

Habitat & Land

This component considers the relation of buildings with their surroundings. Considerations related to "locations and linkages to transport" may include: proximity to facilities and infrastructure networks; alternative transport options; shared tenant facilities; pedestrian and cyclist safety; parking areas; community

interactions; a transportation impact assessment; and barriers to transport. Considerations related to "sustainable sites, land use and ecology" may include: site selection and location (e.g. the use of brownfields or newly urbanized land); the relationship with the local environment; ecological land value; impact on biodiversity; contaminated soil treatment; land use; the proportion of sealed surfaces (such as pavement); factors related to cultural heritage and identity; and the risk of environmental hazards.

Place & Abode

This component assesses the operation of the building. Considerations may include: the controllability and adaptability of devices, appliances and systems (such as lighting and ventilation); monitoring pollution, energy water and resource flow; refurbishment plans (for both the structure and appliances); maintenance management; functionality and usability; energy efficient equipment; building user guides; lifecycle and service planning; documentation for facility management; lifecycle cost analysis; leak detection; information systems; occupancy verification; buildings with mixed uses; and building reuse.

Construction & settlements

This component includes architectural solutions, planning implications, innovations in design, relevant features in the building process and the relationship between building performance and user behaviour. Considerations related to the "innovation and design process, green features and regional relevance" may include: innovation in design; floor space design; barrier-free planning; modular and standardized design; a comprehensive project brief; an advanced commitment or commissioning plan; urban design integration; design for durability and disassembly; green features; and the environmental efficiency of the building. Considerations related to the "awareness of users" may include: documentation of building material; occupant control of settings; humidity and natural light control; publication of building information; a building user guide; and a homeowner manual (with an explanation of features and benefits).

Emission & waste

Considerations in this component may include: heat islanding; light and noise pollution; air pollution; waste generation; waste treatment; water onsite recycling; waste recycling; CO_2 and NO_x emissions; ozone layer protection; the environmental impacts of building products; composting and storage of waste; construction waste management; materials recovery facility; and hazardous waste treatment.

IV. Comparison of green building certification systems

Certification systems vary greatly in the weight assigned to indicators associated with the various UNGCCP components. Figure 2 shows the relative weight (out of 100%) given to each UNGCCP component in each of the certification systems studied. Table 2 shows summary information about the weight given to the UNGCCP components. Figures 3 through 8 show the weight attached to each of the subgroups in the certification systems studied.

Figure 2: Weight given to UNGCCP ecology components by green building certification systems

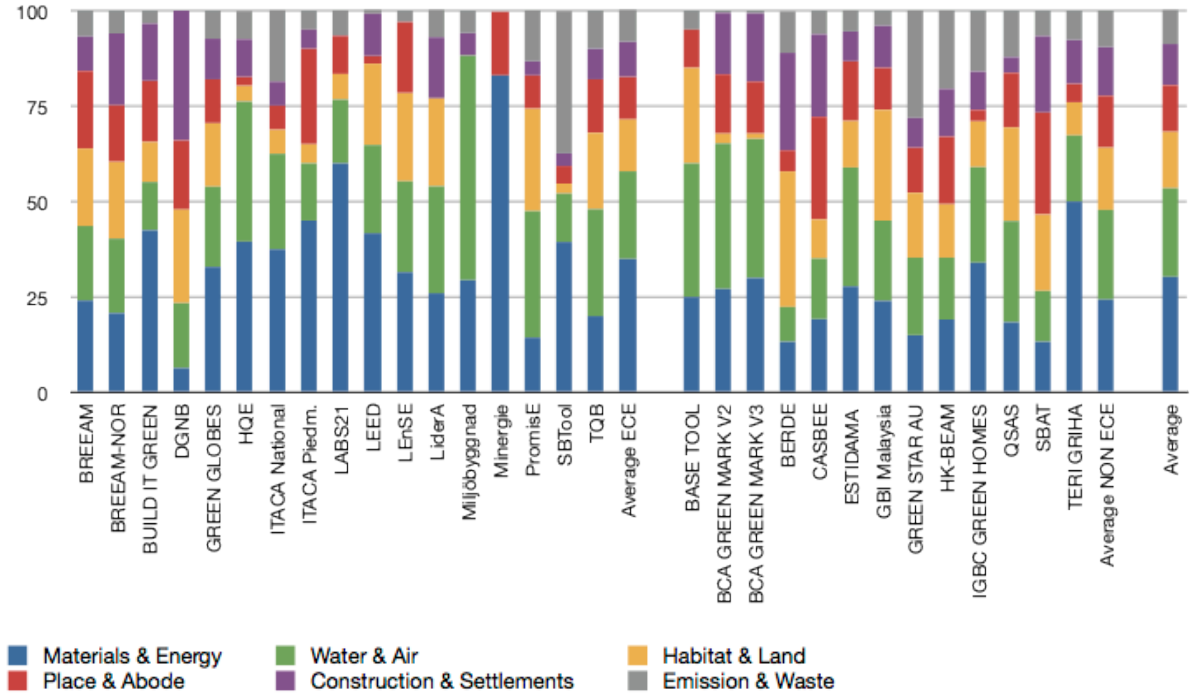


Table 2: Weights given to UNGCCP ecology components (summary information)

UNGCCP component	Average per cent weight given to each subgroup (out of 100%)			System(s) in which subgroup is not considered	System with highest weighting for subgroup (weighting)	System with lowest non-zero weighting for subgroup
	All systems	Systems prevalent in the UNECE region (17 systems)	Systems not prevalent in the UNECE region (13 systems)			
Materials and Energy	30.3	34.9	24.3		Minergie (83%)	DGNB (1%)
Water and Air	23.2	23.0	23.5	Minergie	Miljöbyggnad (58.8%)	BERDE (9.1%)
Habitat and Land	14.8	13.6	16.3	Minergie, Miljöbyggnad[2]	BERDE (35.5 %)	BCA Green Mark v3 (1.4%)
Place and Abode	12.1	11.1	13.6	LiderA, Miljöbyggnad	CASBEE (26.9%)	HQE (2.3%)
Construction and Settlements	10.7	9.2	12.8	Minergie, LEnSE BaseTool[3] Labs21	DGNB (34%)	SBTool (3.3%)

[2] "Sustainable sites, land use & ecology", a subcomponent of "habitat and land", is not assessed in SBTool or BCA Green Mark; the other subcomponent, "location, linkages and transport", is not assessed in LABS21 or ITACA.

[3] "Awareness and education of users", a subcomponent of "construction and settlements", is not considered in SBTool, QSAS, Estidama, BCA Green Mark, TERI-GRIHA, ITACA (PIEDMONT version), TQB or Miljöbyggnad.

Emission and Waste	9.2	8.9	9.6	DGNB, Minergie	SBTool (37.3%)	BCA Green Mark v3 (0.7%)

Figure 3: Weight for "materials and energy" (out of 100%)

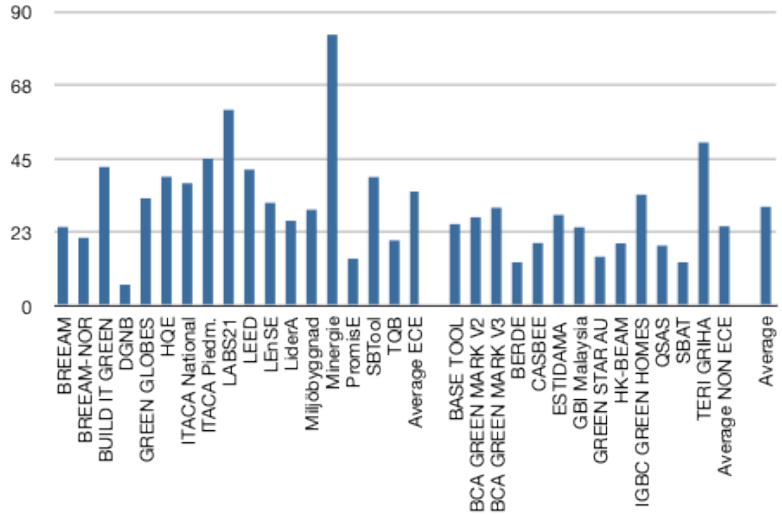


Figure 4: Weight for "water and air" (out of 100%)

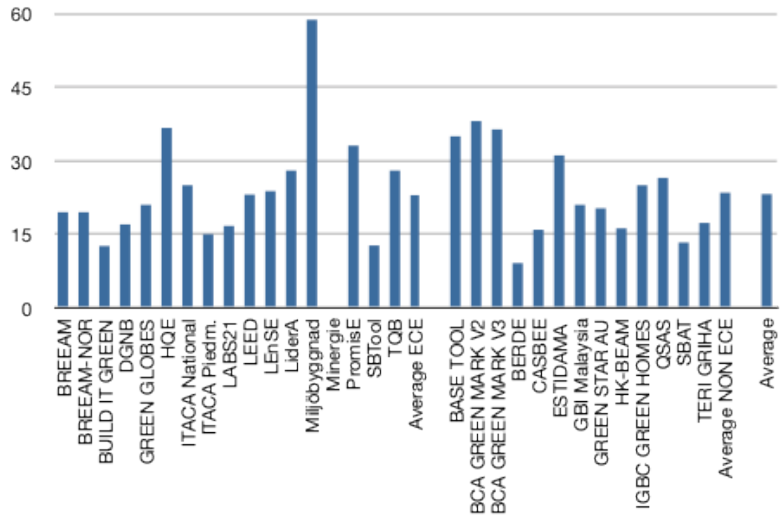


Figure 5: Weight for "habitat and land" (out of 100%)

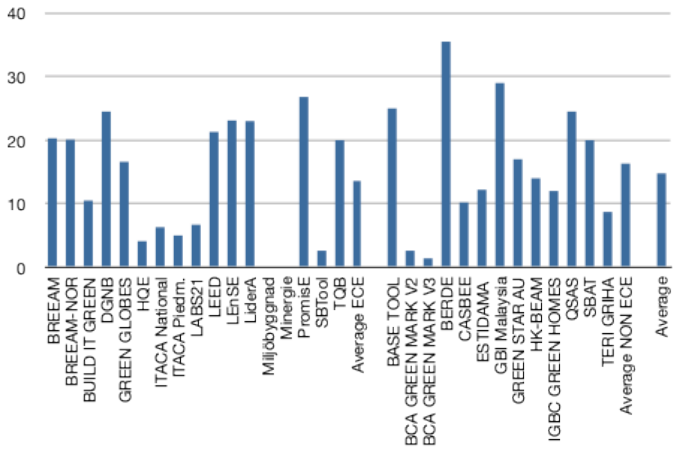


Figure 6: Weight for "place and abode" (out of 100%)

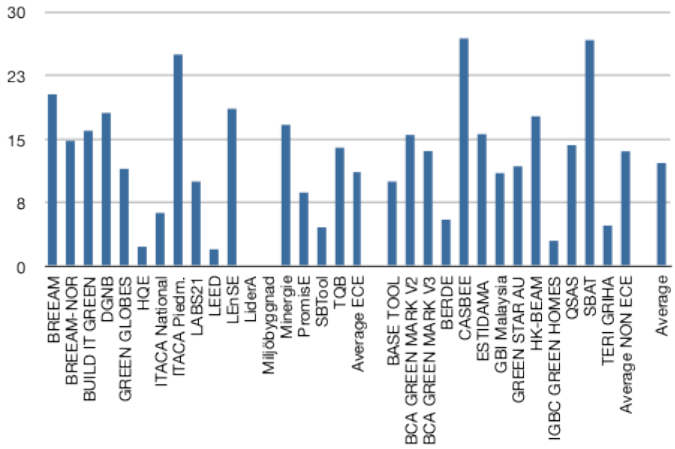


Figure 7: Weight for "construction and settlements" (out of 100%)

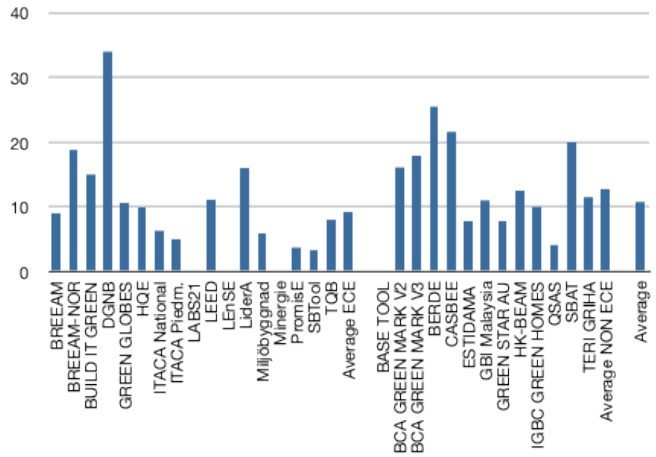
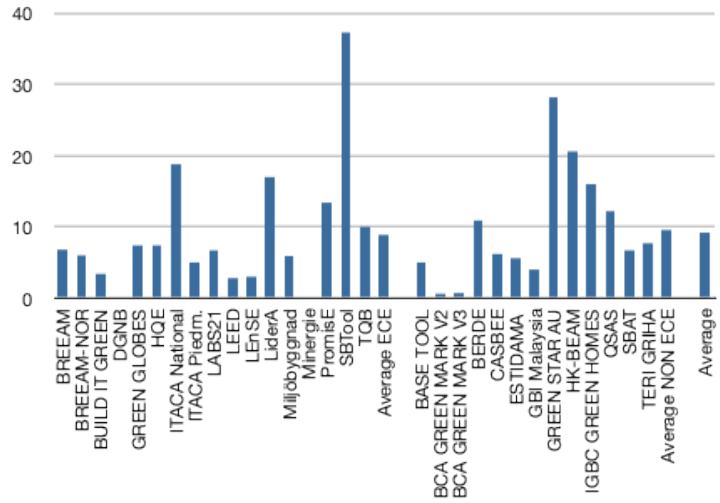


Figure 8: Weight for "emission and waste" (out of 100%)



The comparison shows that of the 30 systems analysed, 23[4] assess each of the six components suggested by the Global Compact, five[5] consider five components, one[6] considers four and one[7] considers only two. The only component assessed in all systems is "materials and energy".

The lack of harmonization in assessing the broad categories of the UNGCCP is clear. An even greater variety is seen in the assessment of subgroups of indicators. Only twelve of thirty reviewed methods assess all subgroups. The least represented subgroups are: "awareness and education of user", which is not considered in thirteen systems; "innovation & design, process, green features and regional relevance", which is not considered in six systems; and "location and linkages, transport and sustainable sites" and "land use and ecology", which are not assessed in five systems. More information on the assessment of indicator subgroups is available in Annex 1.

V. Shortcomings and inconsistencies in certification systems

International organizations have made attempts to harmonize the various green building methodologies. For example, the International Organization for Standards publishes a series of guidelines related to building sustainability (International Organization for Standards 2013) and the United Nations Environment Programme has created guidelines for the construction and use of green buildings (United Nations

[4] LEED, BREEAM, HQE, PromisE, Green Globes, Build it Green, Green Star Australia, CASBEE, ITACA Piemonte-, ITACA -national-, HK-Beam, SBTool, BREEAM-NOR, QSAS, Estidama, IGBC Green Homes, BCA Green mark 2013, BCA Green mark V3, BERDE, GBI, SBAT, TQB and TERI-GRIHA.

[5] DGNB, LiderA, LEnSE, LABS21 and BASE Tool.

[6] Miljöbyggnad.

[7] Minergie.

Environment Programme 2013). Nonetheless, green building certification systems use very different criteria to assess sustainability, and often do not assess key criteria.

For example, many systems focus on building energy efficiency at the expense of other energy-related criteria, such as energy consumption and generation. Energy demand is often neglected and, when it is assessed, the way it is assessed varies widely across systems. Very few methodologies consider the energy source of the power grid, implying that the true environmental footprint of household energy use is often not determined. No methodology considered here assesses electricity substitution measures to cover electricity peak-load times. Only IGBC Green Homes, BERDE and LEED explicitly assess on-site energy production.

Buildings sustainability is a fundamental part of city sustainability. In the United Nations Economic Commission for Europe region[8], cities account for 80% of greenhouse gas emissions (UNECE 2012). Building sustainability has usually been certified through a number of methods, which evaluate the properties of only the building. This approach neglects the importance of policy and urban planning. Furthermore, certification programmes often only consider new buildings and not programmes to renovate existing buildings.

Some building design features are only effective when incorporated in integral neighbourhood design. Climate type, occupancy rates and property structure need to be considered. Occupancy rates are relevant because they affect energy efficiency and user comfort (UNEP, 2010, p 9). Nonetheless, only one methodology analysed here, SBTool, considers the relationship between buildings and its surroundings from an urban planning perspective.

The importance of proper management in ensuring energy efficiency is often not fully considered. Metering primary energy consumption and the operation of devices (such as vents, lights, and air conditioning) can make the difference between a building which is only labeled as “green” and a properly operated, truly sustainable construction. Only a few rating systems considered building user guides and function adaptability and controllability. More attention to education and awareness of users is fundamental to the proper operation of a green building. Furthermore, current systems focus largely on new construction, while refurbishment and improved building operation can also have significant benefits for the environment and for the marketability of the building.

The large and increasing number of certification systems increases the risk that any one system will not be applied on a large scale and makes comparison of energy efficiency assessments more difficult. Nationally developed systems are often very appropriate for local use but are less likely to be comparable with other systems. For example, CASBEE, used in Japan, assesses building resistance to earthquakes and QSAS, used in Qatar, assesses desertification issues.

[8] This region includes Europe, the former Soviet Union, Canada, Israel and the United States of America.

VI. Conclusions

This study shows the intrinsic difficulty of comparing various green building rating systems. The great differences between standards seem to reflect a lack of common objectives. Different systems tend to prevail in different parts of the world. The rating of a building's sustainability may vary considerably according to the system chosen.. This also implies that buildings may be designed only to meet local certification criteria in order to gain higher assessments and increase marketability without achieving the most sustainable performance for the budget.

Many certification systems do not assess the sustainability of a building in the context of its urban environment. Nonetheless, it cannot be assumed that sustainable buildings will necessarily lead to a sustainable city. An array of urban tools and policies, like transportation, energy sourcing and spatial planning, need to be implemented to assure city sustainability in cities.

It is recommended that a set of guidelines be created for the development and use of green building certification systems. Guidelines should be comparable across borders, comprehensively consider methods to reduce the environmental footprint of buildings, and take account of the relationship of a building with its environment. These guidelines would benefit member States as they seek to choose and apply green building standards in their countries and facilitate the comparison of building sustainability across the UNECE region.

VII. References

Intergovernmental Panel for Climate Change. *Climate Change 2007: Synthesis Report*. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm [Accessed 30 July 2013]

Labbé, S (2012) "The Role of Material Use in Green Buildings." Presentation given at "The Green Life of Wood – Life Cycle Assessment Workshop" on 15 October 2012, Geneva, Switzerland

Liu, G; Nolte, I; Potapova, A; Michael, S; and K. Ruekert. (2010) *Longlife. Comparison of worldwide certification systems for sustainable buildings (Oral Presentation).* Presented during the 9th International conference on Sustainable Energy Technologies, Shanghai China. 24 August 2010.

United Nations Global Compact Cities Programme (2013). "Global Compact Cities Programme". http://citiesprogramme.com/ [Accessed 24 July 2013]

United Nations Global Compact Office (2013). United Nations Global Compact. http://www.unglobalcompact.org/index.html [Accessed 24 July 2013]

United Nations Economic Commission for Europe (2010) . *Policy Framework for Sustainable Real Estate Markets: Principles and Guidance for the Development of a Sustainable Real Estate Sector.* New York and Geneva: United Nations.

United Nations Economic Commission for Europe (2011) *Action plan for the energy-efficient housing in the UNECE region.* New York and Geneva: United Nations.

United Nations Economic Commission for Europe (2012) *Climate neutral cities, How to make cities less energy and carbon intensive and more resilient to climatic change.* New York and Geneva: United Nations.

United Nations Environment Programme (2010) *Responsible Property Investing: Metrics for Performance Measurement. Second in a Serie of Toolkits on Responsible Property Investing.* UNEP: Geneva.

United Nations Environment Programme (2010) "Sustainable Buildings and Climate Initiative: Promoting Policies and Practices for the Build Environment". http://www.unep.org/sbci/pdfs/sbci_2pager_eversion_Feb2011.pdf [Accessed 13 August 2013]

Annex 1: Weight and points included per methodology

Weight given to Global Compact components							Subgroups of indicators considered (Red indicates that the subgroup is not considered)								
Materials & Energy	Water & Air	Habitat & Land	Place & Abode	Construction & Settlements	Emission & waste	Certification system	Material & resources	Energy & atmosphere; renewable energy	Water efficiency	Indoor environmental quality; health & wellbeing	Location & linkages, transport; Sustainable sites, land use & ecology	Management, maintenance, operation and ownership	Innovation & design process, green features and regional relevance	Awareness & education of users	Pollution, emissions waste & recycling
24	20	20	20	9	7	BREEAM									
21	20	20	15	19	6	BREEAM-NOR									
43	13	11	16	15	3	BUILD IT GREEN									
6	17	25	18	34	0	DGNB									
33	21	17	12	11	7	GREEN GLOBES									
40	37	4	2	10	7	HQE									
38	25	6	6	6	19	ITACA National									
45	15	5	25	5	5	ITACA Piedmont									
60	17	7	10	0	7	LABS21									
42	23	21	2	11	3	LEED									
32	24	23	19	0	3	LEnSE									
26	28	23	0	16	17	LiderA									

Weight given to Global Compact components							Subgroups of indicators considered (Red indicates that the subgroup is not considered)								
Materials & Energy	Water & Air	Habitat & Land	Place & Abode	Construction & Settlements	Emission & waste	Certification system	Material & resources	Energy & atmosphere; renewable energy	Water efficiency	Indoor environmental quality; health & wellbeing	Location & linkages, transport; Sustainable sites, land use & ecology	Management, maintenance, operation and ownership	Innovation & design process, green features and regional relevance	Awareness & education of users	Pollution, emissions waste & recycling
29	59	0	0	6	6	Miljöbyggnad									
83	0	0	17	0	0	Minergie									
14	33	27	9	4	13	PromisE									
39	13	3	5	3	37	SBTool									
20	28	20	14	8	10	TQB									
25	35	25	10	0	5	BASE TOOL									
27	38	3	16	16	1	BCA GREEN MARK V2									
30	36	1	14	18	1	BCA GREEN MARK V3									
13	9	36	6	26	11	BERDE									
19	16	10	27	22	6	CASBEE									
28	31	12	16	8	6	ESTIDAMA									
24	21	29	11	11	4	GBI Malaysia									

Weight given to Global Compact components							Subgroups of indicators considered (Red indicates that the subgroup is not considered)								
Materials & Energy	Water & Air	Habitat & Land	Place & Abode	Construction & Settlements	Emission & waste	Certification system	Material & resources	Energy & atmosphere; renewable energy	Water efficiency	Indoor environmental quality; health & wellbeing	Location & linkages, transport; Sustainable sites, land use & ecology	Management, maintenance, operation and ownership	Innovation & design process, green features and regional relevance	Awareness & education of users	Pollution, emissions waste & recycling
15	20	17	12	8	28	GREEN STAR AU									
19	16	14	18	13	21	HK-BEAM									
34	25	12	3	10	16	IGBC GREEN HOMES									
18	27	25	14	4	12	QSAS									
13	13	20	27	20	7	SBAT									
50	17	9	5	12	8	TERI GRIHA									
30	23	15	12	11	9	Average									