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ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ

UNEP SBCI

Sustainable Buildings & Climate Initiative

DRAFT BRIEFING ON THE SUSTAINABLE BUILDING INDEX

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UNEP-SBCI briefing on the Sustainable Buildings (SB) Index and supporting Steering Committee (SC) and Technical Advisory Committees (TACs)

SB Index - Background

Globally, buildings are responsible for 40% of annual energy consumption and up to 30% of all energy-related greenhouse gas (GHG) emissions. The building sector has also been shown to provide the greatest potential for delivering significant cuts in emissions at low- or no-cost or net savings to economies. Collectively the building sector is responsible for one-third of humanity's resource consumption, including 12% of all fresh-water use, and produce up to 40% of our solid waste. The sector also employs, on average, more that 10% of our workforce. With urbanization increasing rapidly in the world's most populous countries, building sustainably is essential to achieving sustainable development.

The need for a common language and definition for sustainable buildings is widely recognized within the building sector. While some countries have defined sustainable buildings through national rating systems and legislation, most countries do not yet have such references. Without global consensus, the definition of basic issues, indicators, and metrics and the costs and benefits associated with sustainable buildings, tend to vary. This is causing confusion in the market, inaccurate perceptions of political or financial risks to persist, and undermining efforts to fully implement sustainable building practices.

A common language for and definition of sustainable buildings have been core to UNEP-SBCI's mission since its inception in 2006. Upon receipt of three key background reports in December 2008 and 2009, UNEP-SBCI members and think tank representatives proposed developing an index of common metrics, based on a life-cycle approach that could be used to report on progress made by various countries in addressing key building-related sustainability issues. In 2009, the effort focused on the highest ranking core global issue – Climate Change. UNEP-SBCI convened two meetings in 2009 of international organisations to reach consensus on a common carbon metric for building operations. This was achieved and the Common Carbon Metric (CCM) was launched at the 15th Conference of the Parties (COP15) in Copenhagen on 11 December 2009.

The UNEP-SB Index

The UNEP-SB Index will provide a globally consistent framework to understand, measure, report, and verify actual building performance on core sustainability issues, particularly in developing countries. The Index is envisaged as a tool for generating a global annual report on progress made by jurisdictions in improving the sustainability of building stock. The Index is not intended to be a rating system, but rather intended to steer and focus building industry stakeholders on the primary issues agreed upon by the leaders and decision-makers of this sector. The Index shall focus on measureable, reportable, and verifiable indicators, be applicable to existing residential and non-residential buildings and facilitate both top-down and bottom-up aggregation of the performance of building stock[1]. The Index shall include aspects of the buildings' impact and benefits with regards to:

- Energy/Greenhouse Gas Emissions (GHG);
- Water;
- Materials (consumption, scarcity, life-cycle and waste generation);
- Social Issues;
- Biodiversity; and
- Economics.

The UNEP-SBCI Membership has focused on climate change as its priority issue in 2009 and thus tackled the issue of building energy efficiency and emission of greenhouse gases first.

In 2010, UNEP-SBCI is working to progress the general development of the SB Index structure, with strong focus on completing the work on the Common Carbon Metric. UNEP-SBCI engaged the World Resources Institute (WRI), developer of the globally recognized Greenhouse Gas (GHG) Protocol, to draft measurement protocol, calculation tool, and a reporting template for the Membership's review at the Annual General Meeting (AGM) in May. A Pilot testing version of this reporting protocol will be launched in Paris on 19th May. Technical Advisory Committees (TAC) are also being convened to develop common metrics for other core issues. The general terms of reference for the SB Index committee structure is described below. Briefing notes for each core TAC are provided within.

[1] Refer to the Common Carbon Metric for description of top-down and bottom-up approaches.

Committee Structure

Steering Committee (SC) & Technical Advisory Committees (TAC)

It became clear through UNEP-SBCI's stakeholder meetings in Paris and Singapore, in 2009, that a group of experts with diverse viewpoints is needed to guide and manage the development of the UNEP-SB Index and that policies and procedures of this group must be defined to support the work. This proposed group, the UNEP-SB Index SC, has a long-term mission to deliver the UNEP-SB Index; providing common understanding of the core issues, measuring tools, reporting protocols and verification process for sustainable buildings. UNEP-SBCI is committed to working with other international and national organisations working toward similar goals.

The SC shall be supported by the gradual establishment of TACs as resources become available. The mission of each TAC shall be to develop measurement and reporting metrics, protocols and templates for specific core issues. SC and TACs shall be formally established at the AGM. (See figure below)Participation in and leadership of each TAC shall be determined by the UNEP-SBCI Membership.

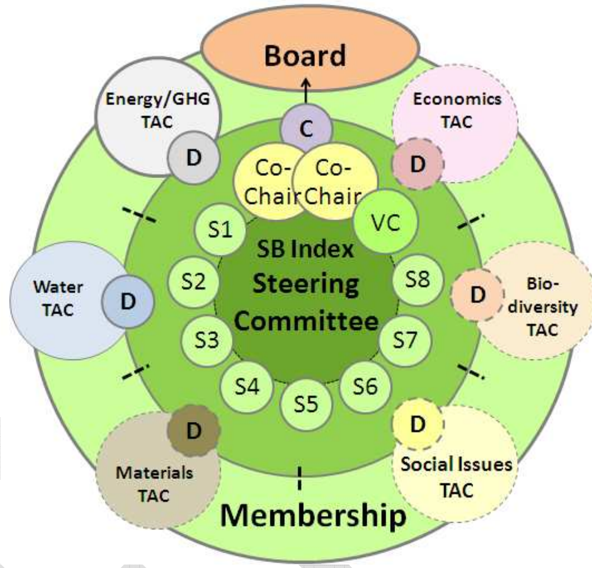

Figure 1: Steering Committee Diagram (D=Donor, VC=Vice Chair, S=Seat, and C=Coordinator).

Governance & Coordination

SC members shall be nominated by UNEP-SBCI members and elected by the Membership at the AGM. Committee members must be members of UNEP-SBCI or have a formal association with the Initiative. The SC shall be directed and governed by the UNEP-SBCI Board and coordinated by the UNEP-SBCI Secretariat. Expert Advisors (outside the Membership) may be approved to participate in committee meetings when approved by the respective committee members.

Financial Support

The SC shall be sponsored by one UNEP-SBCI Member for a period of one year. The Sustainable Buildings (SB) Alliance has graciously agreed to Sponsor the Steering Committee for this membership year. The Sponsor shall assume a voting position on the SC and fund the SC Meetings. Each TAC shall be sponsored by one Donor for a period of one membership year. The Donor shall be approved by UNEP. Each Donor shall assume a voting position on their TAC and fund their TAC Meetings. The Sponsor is prohibited from co-chairing the SC and Donors are prohibited from chairing their TAC to keep the integrity of the committee free and clear of financial persuasion or special interests.

Measurement and Reporting Protocols

UNEP-SBCI intends to apply metrics to measure and report on the sustainability performance of existing building stock, particularly in developing countries. Protocols should therefore use a consistent framework for reporting by building type (residential and non-residential) and climate region. Account may also be taken for the age of the buildings stock.

Due to the lack of life-cycle data in many regions, measurement must be a combination of top-down approaches (e.g. based on national or local economy input-output data) and bottom-up (e.g. samples of building-by-building analysis). Qualitative life-cycle design indicators could also be considered. All TACs should refer to the Common Carbon Metric & Protocol, together with its Calculation Tool and Reporting Template as an example and model for scope of measurement and structure of reporting within the SB Index.

Synergies and Links with Similar Initiatives

A number of international and national initiatives provide common metrics and reporting frameworks for common indicators in the built-environment, including GHG emissions, some of which have already contributed actively to the current development of the SB Index in general and the common carbon metric work in particular. Table 1 provides an overview of some initiatives which UNEP-SBCI has already been working with. To what extent and how the SB Index should refer and/or contribute to other initiatives is part of the work of the SC.

Organisation	Initiative	Scope	Reference
Global Reporting Initiative (GRI)	Construction and Real-Estate Sector Supplement (CRESS)	Sustainability reporting: Organisations	www.globalreporting.org/ReportingFramework/SectorSupplements/ConstructionandRealEstate/
Cities Alliance/World Bank/UN-Habitat	Joint Work Program	GHG Standard for Cities	www.unep.org/urban_environment
OECD/IEA	Sustainable Building Network	Proposals for new energy efficiency policies for buildings.	www.iea.org/subjectqueries/buildings.asp
International Organisation for Standardisation (ISO)	TC59/SC17	Guidelines, Indicators & Frameworks for sustainability in building construction	www.iso.org/iso/standards_development/technical_committees/list_of_iso_technical_committees/iso_technical_committee.htm?commid=49070
European Committee for Standardization	CEN 350	Assessment of the sustainability aspects of new and existing construction works	www.cen.eu/CEN/sectors/sectors/construction/sustainableconstruction/Pages/cen_tc350.aspx
Sustainable Buildings Alliance	Common Metrics	Common Carbon Metric & SB Index	www.sballiance.org
UK Green Property Alliance	Measurement & Reporting Sub-Group	Common metrics for measuring sustainable building performance	www.ipf.org.uk

Table 1: Initiatives with synergies with the SB Index and scope of work of the UNEP SBCI Energy/GHG TAC
Note: this is not an exhaustive list.

Background Research

The SB Index work to date has been supported through the following parallel studies/reports commissioned to identify core issues and indicators that are essential to sustainable buildings. These are available to TACs upon request or downloadable from the UNEP-SBCI website www.unep.org/sbci

***The 'State of Play' Report* (2009)** on environmentally high-performance buildings sought to identify issues that the industry was dealing with and to report on best-practice performance being attained. Carnegie-Mellon University's Centre for Building Performance analyzed over 130 high-environmental-performance buildings of various uses in several countries and found that the industry engaged most with energy efficiency and low energy consumption.

Author: Dr. Ing., Dr. H.C. Volker Hartkopf, Professor of Architecture, Director of Center for Building Performance and Diagnostics (CBPD) Carnegie Mellon University, USA
Co-authors: Xiaodi Yang, Ph.D candidate; Azizan Aziz; Senior Researcher
Citation: Hartkopf, V.H., Yang, X., Aziz, A (2009) *Case studies of High performance Sustainable Buildings,* Carnegie Mellon University, January

***The 'State of Play' Report* (2010)** The Energy & Resources Institute (TERI) in India produced a report on the state of sustainable buildings in India, which included analysis of the role and potentials of vernacular approaches to building design and construction.

Authors: The Energy & Resources Institute, Delhi India
Citation: UNEP-SBCI (2010 in-press) *A Report on the State of Play of Sustainable Building in India*, Paris

***The 'Knowledge Base' Report* (2009)** was commissioned in partnership with UNEP's Finance Initiative - Property Working Group. A desk-top global survey of building rating schemes and performance assessment tools for sustainable buildings was conducted to identify the issues which were common to a majority of systems and their treatment of financial viability criteria. The survey was authored by the Building Research Establishment (BRE) Global and CSTB and reviewed by members of the Sustainable Buildings Alliance.

Authors: Clare Lowe Building Research Establishment (BRE) UK & Alfonso Ponce, CSTB France

Contributors: Nils Larsson, FRAIC, executive director iiSBE; Dr. David Lorenz, Lorenz property advisors, chartered surveyors; Prof. Dr. Ing. Habil Thomas Lützkendorf, Karlsrühe University, Andrea Moro, iiSBE Italia & Dr. Josephine Prior BRE Global.

Citation: Lowe, C. & Ponce, A. (2009) *UNEP-FI/UNEP-SBCI Financial & Sustainability Metrics Report: An international review of sustainable building performance indicators & benchmarks* BRE/CSTB, May

The Delphi Study authored by the Commonwealth Science & Industry Research Organisation (CSIRO), Australia, involved experts on building performance assessment and was conducted to identify which issues and indicators should be included in a limited set of 10 most critical criteria.

Authors: S. Seo, G.C. Foliente and S.N. Tucker, CSIRO Sustainable Ecosystems. Australia

Citation: Seo, S., Foliente, G. Tucker, S., (2009) *Developing a consensus on a global framework and indicators for performance reporting of sustainable building* UNEP SBCI Technical Report, May.

Draft Energy Conservation Guidelines prepared for the think tanks by BROAD Air-conditioning, suggested a framework for prescribing energy performance levels for various building types. These findings were synthesized by BROAD into a guideline for Energy Efficiency retrofitting of BROAD's Changsha Campus in China.

Author: Zhang Yue, Founder & Chairman of BROAD Air

Buildings & Climate Change Reports were commissioned to test the feasibility of reporting on base-line building related GHG emissions at a national level. The reports provided new information about the contribution of buildings to climate change in various countries, mitigation potentials, and advice on reporting methodologies.

- UNEP SBCI (2009) *Buildings & Climate Change: A Summary for Decision-Makers*;
- UNEP SBCI (2009) *GHG Emission Baselines and Reduction Potentials from Buildings in Mexico*;
- UNEP SBCI (2009) *GHG Emission Baselines and Reduction Potentials from Buildings in South Africa*; and
- UNEP SBCI (2010 – in-press) *GHG Emission Baselines and Reduction Potentials from Buildings in India*.

Common Carbon Metric & Draft Protocol Expert stakeholder meetings were convened in Paris (September 09-11, 2009) and Singapore (October 26-27, 2009) to discuss, develop and finally agree on this metric for the building sector. This agreement defines the calculations to be used for measuring energy use and reporting energy-related greenhouse gas emissions from building operations. This work was officially released at COP15 on December 12 2009, as the Common Carbon Metric. The World Resources Institute was then engaged to develop a reporting protocol for pilot testing.

- *Common Carbon Metric for Measuring Energy Use & Reporting Greenhouse Gas Emissions from Building Operations*, UNEP-SBCI (2009); and
- *Common Carbon Metric: Protocol for Measuring Energy Use & Reporting Greenhouse Gas Emissions from Building Operations*, DRAFT for PILOT Testing, UNEP-SBCI (2010).

World Building Energy Use Scenario Modeling This study was commissioned to better understand the building sector's direct contribution to total world energy consumption and GHG emissions currently and into the future. The work is a collaborative effort between UNEP-SBCI and the International Institute of Applied Systems Analysis (IIASA) Global Energy Assessment (GEA) which includes several sectors including Agriculture, Industry, Transportation, and Buildings.

Author: Professor Diana-Urge Vorsatz, Director of the Centre for Climate Change and Sustainable Energy Policy, Central European University

Co-Authors: Andrew Butcher & Maria Sharmina (Junior Researchers)

Citation: *World Building Energy Use Scenario Modeling* (in-press 2010)

CHAPTER 1: UNEP-SBCI Sustainable Buildings (SB) Index
Energy/Greenhouse Gas (GHG) Emissions Technical Advisory Committee (TAC) – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related to the Economics of sustainable buildings; and
- To outline the mission and goals for the Energy/GHG TAC.

Overview of Key Issues

The building sector represents 40% of the world's energy consumption and related one third of global greenhouse gas (GHG) emissions and is in need of a way to measure, report, and verify (MRV) reductions in a globally consistent and comparable way. With its high share of emissions the building sector has the responsibility and opportunity to take the global lead in reduction strategies. Awareness of these facts and widespread use of this tool for measuring and reporting is the key.

The building sector has more potential to deliver quick, deep and cost effective GHG mitigation than any other. Significantly increasing building energy efficiency can be achieved in the short-term. Energy consumption in both new and existing buildings could be cut by an estimated 30-50% by 2020 through readily available technologies, design, equipment, management systems, and alternative generation solutions. This can be funded through investments that quickly payback and result in significant environmental, social, and economic benefits. A universal measuring stick for building emissions would provide the foundation for accurate performance baselines to be drawn, national targets set, and carbon traded on a level playing field.

Data Availability & Quality – Particularly in Developing Countries

Reports on baseline GHG emissions and mitigation potentials from the building stock of Mexico, South Africa and India were commissioned by UNEP-SBCI in 2008-09 to test the feasibility of regional or national reporting.[i] While agreed on the importance of such reports, a consistent challenge in all cases was the general lack of data on building stock, patterns of energy use, and associated GHG emissions. Where data existed, questions were raised about its reliability. In the absence of data, each report used different assumptions and methodologies for extrapolating available data to provide an estimate of baseline GHG emissions and mitigation potentials.

Providing a Common Template for the Buildings & Climate Change Report

The fundamental rationale for reporting building related GHG emissions is to provide baseline data that can inform policy development. However, the building sector is fragmented with diverse emission-reduction potentials dispersed across building life-cycles. Therefore, providing baselines alone does not necessarily solve the problem of how to measure progress over time. Questions of how to attribute progress to specific mitigation strategies, whether they are related to policy, technology, design education etc. must be addressed.

Energy Services & Equity

Many developing and transitional economies are planning major increases in energy supply and use in the next 20 years. In India, for example, programs are underway to bring electricity to the more than 400 million people that lack access to basic energy services. Providing such basic service to all of its citizens will require a three to four fold increase in primary energy supply and a five to six fold increase in electricity generation over 2005 capacity by 2030.[ii] Such actions will inevitably lead to increases in total energy consumption and associated GHG emissions.

National Appropriate Mitigation Actions (NAMA)

Under the Bali Action Plan, developing country Parties to the UNFCCC were encouraged to implement "Nationally appropriate mitigation actions … in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner."[iii] The importance of NAMA as key mechanisms under the Convention was further recognized in the Copenhagen Accord in which Annex 1 developing countries agreed to register and implement NAMA. These would be recognized internationally by the United Nations Framework Convention on Climate Change (UNFCCC) if they provide MRV GHG mitigation.[iv]

Examples of NAMA that can be registered include measures such as, "…sector-wide technology standards, laws & regulations, standards (energy efficiency standards), cap-and-trade schemes, renewable energy ratio, sectoral targets, building insulation codes, congestion charges and carbon tax to promote public transportation."[v]

More specific NAMA for the building sector have also been suggested,[vi] such as:

- Mandatory minimum energy performance based standards;
- Mandatory or voluntary building rating, labeling and certification programs;
- Loans, subsidies, incentives and tax breaks;
- Building auditing programs for compliance and certification;
- Mandatory building inventory, survey and monitoring programs, including baseline energy performance by type and climate region for MRV purposes;
- Building professional (including auditors) certification and education programs;
- Technology need assessment, demonstration and model house programs;
- Public sector building improvement and high performance building deployment programs;
- Research and development programs for new building materials, technologies, and practices; and
- Awareness raising and informational campaign programs.

Actions such as these are already taking place in many developing countries. NAMA registration therefore could enable existing mitigation actions to be recognized by UNFCCC.

As previously noted, GHG emissions from the building sector are dispersed and diverse. The above list of proposals for building related NAMA are equally diverse, containing mitigation strategies relating to different stakeholders throughout the building process. The feasibility of one common MRV methodology for NAMAs is therefore questionable. An alternative approach which would enable NAMA-specific indicators to be used has also recently been proposed.

Support for National Approved Mitigation Actions (NAMA) and Emissions Trading
Opportunities exist for achieving significant GHG emission reductions and energy efficiency gains from the building sector.[vii] Effective action for realizing this potential requires a combination of mandatory minimum performance requirements, economic incentives, capacity building, awareness raising and recognition of leadership (a combination of sticks, carrots and tambourines).[viii] To support the implementation of such strategies under the UNFCCC framework for NAMA, the MRV of the effectiveness of specific strategies, rather than the building sector, building stock or building typologies is suggested.[ix]

Proposals for developing carbon markets for the property sector conversely require MRV data by building type and climate region to allow for reliable aggregation and verification of efficiency gains and GHG emissions saved for cap and trade purposes.

Mission and Goals for the Energy/GHG TAC

The mission of the Energy/GHG TAC is to further develop measurement and reporting metrics, protocols, calculations and templates on building related energy and GHG emissions for inclusion in UNEP-SBCI SB Index. The Index shall focus on MRV indicators, be applicable to existing residential and non-residential buildings and facilitate both top-down and bottom-up aggregation of the performance of building stock.[1]

The Common Carbon Metric

After two years of international consensus building and technical meetings, the Common Carbon Metric (CCM) was released at the 15th Conference of the Parties (COP15) in Copenhagen on 11 December 2009. The metric sets out agreed indicators for measuring energy use and reporting on energy-related GHG emissions associated with building operations. These indicators are:

Energy Intensity = kWh/m^2/year *(kilo Watt hours per square meter per year)*

The scope of emissions associated with building energy end-use included are; purchased electricity, purchased coolth/steam/heat, and/or on-site generated power used to support the building operations. If available, emissions associated with fugitives and refrigerants used in building operations can also be reported separately. If available, occupancy data shall be correlated with the building area to allow Energy Intensity per occupant (o) to be calculated = kWh/o/year. GHG emissions are calculated by multiplying the above Energy Intensity times the

[1] Refer to the Common Carbon Metric for description of top-down and bottom-up approaches.

Intergovernmental Panel on Climate Change (IPCC) GHG emission coefficients, for the reporting year, for each fuel source used.

Carbon Intensity = $kgCO_2e/m^2/year$ and **$kgCO_2e/o/year$** *(kilograms of carbon dioxide equivalent per square meter or per occupant per year)*

The priority for Energy/GHG TAC is to define the application of the metric through a standardized protocol or methodology for measuring energy use and reporting baseline greenhouse gas emissions from building operations. The World Resources Institute (WRI) was commissioned in January 2010 to draft a protocol, calculator and reporting template for this purpose. Pilot testing of this tool shall be launched on May 19, 2010. The Energy/GHG TAC is, among other things, tasked with providing expert peer review of the results of this pilot project.

The vision for the SB Index is to enable UNEP-SBCI to produce global progress reports on the building sectors effectiveness in implementing sustainable building. On the key issue of energy and GHG emissions, UNEP-SBCI intends to develop the *Buildings & Climate Change* report into an authoritative strategic review of the effectiveness of mitigation strategies in the building sector and aim for future publication. The Common Carbon Metric and Protocol is intended as the mechanism by which MRV data can be collected for this report. The lack of data in developing countries presents a major challenge for the reporting protocol developed for UNEP- SBCI by WRI. A key question for the Energy and GHG TAC therefore is how to augment the protocol with a consistent methodology for reporting in data-poor regions. Specifically, defining resources and a more consistent set of assumptions need to be used in these cases.

Other Programmes

A number of other initiatives are working on GHG emission reporting. These include the Carbon Disclosure Project (CDP), Climate Group, Climate Leaders, Climate Registry and others. These carbon accounting systems have not yet drilled down to accounting of emissions related to the building stock. The Global Reporting Initiative Construction & Real Estate Sector Supplement is committed to using the Common Carbon Metric to provide a consistent method to add this capacity. UNEP-SBCI shall work to gain consensus of these other initiatives to apply the Common Carbon Metric to their programs as the method for accounting for emissions related to building operations.

References

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[i] B&CC: GHG Emission Reduction Potentials in Mexico(November 2009), B&CC: GHG Emission Reduction Potentials in South Africa (November 2009) – download at: www.unep.org/sbci B&CC: GHG Emission Reduction Potentials in India (In-process 2010)

[ii] Planning Commission (2006). Integrated Energy Policy Report of Expert Committee. Government of India, Planning Commission, New Delhi.

[iii] Bali Action Plan (2007) UNFCCC Decision 1/CP.13 3-15 December, Bali Indonesia

[iv] Copenhagen Accord (2009) UNFCCC Decision 2/CP.15 18 December Copenhagen, Denmark

[v] Republic of Korea (2009) Proposal to AWG-LCA, February

[vi] Cheng, C.C. (in-press) ibid.

[vii] UNEP SBCI (2009) *Buildings & Climate Change: A Summary for Decision-Makers*, December, Paris.

[viii] UNEP SBCI (2007) *Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from the Building Sector,* Central European University, September, Budapest

[ix] Cheng, C.C. (in-press) “A New NAMA Framework for Dispersed Energy End-Use Sectors” accepted for publication in *Energy Policy* May.

CHAPTER 2: UNEP-SBCI Sustainable Buildings (SB) Index
Water Technical Advisory Committee (TAC) – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related to water use by the building sector; and
- To outline the mission and goals for the Water TAC.

Overview of Key Issues

Sustainability of Supply

Although water is a renewable resource, whether its use is sustainable or not depends on rates of consumption and replenishment of water sources. Freshwater is a valuable and often scarce resource. Only 2.5 percent of the Earth's water is fresh (not salt water). Of this, only 0.3 percent is readily available in lakes and rivers, 70 percent resides in the form of ice and snow and the remaining 30 percent is groundwater. Based on best available estimates, buildings are responsible for between eight and 16 percent of global freshwater consumption and in urban areas, they generate approximately 20 percent of wastewater production. Most calculations exclude water required for electricity production and manufacturing building materials. Freshwater use in buildings is in turn responsible for two to three percent of world energy consumption, predominantly for pumping and treatment.[i][ii][iii]

Globally a substantial amount of fresh water is used in generating electricity, of which buildings are typically a primary user. For example hydro-electric plants in the U.S.A. evaporate an average of 68 L/kWh/end user. Thermo-electric plants which provide more than 80% of U.S. electricity evaporate 1.8 L/kWh/end user.[iv]

Building-related water use is estimated at 12 percent in Mexico, the United States and Canada.[v] However, there are significant regional variations depending on the level of urbanization in a country and the size of its agricultural and industrial base. Building-related water use in Singapore, for example, has been estimated at 53 percent.[vi] Most Indian cities rely heavily on groundwater for use in buildings where ground-water levels are projected to drop well below the international benchmark for water stress of $1700m^3$/person/year by 2030.

Urban Water Cycles

The efficiency of urban water-cycles is a key determinant of sustainable use of water in buildings. Water efficient buildings connected to poor infrastructure may not positively influence sustainable water use. For example, approximately 30 percent of potable urban water is wasted each year due to leaking infrastructure.[vii] On-site rainwater harvesting and/or grey or black water recycling can reduce demand on infrastructure, but are not widely implemented in urban areas despite demand for water often outstripping supply. Reducing pollution from urban runoff is also a key concern, with storm-water often carrying oil, garbage, toxins and nutrients untreated into natural waterways with negative effects on human and ecosystem health.

Efficiency of Consumption

Residential End Use:

The discussions of residential use include detached, multi-unit and high-rise housing. In the United States and Australia, up to 50 percent of domestic water is used for garden watering regardless of typology.[viii] Showers use accounts for an additional 18-20 percent of household water.[ix] Other significant uses include toilet flushing, laundry and kitchen and bathroom sinks. Conversely, there is a need for greatly expanding clean water supply in developing countries. In rural India, for example, more than 75 percent of the population does not have access to sanitation.[x][xi]

Non-Residential End Use:

The discussions of non-residential use include commercial and retail buildings, hotels and public buildings such as hospitals and schools. The kind of end-use consumption depends on the building type, but generally, buildings with large water-cooled air-conditioned systems use the most water. Educational buildings tend to use the majority of their water for irrigation, while restaurants use most of their water in kitchens.

Embodied Water:

Embodied water is a term used to describe water that is used in the process of manufacturing materials. Studies of embodied water in building materials have been conducted but there is a reported lack of process-water data upon which to base accurate performance assessments.[xii]

Mission and Goals for the Water TAC

The mission of the Water TAC is to develop measurement and reporting metrics, protocols and templates for water use in buildings for inclusion in UNEP-SBCI SB Index. The Index shall focus on measureable, reportable, and verifiable (MRV) indicators, be applicable to existing residential and non-residential buildings and facilitate both top-down and bottom-up aggregation of the performance of building stock.[1] Key reports commissioned by UNEP-SBCI to identify core issues for monitoring the 'sustainability' of buildings presented a basic consensus on ten issues. Water is the second-ranked issue behind energy and climate change.

The consensus process was used in the Delphi Study and an expert workshop to determine the most suitable performance indicator for each core issue. The choice of indicator depends on the performance to be measured. For example, when environmental performance was considered, an indicator of water use efficiency was suggested - *annual consumption of water supplied from off-site sources* measured in MLitres/m^2/yr. An absolute impact indicator was also considered: *water consumption from operating a building over its entire life-cycle* which would be measured in MLitres.

The *service* performance of buildings requires further indicators such as the availability of clean water for drinking. However, this aspect was not prioritised during the consensus process. As a result of having to limit the choice of issues and indicators to ten, and having taken the view that the SB Index would be reporting on 'sustainability' rather than environmental performance, the preferred indicator for water was *storm & sanitary water harvested & treated on & off-site (recycling water use)* also measured in MLitres/m^2/yr.

However, sustainable consumption must also be considered, particularly in relation to the scarcity of water supply, the distance it has to travel, drought and rainfall cycles, the efficiency of urban metabolism and rates of urbanization and projected climate change vulnerabilities.

Indicator of *Sustainable* water use	**Unit**	**Data**
Storm and sanitary water harvested and treated/used on and off site (recycling water use)	Mlitre/m^2/yr	Simulation/ Measurement

Table 1: Consensus Indicators for sustainable use of water in buildings.[xiii]

It appears that the quality of generally available data on building-related water consumption is poor and dated. Precise figures for end-use water consumption are difficult to collect due to the majority of end-use water consumption being un-metered. Extrapolation from discrete studies and estimates is often necessary. Moreover, data is commonly scarce in developing countries.

Due to the paucity of data in many regions, measurement must be a combination of top-down approaches (e.g. based on national and local economy input-output data) and bottom-up (e.g. samples of building-by-building performance surveys). All TACs should refer to the *Common Carbon Metric & Protocol*, together with its *Calculation Tool and Reporting Template* as an example and model for scope of measurement and structure of reporting within the SB Index.

Glossary of Terms

Rain Water: Water falling as rain on to external surfaces of buildings such as roofs. Rainwater Harvesting commonly refers to the collection of this water for reuse in buildings or irrigation.
Storm-Water (Urban Run-Off): Water run-off due to rainfall collected in drainage systems, impervious surfaces.
Grey Water: Water that has been discharged after kitchen, bathroom and laundry uses (e.g. from kitchen sinks, washing machines, wash basins etc.). Or any water used in buildings that contains no sewage.
Black Water: Commonly known as sewage – water containing human wastes and other biological
Ground Water: Water sourced in subterranean aquifers.
Water Efficiency: Various: Volume of water used per service unit e.g. MLitre/m^2 (floor area)/yr or Ml/m^2/occupant/yr

[1] Refer to the Common Carbon Metric for description of top-down and bottom-up approaches.

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CHAPTER 3: UNEP-SBCI Sustainable Buildings (SB) Index
Materials Technical Advisory Committee (TAC) – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related to materials use by the building sector; and
- To outline the mission and goals of the Materials TAC.

Overview of Key Issues

The building sector is responsible for more than one third of global resource consumption annually[i] and the manufacture of building materials consumes about ten percent of global energy supply.[ii] Construction and demolition waste contribute about 30 percent to solid waste streams in developed countries, with most waste associated with the demolition phase.[iii] While policy papers, technical studies, and developed tools are emerging in countries and industrial sectors, the holistic life-cycle perspective of building materials use, including reducing environmental impacts, improving efficiency and sustainable consumption is still largely missing.[iv] Therefore, a number of difficult issues must be considered for the SB Index to accurately measure and report on sustainable use of building materials.

Unprecedented Rates of Consumption

The current construction boom in Asia, particularly in China and India, is creating unprecedented demand for construction materials and products. In India, for example, the volume of new construction doubled from 2000 to 2005, while 50 percent of all new construction globally is occurring in China.[v] At such rates, the implication is that the majority of buildings that will exist in Asia in 2030 are not yet built. Population growth and rapid urbanization are key factors contributing to the pressure on building markets to rapidly increase the number of units, particularly in urban centres. This pressure is further accentuated by often poorly maintained and deteriorating existing building stock. Many buildings constructed in recent decades have been rapidly assembled with little consideration for durability, sustainability or environmental health. Standard solutions are also often copied from different locations with no consideration of the actual needs of the users and the local climate conditions. This situation can contribute to sub-standard, low-cost housing with high maintenance costs and short life spans.

Informal Construction

A significant proportion of construction activity occurs outside of formal economies and industrial building practices. In Brazil, for example, more than 50 percent of all low-cost homes are built by the informal sector.[vi] So called ‘illegal’ or ‘informal’ settlements drive demand for low quality or salvaged materials, which can lead to significant degradation of local natural resources and urban environmental quality. In these circumstances, there is an imperative to develop markets, enterprises and employment around the provision of appropriate, sustainable construction materials and systems. Reporting on progress made in sustainable materials use should therefore consider these issues, given the large contribution of informal construction in many countries.

Eliminating Waste

Avoiding waste over a building’s life-cycle is crucial to the sustainable performance of buildings and construction. Reporting on the resource efficiency of the building sector at a national scale has been conducted using hybrid methodologies for embodied energy analysis.[vii] These approaches calculate embodied energy from economic input/output tables augmented with process-energy case-studies. The amount of embodied energy in the construction and demolition waste stream has also been used to indicate the sustainability of resource use.[viii] Such calculations require data on the flow of materials through the building sector. This method can in turn also be used to generate an overview of how far from zero- construction waste an economy might be. Figure 1 shows an Australian example.

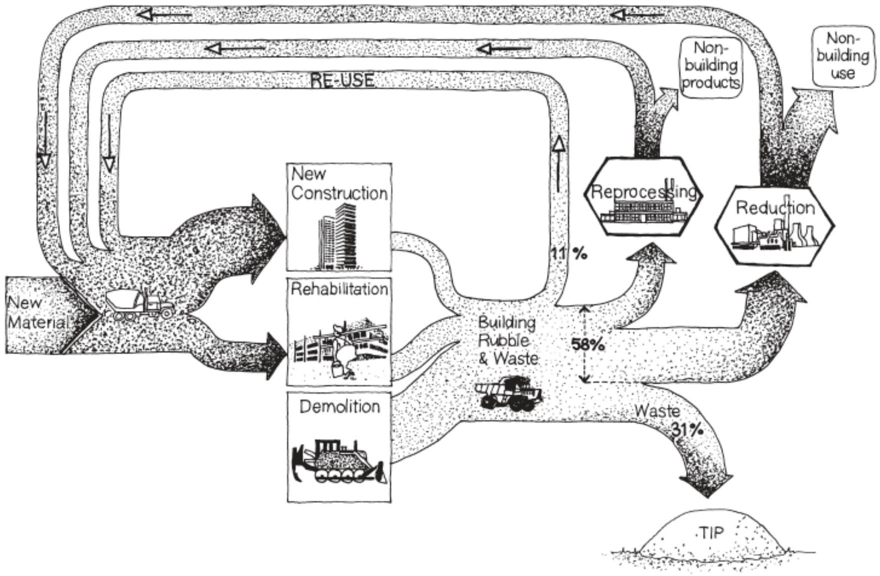

Figure 1. Proportion of waste, reuse and recycling of C&D material as indicators of the sustainability of material use in the Australian building sector.[ix]

Service Life and Adaptability

The contribution of building materials to sustainable development needs to be considered over the entire product and building life-cycle. Assuming data and tools are available, life-cycle environmental impacts can be addressed by Life-Cycle Assessment (LCA). Where LCA data does not exist, consideration could be given to the total service-life of buildings and whether buildings are designed to be technically, functionally and climatically adaptable.

Indicators of *technical adaptability* relate to space-plan flexibility, ease of access to building services and whether short-lived materials or layers can be removed without damaging long-lived layers.[x] [xi]Figure 2 shows how consideration of technical adaptability can be applied to the analysis of building designs.

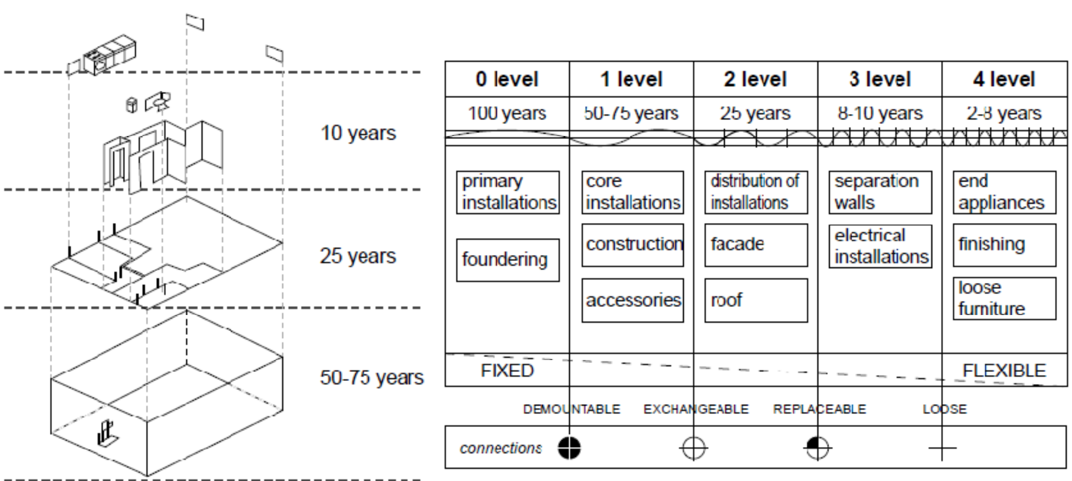

Figure 2. A 'Design for Adaptability' concept for a Dutch House showing relation to types of connections used in construction.[xii]

Functional adaptability is the ability of a building to be adaptively reused for a different purpose to that for which it was originally designed. This is indicated by qualities of design such as generous ceiling heights, over-designed structure, and high-levels of 'buildability' (a combination of simple, standardized construction and often prefabricated construction systems). Climate change adaptability requires the use or resilient materials, bioclimatic design strategies and integration of strategies for more autonomous provision of essential building services. The extent to which buildings are designed for deconstruction using recyclable materials is also an important indicator of the potential for future economic feasibility of achieving a zero-waste building sector.

Sustainable Material Use & Recycling

Materials can be used in sustainable ways. For example, materials sourced from certified sustainably managed resources, that are non- or low-toxic, can cause minimal ecological impacts, are low in embodied energy, durable, appropriate to their climate region, and require little maintenance. By default, materials must meet regulatory performance standards, as well as the aesthetic and economic expectations of the client. The implementation of eco-labeling programs according to the International Organisation for Standardisation (ISO) classification for building materials may also serve as a proxy indicator of progress toward sustainable material use at a sectoral level.

Although recycling building materials requires energy consumption, studies for some materials show that recycling materials still delivers net emissions savings. For example, following a life-cycle approach Balázs Sára[xiii] compared CO_2 emissions from produced recycled clay/gravel with and without selective dismantling and classification. The research indicates that CO_2 emissions were reduced from 107.7 kg to 6 kg per tonne of recycled clay/ gravel produced. Assuming data can be collected, recycling rates of specific materials that are significant in construction and demolition waste streams could be a useful sustainability indicator.

Mission and Goals of the Materials TAC

The mission of the Materials TAC is to develop measurement and reporting metrics, protocols and templates for the use of materials in buildings for inclusion in UNEP-SBCI SB Index. Previously, the UNEP-SBCI Benchmarking Think Tank (BTT) identified and ranked indicators for materials to be included in the SB Index (See Table 1). Debate about the indicators to select for the SB Index centered on whether the SB Index was reporting environmental performance (impacts), sustainability performance (variously defined relating to positive influence) or service performance (e.g. durability/adaptability).

Indicator	**%***	**Measurement**	**Target**
Resource use	25	Environmental product declaration/ LCA	Lowest impact materials possible
Resource depletion	25		
Use of recycled materials in construction	50		
Use materials from rapidly renewable sources	25		
Design material efficiency	50		

* Percentage (%) of agreed for each of the indicators rated by 4 groups of participants

Table 1: Top ranked indicators for materials indicators.

The goal of the BTT's process was restricted to a maximum of ten core issues and indicators for the index, therefore, they focused on *sustainability performance.* As shown in Table 1, the use of recycled material or its related measure of design material efficiency was the preferred *sustainability* indicator, calculated or measured from information based on available LCA data (See Table 2) with the established target being the lowest achievable materials impact.

Materials	Use of recycled materials in construction	% by mass	Environmental product declaration/ LCA

Table 2: Consensus Indicator for sustainable use of materials in buildings.[xiv]

There still remain unresolved issues concerning the indicator chosen, such as the applicability of the indicators to developing countries, access to data and accordance with a life-cycle approach and measurable, reportable and verifiable data. A key role for the Materials TAC is to consider these issues and develop a metric and protocol for measuring progress made toward the sustainable use of materials at the level of building stock.

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CHAPTER 4: UNEP-SBCI Sustainable Buildings (SB) Index
Social Issues Technical Advisory Committee (TAC) – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related to social issues of the building sector; and
- To outline the mission and goals of the Social Issues TAC.

Overview of Key Issues

Human health and comfort are fundamental requirements for sustainable buildings. The quality of the indoor environment presents direct health risks and impacts our productivity and satisfaction with buildings. However, there are unresolved concerns regarding the issue and indicators chosen, such as the applicability of the indicators to conditions in developing countries, access to data and the ability to aggregate IEQ analysis beyond building by building surveys. Variation in perceived comfort and quality that occur throughout human populations must be considered. A crucial goal for the Social Issues TAC is to consider indoor environmental quality issues and develop a metric and protocol for measuring progress made toward the contribution of buildings to social sustainability focusing initially on indoor environment quality at the level of building stock. The UNEP-SBCI BTT suggested indicator *'pollution level/m3,'* provides room for SB Index reports to respond to context-specific priorities by not specifying particular pollutants as indicators.

Indoor Pollution

Many common materials contain substances that are toxic and which can lead to serious health impacts and decrease in productivity. Indoor environments can become polluted from off-gassing from materials, bacteria or viruses in poorly maintained ventilation systems or finishes, or lack of fresh air. The use of solid fuel for cooking and heating, combined with inefficient combustion, poses a major health risk to people, particularly in developing countries. A range of factors influence levels of indoor pollution. The relationship between indoor air quality and ventilation is crucial because higher ventilation rates help disperse air-born contaminants. However, the predominant sources of pollution vary by building type and region and this issue needs to be reflected in performance reporting.

Solid Fuels

In residential buildings in many developing countries, indoor pollution from poorly combusted solid fuels, such as coal or biomass combined with poor ventilation are a major cause of serious illness and premature death.[i] Indoor pollution was estimated in 2006 to have contributed to more than 800,000 premature deaths in China and India.[ii] Lower respiratory infections such as pneumonia and tuberculosis linked to indoor pollution are estimated to cause about 11 percent of all human deaths globally each year.[iii] Women and children tend to be most at risk due to their daily exposure.[iv] Provision of electricity, efficient stoves and heaters enable major improvements in indoor conditions. These could perhaps be considered as proxy indicators in data poor areas. However, such strategies do not eliminate indoor pollution risks.

Sick Building Syndrome

Indoor air quality is also affected by off-gassing of synthetic and natural materials, as well as microbial triggers for allergies and asthma. Volatile Organic Compounds (VOCs) and hazardous chemicals are common in paints, adhesives, plastics and sealants. Emissions from these materials can build up indoors and lead to symptoms of 'sick-building syndrome' ranging from lethargy and irritated eyes, to respiratory problems and head-aches. For example, a study in Osaka, Japan found chemical concentrations exceeded the national safe minimum in more than 25 percent of households. Similarly, a study of office buildings in the United States found pollution levels indoors to be between two to five times, and sometimes up to 100 times, more concentrated than outdoors.[v] The annual cost of building-related sickness in the United States has been estimated at US$58 billion.[vi]

Increasing ventilation rates and using natural ventilation can reduce incidence of sick-building syndrome and spread of infectious diseases.[vii] However, increased use of energy efficiency measures such as constructing air-tight building envelopes have contributed to deterioration in indoor air quality, particularly in office buildings due to reduced ventilation.[viii] This can be avoided through integrated approaches to building design, in which key services such as IEQ and energy efficiency are considered together from conceptual design onwards.

Productivity & Satisfaction

Indoor air quality, along with illumination, thermal comfort, noise levels and ergonomics affect levels of satisfaction with, and productivity of building occupants and ultimately the cost of doing business.[ix] Poor IEQ has been shown to adversely affect the performance of students.[x] In health-care facilities improving day-lighting, providing access to windows with views and sunlight, and reducing noise levels have been linked to improved healing and reduced stress in patients.[xi] Productivity is also linked to thermal comfort. For example, concentration becomes difficult and productivity drops by as much as 20 percent for each additional 1°C degree of heating above 26°C.[xii]

Understanding and optimizing the relationship between these variables has been of prime concern in commercial office design where good IEQ has been linked to higher rental returns, increased profitability due to improved worker productivity, reduced health-related costs and increased job satisfaction.[xiii] Research from the United Kingdom estimates that a two to five percent increase in staff performance can cover an organization's annual accommodation costs. The same study found that the quality of workplaces contributes about 25 percent to job satisfaction, thus affecting staff performance and associated costs. For example, in New York office buildings, cost savings of between US$31/$m^2$ - $66/$m^2$ have been attributed to improved air quality.[xiv] Estimates of the overall economic value of good IEQ have been as high as US$200 billion/yr.[xv] Therefore, if all other financial and performance factors are equal, buildings with good IEQ are more likely to be more productive, profitable and healthy places to live and work.

Thermal Comfort

Thermal Comfort can be defined both psychologically and physiologically. According to the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), thermal comfort is a state of satisfaction with the surrounding environment.[xvi] Physiologically, thermal comfort relates to the lack of physical discomfort with surrounding environmental conditions and is influenced most by ambient temperature, humidity, air-flow, clothing and metabolism. While the most widely used building-related thermal comfort indicator is Predicted Mean Vote (PMV)[xvii], it may not be the most appropriate indicator for the influences of thermal comfort in buildings for sustainability reporting.

Energy Poverty

Energy poverty can be described as the inability to afford space-heating/cooling to maintain average room temperatures of 21°C in the main living space and 18°C in other occupied rooms.[xviii] Long exposure to temperatures less than 10°C can increase our susceptibility to influenza,[xix] while prolonged exposure to temperatures above 35°C can lead to heat stress and hyperthermia.[xx] Many people are experiencing energy poverty, meaning they cannot afford to adequately heat or cool their homes and avoid such extremes. Many low-income people also live in low-quality housing, which tend to be poorly insulated and serviced by poor-quality and inefficient appliances. Operational costs can therefore be relatively high, trapping households in situations where affording thermal comfort becomes increasingly difficult. People are also considered living in energy poverty when they have no choice but to use fuels such as biomass, waste or dung, or have no access to electricity. Collectively, these conditions affect approximately 4 billion people worldwide, around 60 percent of humanity.

Climate Change & Urban Heating

Urban heat island effects are becoming more pronounced. Increased urban temperatures in turn challenge the ability of buildings to provide healthy and thermally comfortable indoor conditions. Perhaps most challenged are aged-care and health facilities. However, bioclimatic design and careful integration of natural ventilation in the design of health-care facilities has been shown to improve their resilience.[xxi]

Increased urban temperatures have been linked to increased incidence of infectious diseases. Increased night-time temperatures in tropical cities have also led to increased incidence of sleep-disorders. In Tokyo economic losses associated with insomnia were estimated to be in the order of US$3.2 billion.[xxii]

Given the range of issues influenced by and affecting thermal comfort in buildings, the suggested indicator – Predicted Mean Vote - may not be sufficient, particularly when trying to provide an aggregated performance report. Paying careful attention to climate-zone, building type and climate change vulnerability will be necessary for reporting. In addition, design-based indicators such as integration of bio-climatic and adaptable design features may provide a top-down view of the potential resilience of building stock to climate change.

Mission and Goals of the Social Issues TAC

The mission of the Social Issues TAC is to develop measurement and reporting metrics, protocols and templates for contributions of buildings to social sustainability for inclusion in UNEP-SBCI SB Index. There are a number of key social issues that directly influence the contribution of the building sector to social sustainability. Some of these include rates of employment and green jobs, provision of equitable, safe and decent working conditions,[xxiii] and Indoor Environmental Quality (IEQ). UNEP-SBCI Benchmarking Think Tank (BTT) considered IEQ as the most appropriate to include in the core of the SB Index. Appropriate Indicators for the large range of performance factors that contribute to IEQ were then ranked. Four key indicators for IEQ are identified below (See Table 1).

Issue	Indicator	Unit	Measurement
Indoor Environmental Quality (IEQ)	Indoor air pollutants level	Pollutant level/m^3	Sample measurement/ simulation
	Lighting for suitable task	Lux	
	Noise	dB	
	Thermal comfort	PMV Index	

Table 1: Consensus performance Indicators for IEQ in buildings.[xxiv]

Indoor environmental quality: "The physical and perceptual attributes of indoor spaces in the building, including indoor air quality and their thermal, acoustic and visual properties."[xxv]

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CHAPTER 5: UNEP-SBCI Sustainable Buildings (SB) Index
Biodiversity Technical Advisory Committee – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related the building sector's impact on biodiversity; and
- To outline the mission and goals for the Biodiversity TAC.

Overview of Key Issues

The United Nations has declared 2010 as the *International Year of Biodiversity* with the goal of returning to mainstream consciousness the understanding that we rely upon the incredible diversity of life on Earth for our fundamental survival. Global biological diversity is declining and the loss of biological diversity is considered one of the major environmental threats to continued human survival and opportunity. UNEP's latest Global Biodiversity Outlook presents a clear warning that failing to halt biodiversity loss could undermine the viability of human society:

"It is clear that continuing with business as usual will jeopardize the future of all human societies…" [i]

Biological diversity is a necessary aspect of resilient ecosystems and provides humans with the biological resources required to support our ways of life and our building industries. The building industry relies on biodiversity for providing essential ecosystem services[1] that provide materials such as timber and natural fibers, treat sewage, storm-water and organic matter, purify air and soil and maintain healthy drinking water. At the same time, biodiversity is directly threatened by the building sector.[ii]

Terrestrial Ecosystems

Only about 18 percent of the Earth's surface is arable or able to provide ecosystem services. Built environments and roads take up to two percent of this available land but demand is increasing.[iii] Urbanization is a significant contributor to biodiversity loss through land conversion. When land is developed for housing or infrastructure, there is generally a decline in biodiversity in the area directly affected by the change in use. Urban sprawl in particular poses a key threat to natural and agricultural biodiversity and has led to the eradication or fragmentation of many habitats and the introduction of invasive species.[iv] In the United States for example, the total area of suburban settlement far exceeds the total combined area of National Parks and conservation areas.[v]

Urban sprawl is one of the largest causes of local species extinction. Increases in the number of small households, normally manifest as urban sprawl, are occurring more rapidly in 'biodiversity hot spots,[2] which more severely limits biodiversity conservation.[vi] Grasslands and savannah ecosystems have been among the most impacted. According to UNEP, more than 90 percent of North American grasslands have been lost.[vii]

Increasing urban density and urban 'brown-field' development can reduce direct losses of biodiversity. However, urban planning must integrate and protect green-space, wildlife corridors and food production in dense urban areas. Otherwise, the urban impacts on biodiversity are simply exported to remote ecosystems. In central and southern Africa, for example, significant woodlands such as the Miombo are being degraded by wood extraction for building materials and fuel. Freshwater demand for human settlements is growing with inland cities placing pressures on river ecosystems for freshwater supply and as a sink for wastes.[viii] More than 80 percent of the Jordan rivers waters, for example, are diverted for irrigation and urban consumption, before it reaches the Dead Sea.[ix]

Biodiversity of areas in which minerals for buildings are derived are initially completely destroyed by mining operations and potentially degraded by mine wastes and tailings. Some materials, particularly heavy metals like zinc, copper, chromium, mercury, cadmium and lead, persist in the environment after they have been extracted and processed and can build up in ecosystems over time.

[1] *Ecosystem services* are the benefits obtained from ecosystems including food, water, timber, regulation of weather, climate, disease, wastes and water quality. Supporting services such as soil formation, photosynthesis and nutrient cycling. Also, cultural services such as recreation, aesthetics, spiritual benefits. Source: Newman & Jennings 2008 *Cities as Ecosystems: Principles and Practices* Island Press Washington DC.

2 Areas rich in endemic species and threatened by human activities Source: Liu et al. 2003 *Nature* Vol. 421, December pp530-533

Forest Ecosystems

Forests are home to about two-thirds of all known species. They have the greatest species diversity of any type of ecosystem, and contain the largest number of threatened species. However, many are also in decline. Globally, we lose approximately 13 million hectares of forest each year. The building industry uses approximately 875 million cubic meters of timber in construction globally each year, which accounts for 25 percent of global wood consumption annually.[x] In the United States, Scandinavia and Australia, timber is the predominant building material for domestic construction.[xi] Timber specification may therefore have severe consequences on biological diversity if not sourced from third-party certified sustainably managed forests. Countries like the United States[xii] and the United Kingdom[xiii] import the majority of the timber they require. It is therefore harder to determine its source.

Deforestation is also directly related to urban development. In Brisbane, Australia, for example, only 600 of the 6000 hectares of pre-settlement rainforest have survived since the city's establishment in the 1840s. In the Sydney region, less than one percent of the original blue gum high forests and less than 0.5 percent of turpentine-ironbark forests remain.[xiv]

Coastal Ecosystems

Habitat loss in coastal areas as a result of urban encroachment is a major concern. With 60 percent of humans living within 100 kilometers of the coastline, it is not surprising that approximately 51 percent of the world's coastal ecosystems are considered at 'significant risk of degradation.'[xv] Key habitats such as mangrove forests are being lost at a rate of 1000km^2/yr. Average rates of mangrove loss have slowed in regions other than Asia, the region where more than 50 percent of all construction takes place.[xvi]

Coastal development for housing, tourism, industry and infrastructure are also causing other significant impacts in marine ecosystems including degradation of sea-grass and coral reefs due to, for example, effluent discharge, land-reclamation, dredging, and shoreline construction.[xvii] Large-scale mining for building materials such as sand and aggregate also occurs in coastal zones. In the United Kingdom, for example, reports suggest an increasing proportion of the 300 million tonnes of aggregate consumed each year is being quarried in coastal areas.[xviii]

Climate Change

Under conditions of climate change, diversity provides choice, while homogeneity creates vulnerability. Loss of biodiversity at all scales from genetic to species and ecosystems, tests the resilience of ecosystems. The building sector has a major influence on climate change, being directly responsible for about one third of all energy-related emissions.[xix] However, as this briefing demonstrates, it also directly and indirectly contributes to biodiversity loss and therefore undermines humanity's ability to adapt to climate change.

Building's adaptive capacity is therefore imperative. This can be done by regenerating, protecting and developing biodiversity and ecosystem services within built-environments, and through reforms in the building supply chain such as:[xx][xxi][xxii]

- Increasing greater efficiency in land-use, resource production and consumption;
- Encouraging energy efficient and low GHG emission buildings, communities and cities;
- Planning land-use to provide integrated urban ecological and agricultural developments;
- Slowing urban sprawl and integrating habitat into higher-density urban developments; and
- Building developments that provide ecosystem services such as water treatment and reuse, food, and energy generation.

There are winners and losers as climate change impacts ecosystems. It is the poorest human communities, which rely more directly on ecosystem services for their subsistence which are therefore most vulnerable. Biodiversity is fundamental to the resilience of all human societies. Our settlements therefore must tackle climate change in a coordinated way from an ecological and biodiversity perspective, as well as from a resource efficiency perspective.

Adopting an ecological approach to addressing climate change and supporting biodiversity, provides a greater diversity of technical, biophysical, and cultural development options, provides a greater chance of a sustainable future.

Mission and Goals of the Biodiversity TAC

The mission of the Biodiversity TAC is to consider the issues related to land-use and develop related measurement and reporting metrics, protocols and templates for buildings to include biodiversity in UNEP-SBCI SB Index. Previous work by the UNEP-SBCI Benchmarking Think Tank (BTT) on metrics for building performance, developed consensus around the need to include consideration of biodiversity and land-use in the core set of SB Index issues (See Table 1). Further workshops and ranking led to amalgamation of these issues into one indicator for 'land-use and ecology' (See Table 2).

Biodiversity	Impact of construction and operation of a building on local indices of habitat preservation and species conservation.
Land use	The land removed from the natural environment due to the development of a building

Table 1. Core issues relating to biodiversity and land-use after two Delphi rounds.

Issue	**Indicator**	**Unit**	**Measurement**	**Target**
Land use and ecology	Land site previously built on and avoided green field site	Yes/no	Observation	Zero or positive impacts on biodiversity

Table 2. Amalgamated issues and highest ranked indicator recommended for the SB Index after workshops.

Loss, degradation, fragmentation of habitat, species extinction, introduction of exotic species, and genetic assimilation are exacerbated by building activity due to the extraction of resources - particularly rainforest timber, changing land-use through urbanization, as well as water extraction and pollution.[xxiii] Climate change is an added pressure on biodiversity. Building-related risks to biodiversity loss are arguably greatest due to factors such as building design and supply chains, as well as urban planning policy and design.

Buildings and built environments can also regenerate biodiversity. Integration of habitat into building developments, regenerating habitat in urban areas, providing areas for food production, introducing wetland areas for treating wastewater, and selecting timber from third-party certified sustainable sources can all make a positive contribution. Minimizing energy consumption to reduce greenhouse gas (GHG) emissions and selecting building sites that are neither bio-diverse nor in proximity to fragile natural areas can make a positive contribution in regenerating or protecting biodiversity. Increasing urban density can reduce pressure for land-use changes by avoiding sprawl. However, provisions need to be made for the integration of habitat and other ecosystem services in higher density forms of the urban development.

Given the scope of such influences, measuring impacts on or contributions to biodiversity at the level of the building site alone may not be as appropriate as developing a more system-focused and life-cycle based indicator. The goal for the biodiversity TAC is to devise a metric by which to measure, report and verify the building sectors influence and progress related to protection of species loss.

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CHAPTER 6: UNEP-SBCI: Sustainable Buildings (SB) Index
Economics Technical Advisory Committee – Briefing Note

Purpose of this Briefing:

- To provide a general overview of key issues related to the economics of sustainable buildings; and
- To outline the mission and goals for the Economics TAC.

Overview of Key Issues[i]

Groups of actors, their roles and interests

When considering groups of actors in property markets in relation to key performance indicators and benchmarks for sustainable buildings, the discussion has to take a wider scope and move beyond mere single actors and their individual interests. This is because property and construction market actors require constant dialogue and interaction. Secondly, an evaluation of buildings' or property investment products' advantages can only take place within a specific context of a selected group of actors and their respective role, views and interests. This means that the choice of appropriate indicators and benchmarks depends on the individual actors' perspective, operational time horizon and preferred methods for measuring financial costs and benefits. Each of these influencing factors can differ not only between groups of actors, but also within a single group of actors. They can also change over time. For example, a single financial institution can be a property lender, tenant, landlord, buyer, seller, asset and fund manager and investor in indirect property, all at the same time. Consequently, clearly distinguishing between groups of actors and their roles is difficult. This is compounded by the current scarcity of information on buildings' sustainability performance and the lack of structure and standardization for necessary information flow between these key actors.

Possible 'Top-Down' Indicators

From a building stock or portfolio perspective, reporting the compliance of property investment products with the principles of sustainable development or Socially Responsible Investing can, for the moment, can be done using a combination of green building labels and certificates and by checking compliance with standards like the Global Reporting Initiative (GRI). Possible Indicators include:

- Purchase and/or disposal of property assets that meet/don't meet predefined environmental and social performance requirements;
- Investments in new building projects that are designed, constructed and subsequently managed according to the requirements of sustainable buildings;
- Investments in the existing building stock in order to systematically improve sustainability performance; and
- Investments in community projects such as affordable housing and urban revitalization in order to foster a more sustainable society.

As with single buildings, sustainable property investment products (e.g. 'green' Real Estate Investment Trusts, unlisted 'green' funds, etc.) can be reviewed as to their relative risk-return ratio compared to conventional property investments; relative attractiveness for Socially Responsible Investment (SRI)-interested investors; and stability of value and higher value growth potential. However, sustainable property investment products are more than just a set of sustainable buildings. They might also qualify as 'sustainable' by virtue of their active portfolio management which adheres to the principles of sustainable development; inclusion of sustainability issues within the product prospectus; and/or the inclusion of sustainability issues within their annual report.

Possible 'Bottom-Up' Indicators

At the level of individual buildings, more specific quantitative indicators may be applicable. These are shown in Figure 1 below in relation to the most concerned stakeholders. Questions relating to the development and application of indicators for assessing the economic aspects of sustainable buildings remain the subject of scientific discussion[1]. Possible building level indicators include comparing the:

- ***Risk Return Ratio*** of a sustainable investment to that of a conventional investment;

[1] For example, at the international level through ISO TC 59 SC 14 and SC17 and in Europe through CEN TC 350

- ***Investment Performance/Total Return*** of sustainable property investments to those of conventional property investments;
- ***Construction Cost/Additional Construction Cost*** of sustainable buildings to those of similar conventional construction;
- ***Life-cycle cost/total cost of ownership/Full cost,*** over time, of space in a sustainable building in annualized format;
- ***Occupational cost attributable to tenants*** in a sustainable building versus those in a conventional building;
- ***Maintenance & repair costs attributable to owner*** in a sustainable building to those in a conventional building;
- ***Rental Growth Net of Depreciation*** (Including the prevailing vacancy rates) in sustainable buildings to that of conventional buildings.
- ***Capital Value Growth*** in sustainable buildings compared to that in conventional buildings; and
- ***Asset Specific Risk*** *(*investment risk premium) attributable to sustainable buildings to that of conventional buildings.

Indicators of interest / Actors & their roles	Risk return ratio	Investment performance / Total return	Construction cost / Additional construction cost	Life cycle cost / total cost of ownership / Full cost	Level of operating costs non attribuable to tenant	Rent Level	Value/Stability & development of value	Risk asset specific
Individual & institutional investors with medium to long term interests	✓	✓		✓			✓	✓
Individual & institutional investors with medium to short term interests	✓	✓					✓	✓
Project developers			✓			✓	✓	✓
Landlords / awarding authorities and buyers of rental assets		✓	✓	✓	✓	✓	✓	✓
Awarding authorities and buyers/ owners of self-occupied assets			✓	✓			✓	✓
Tenants					✓		✓	
Financiers	✓	✓	✓	✓		✓	✓	✓
Fund managers	✓	✓		✓	✓	✓	✓	✓

Figure 1: Summary of Possible Financial Indicators and relevance to different stakeholders.[ii]

Mission and Goals for the Economics TAC

The mission of the Economics TAC is to develop measurement and reporting metrics, protocols and templates to report on investment in sustainable buildings for inclusion in UNEP-SBCI SB Index. The Index shall focus on measureable, reportable, and verifiable indicators, be applicable to existing residential and non-residential buildings and facilitate both top-down and bottom-up aggregation of the performance of building stock[2] and based

[2] Refer to the Common Carbon Metric for description of top-down and bottom-up approaches.

on key reports commissioned by UNEP-SBCI to identify core issues for monitoring the 'sustainability' of buildings presented a basic consensus on ten issues.

Economic Issues are added to flush out the true scope of SB Index and as important common issues in the context of life-cycle costing. Consensus has not yet been reached on economic metrics for inclusion in the SB Index. However, the authors of the UNEP-SBCI Benchmarking Think Tank report suggested the inclusion of a form of life-cycle costing as an indicator, in order to provide a place-holder for consideration of economic issues (See Table 1).

	Life cycle costing	Annualised total life cycle cost	US$/m^2/yr	Calculation

Table 1: Consensus Indicator for economics of sustainable buildings.[iii]

Measurement and Reporting Protocols

A recent report commissioned jointly by UNEP-SBCI and UNEP Finance Initiative (UNEP FI)[iv] demonstrates that within the property sector sustainability issues link to financial performance in many ways. In some cases, the relationships are straightforward, and in others, they are less clear and more difficult to measure. There is a need to link information from different and diverse sources over the life-cycle of a building. There is also a need to bridge the gap between financial, environmental, social, physical and technical performance measures in order to establish the necessary feedback mechanisms to incentivize and value sustainable buildings within the property industry.

Integration of the traditional methods and tools for valuation, risk analysis and cost estimation with the methods and tools developed by the sustainable building community for assessing and communicating the contribution of buildings to sustainable development will be necessary. Distinctions need to be made between indicators for reporting trends in investment at a portfolio or building stock level, and indicators for reporting the financial performance of investments in individual sustainable building projects. Consideration must also be given to broader market conditions at the time of investment or reporting.

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