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Buildings and construction as tools for promoting more sustainable patterns of consumption and production

Mainstreaming sustainability and sustainable use of energy in particular as a principle of urban development has emerged as a crucial challenge. This Brief examines current issues in the area of sustainable buildings and construction, and looks at policies that would need to be implemented to mainstream sustainability in that sector.

The global level of urbanization has recently reached the 50 per cent watershed. Urbanization will continue to expand rapidly. It will touch upon the lives and energy consumption patterns of hundreds of millions of people, who are going to move to urban areas which are being built right now. One of the crucial questions of our time is how to mainstream sustainability, and sustainable use of energy in particular, as a key principle of urban development.

Buildings and urban infrastructure create the framework for our daily life. Real estate represents a massive share of public and private property, and its long-term value is linked with financial stability. As major sectors of national economies, both production of building materials and construction create hundreds of millions of jobs all over the world.

From a life-cycle perspective products from only three areas of consumption — food and drink, private transportation, and housing — together are responsible

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Photo: *Indian Health Institute under construction. Architect: Ashok Lall.*

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for 70-80 per cent of the environmental impacts of private consumption. Both housing and mobility are interdependent key elements of the built environment. About 30 per cent of carbon dioxide emissions are caused by fossil-based energy that is used in buildings.

Achieving sustainability of the built environment is not only a local but also a global challenge. It depends on overcoming major hurdles illustrated by the following numbers:

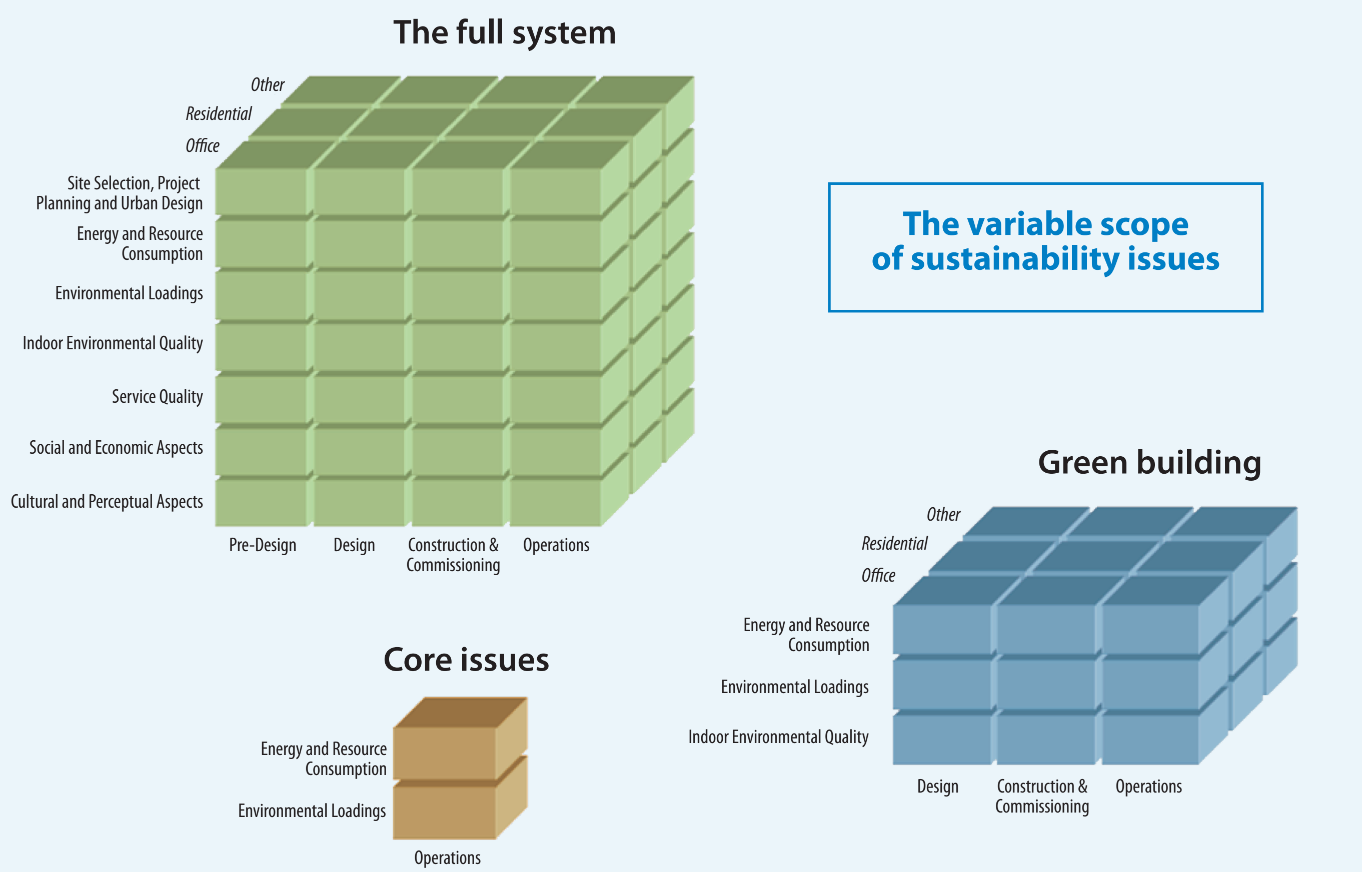
- 1.8 billion people are expected to suffer from fresh water scarcity by 2025, mostly in Asia and Africa.
- 1.6 billion people are without access to modern energy.
- Each year, 2 million people globally die prematurely due to indoor and outdoor air pollution.
- Currently, 1 billion people are slum dwellers, lacking clean water and sanitation.
- Millions of people are threatened by flooding related to climate change.

The overall challenge posed by land use, construction and real estate is massive throughout societies, both at the macro and micro levels. The impact of decisions in these sectors can be immeasurably long-term. It is not possible to reach any sustainability targets if the built environment and its stakeholders are not included in the effort. This brief highlights some facts and current debates concerning Sustainable Buildings and Construction (SBC).

What is Sustainable Construction? What are Sustainable Buildings?

Construction refers to the production processes of new buildings and infrastructure, as well as

Figure 1



Source: Nils Larsson, iiSBE

to their refurbishment and reconstruction. In discussing *buildings* we refer to the consumption phase, which covers the use, operation and maintenance of existing buildings. The production processes represent the supply side with the involvement of the building materials and construction industries, as well as engineering and design professions, among others. Occupation of spaces and maintaining the functionality of their structural and mechanical systems can be understood as the demand side, with both the owners of real estate and users of space in charge.

With a few exceptions this text focuses on buildings, even if it is difficult to outline system boundaries between a house, a city block, a community, an urban or rural settlement, and a megacity. Mobility and urban infrastructure are elements linking individual buildings with each other. However, municipalities as systems of governance and providers of basic services are much more than just built environments.

There is no universal definition of sustainable construction. It is constantly evolving as our understanding of the complexity of the issues increases. Participants of the Marrakech Task Force on Sustainable Buildings and Construction worked out definitions of SBC. Out of a variety of possible formulations, one is included here as food for thought. It is based on an earlier ISO description: "Sustainable construction brings about the required performance with the least unfavourable ecological impacts while encouraging economic, social and cultural improvement at local, regional and global level."

The concept of sustainability of buildings and construction covers not only environmental or ecological ("green") aspects, but also economic, social and societal aspects of the built environment. All these dimensions have to be considered from a long-term, life-cycle perspective. The assessment of economic sustainability considers not only the initial investment in land and construction, but also questions such as the cost of maintaining and operating a building over a longer period of time. Social and societal sustainability covers issues which are often closely linked with economic and environmental ones, such as access to basic services, upgrading poor housing conditions, creating decent jobs, fair trade of construction materials, transparency of tenders for contracts, cultural values embedded in old buildings, and accessibility to buildings.

Figure 1 illustrates the broader scopes of issues to be assessed in green and sustainable buildings, compared to traditional assessment of building performance. The smallest box highlights the common view that the environmental loadings caused by energy and resource consumption during the operational phase of a building are the core variables to be monitored. The selection of these core issues reflects the present emphasis of both the public and professional debates on climate issues. However, sustainable buildings have many more criteria to fulfill. For "green" buildings (the middle-size box), more phases of the building life-cycle are considered, and indoor environmental quality is added as a variable. For sustainable buildings (the bigger box), the numbers of variables and stages of the building life-cycle considered are even larger. Besides the variables shown on Figure 1, two more dimensions are often added to the full system: the impacts of the production and transport of construction materials, and the mobility impacts of the selection of a certain construction site.

The life-cycle of a building is a process, which starts with the formulation of a need to construct, the selection of a site and preliminary planning. Construction itself covers a rather short period, in contrast to the use and reuse of buildings, eventually ending in the demolition of the building and waste management, or deconstruction and reuse of building elements. The process can take anything from a few years up to hundreds of years. During every phase of the life cycle, decisions are made concerning the performance of the building, with or without consideration of the full potential impacts of these decisions.

The "layman's checklist" (**Table 1**) is an indicative table that covers some of the phases of the life cycle of a building; the most basic environmental, economic, social, societal and cultural issues that have to be considered; and possible impacts of the production and consumption choices that are made.

Measuring progress. The implementation of sustainability requires that there is a consensus at the local level of what is the baseline condition on various dimensions (water, heating, cooling, floor area per inhabitant or office worker, average room temperature, minimum level of lighting, maximum level of noise, etc.), the "business as usual", against which progress is measured. This means that measurable targets and minimum requirements and their indicators have to be defined. Additionally, a system and a timeline for monitoring and reporting performance have to be decided upon, including sharing of responsibilities — who does what.

At the beginning of any construction project, before setting their own priorities, the stakeholders need to be aware of the great variety of issues that should be re-evaluated from the perspectives of sustainability and life-cycle. A similar evaluation is needed when the appropriateness of national or municipal building policies is assessed.

Assessment, rating, labelling and certification. Different evaluation systems have different tasks to fulfil, depending on the phase of the building's life-cycle during which they are used. The basic questions are: How well does the building perform? What kind of performance is meant, and when is it measured — is it the predicted performance which is assessed

Table 1

Layman's Checklist of Issues to Be Considered in Sustainable Buildings and Construction

LIFE CYCLE	SUSTAINABILITY ISSUES			POTENTIAL IMPACTS	
Phase of the cycle	*Consumption of natural resources*	*Consumption of financial resources*	*Human conditions*	*Negative impacts*	*Positive impacts & co-benefits*
• production of construction materials • selection of a construction site • design (architectural, engineering, technical) • procurement of materials and construction works • construction • maintenance of the building • refurbishment • reuse of buildings • recycling of construction materials	• land • freshwater • non-renewable energy sources • renewable energy sources • wood • metals • minerals • stone, gravel	• initial investment • material vs. labour costs • bribery costs • operational costs, including water and energy • maintenance costs • refurbishment costs • long-term value of property • transport costs of construction materials • waste management costs	• access to freshwater and sanitation • access to clean energy • availability of public transport • accessibility of services and amenities • indoor air quality • decent housing • structural safety • security in the community • cultural value of existing buildings • decent work	• disruption of ecosystems due to land-use changes • pollution of air, soil and water • contribution to climate change • waste • traffic congestion • noise • informal settlements • corruption • poor return on investment	• reduced consumption of non-renewable resources • energy savings • clean water • improved human health • job creation • workplace safety • transparent governance • saved financial resources • buildings as collateral

Source: Author's elaboration

at the design stage, or the actual performance during the operation of the building? To what is the performance of the building being compared — is it compared to set standards or to other similar buildings? For what purpose is the performance assessment needed — e.g., for evaluating returns on real estate investments, for measuring national contributions to climate change mitigation?

Rating gives a score or result relative to a norm or benchmark. Ratings can be based on self-assessment or carried out by third parties. Certification means the validation of a rating or assessment result by a knowledgeable third party that is independent of both the developer and designer, and the developer of the tool used. Labelling gives proof of a rating or certification result which has been issued by the certifier. A great number of evaluation and certification systems have been developed, such as LEED in North America, BREEAM in the UK, HQE in France, CASBEE in Japan, GRIHA in India (**Box 1**), HK-BEAM in Hong Kong, PromisE in Finland, MINERGIE in Switzerland, Protocollo ITACA in Italy, SBTool as a generic R&D platform, and several others. Even if many of the challenges are global and similar indicators can be used, any rating or labelling system should be adapted to its region of use.

When the rating system is developed within a specific region, it can contain assumptions about appropriate performance benchmarks and the relative importance of issues such as water resources, energy resources, risk of

Box 1

GRIHA, the Indian rating system for buildings

GRIHA stands for Green Rating for Integrated Habitat Assessment, the National Rating System of India. Internationally, voluntary building rating systems have been instrumental in raising awareness. However, most of the existing rating systems have been tailored to suit the building industry of the country where they were developed. That is why The Energy and Resources Institute (TERI), jointly with the Ministry of New and Renewable Energy (MNRE) of India, took the responsibility of developing a tool for measuring and rating a building's environmental performance in the context of India's varied climate and building practices.

GRIHA is a building 'design evaluation system' which is suitable for all kinds of buildings. The aim is to minimize the demand for non-renewable resources by focusing on reducing water and energy consumption, limiting waste generation through recycling, and reducing pollution. GRIHA emphasizes cost effectiveness and the integration of traditional heritage with scientific tools. GRIHA is a rating tool that helps people assess the performance of their building against certain nationally acceptable benchmarks. It will evaluate the environmental performance of a building holistically over its entire life cycle. An appraisal of the guidelines and criteria may be done every three years.

The Government of India, the MNRE specifically, has recently announced that all government buildings must be at a minimum 3-star GRIHA compliant. In addition, the Energy Conservation Building Code (ECBC) has been made mandatory in eight States of India.

Top photo: *Holcim office building in Costa Rica. Architect: Bruno Stagno.*

Bottom photo: *Development Alternatives Headquarters, India. Architect: Ashok Lall.*

earthquakes or flooding, local climate, solar hours, cultural aspects, availability of some materials, and so on. An overview of some of the systems has been published, among others, by UNEP Sustainable Buildings and Climate Initiative and Finance Initiative: *Financial & Sustainability Metrics Report.*

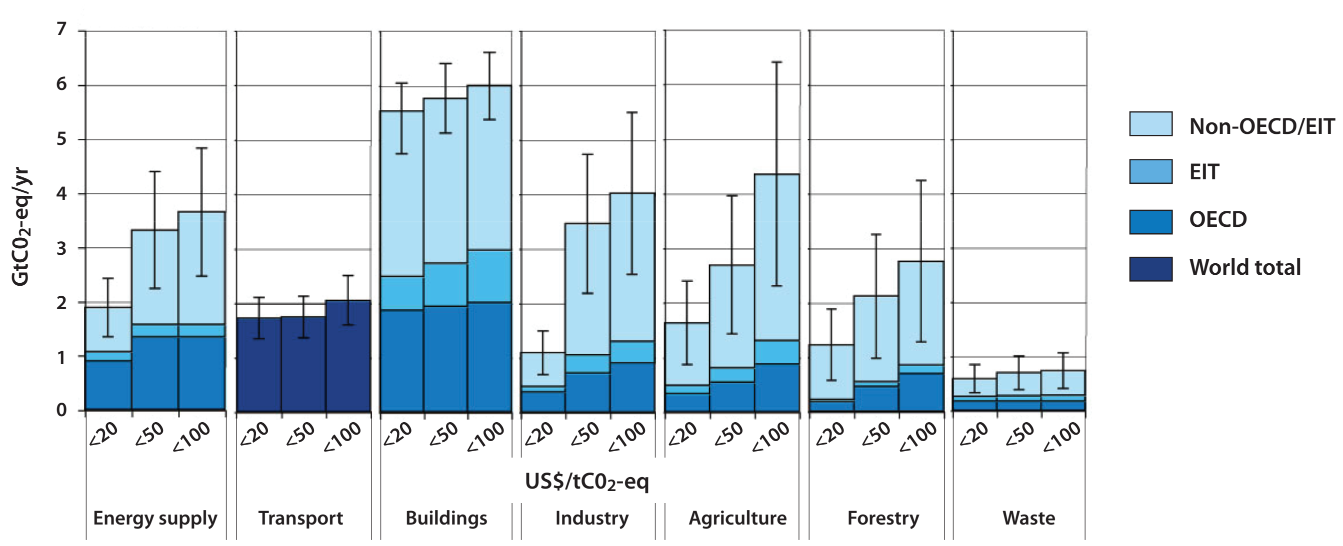
Availability of technology. Sustainable construction does not require expensive new technology. It is necessary to acknowledge the many advances of 20th century modern architecture, such as an increased interest in housing issues, and the development of industrial mass production of building elements, which has made many products available at a lower cost. But by now, we are also familiar with the negative impacts of the so-called International Style, which led to a non-critical dissemination of the same modes of construction all over the world. It resulted in buildings that apply similar solutions and technologies regardless of the local climate, or local patterns of space use and maintenance. These buildings not only waste resources, but age rapidly and are difficult to refurbish and reuse. Mass housing or office buildings built since the 1960s across the globe offer examples of this.

In every climatic and cultural region, much can be learned from traditional architecture regarding, for example, orientation of buildings on the site, the use of local materials, and heating and ventilation systems. The skill needed now is to translate the traditional knowledge into responses to contemporary demands. Examples from around the world show that this is possible.

Connecting stakeholders. The process of financing, commissioning, designing, constructing, using, operating, maintaining and refurbishing buildings is long and complex. This means not only that several different actors and professions are going to be involved, but also that the owner, the user and the operator of a building do not automatically share the same priorities. In order to have a positive impact, it is necessary to engage different stakeholders

Figure 2

Economic mitigation potentials by sector in 2030, estimated from bottom-up studies



Source: IPCC (2007).

and have input at several stages of the process, starting with the land owner and ending up with the caretaker of the building. The design decisions that are made at the beginning of the process have the greatest impact. For this reason, the viewpoints of as many experts and stakeholders as possible should be integrated into the process as early as possible.

CSER. The concept of Corporate Social and Environmental Responsibility (CSER) implies that a private company not only acts according to local legislation but is proactive in looking for solutions to improve its sustainability performance. The Global Reporting Initiative (GRI) offers tools for companies to assess their performance. GRI is presently working with construction and real estate companies and their stakeholders to create sector-specific commentary on its more generic G3 reporting guidelines and additional sector-specific performance indicators. The UNEP Finance Initiative (FI), together with sector stakeholders, has developed Principles for Responsible Investment (PRI). UNEP FI has a specialized working group on property investing, which has published a number of useful reports and toolkits, including *Owner-Tenant Engagement in Responsible Property Investing* and *Responsible Property Investing — Committing and Engaging*, both of which are available on the UNEP FI website. A practical example comes from India, where the *Green Pledge* aims to engage the leaders of the corporate world in committing to sustainable building practices and moving towards a sustainable built environment. The appeal was announced in January 2010, and it has been initiated by the Ministry of New and Renewable Energy of India. The pledge will be taken forward by the GRIHA Secretariat.

Corruption. Real estate development and construction are infamous for corruption all over the world. The most perfect legislation, the clearest guidelines and the best of intentions do not make construction any more sustainable, if corruption cuts the long process into fragments and pushes original goals aside.

Transparency International (TI) has developed a Project Anti-Corruption System (PACS) specifically for construction projects. The continuing prevalence of corruption in construction projects requires governments, funders and project owners to take preventive measures to limit corruption on a project-by-project basis. PACS is designed for this purpose.

Buildings and Climate Change

Worldwide, roughly 40 per cent of all energy produced is consumed in buildings, which translates to about 30 per cent of all carbon dioxide emissions. The 4th assessment report (2007) of the Intergovernmental Panel on Climate Change (IPCC) compares the emission reduction potential of various sectors with the costs of implementing them (**Figure 2**). The comparison makes it clear that buildings are one of the "low-hanging fruits", where the huge emission-savings potential is the cheapest to implement.

The key fact is that, while the high level of emissions from the production of construction materials and the resulting embodied energy must not be underestimated, the focus has to be on the operational phase of the building,

Box 2

Energy consumption benchmarks for sustainable buildings

A shared view among technical experts is that in order to be considered compatible with sustainability, using "green materials" alone (minimizing the amount of embodied energy) is definitely not enough.

In Europe, the best practice for *new* buildings is the so called "Passive House Standard". Some key figures are as follows: 15 kWh per square meter per year of space heat demand, 120 kWh per square meter per year of primary energy demand (as the sum of space heat, domestic hot water and electricity).

***Retrofits* should aim at a space heat consumption between 25 and 40 kWh per square meter per year.**

Source: Hermelink, 2006

when at least 80 per cent of the energy is used. Thus, any decision taken today on how buildings and cities are built will have a long-term impact. From today, each new building constructed in an energy-wasting manner or retrofitted to a suboptimal level will lock us into a high climate footprint future.

The other side of the coin is that we cannot focus on new construction only, as existing buildings also need to be refurbished so that their energy consumption is reduced radically. Buildings are key to climate change mitigation in each world region and the greatest potential is in the refurbishment of old buildings. By 2050 (as compared to 2005) as much as 77 per cent of final thermal energy consumption can be eliminated while living standards increase and energy poverty is eliminated. However, the level of emissions in 2050 is extremely sensitive to the retrofit rate: the 77 per cent energy saving is based on a 3 per cent retrofit rate, but if this rate drops to 1.4 per cent, energy savings drop to 37 per cent. At the same time, suboptimal retrofit represents a major climate lock-in risk for many decades. For this reason, only retrofits where the best available professional knowledge and technology are used should be supported (**Box 2**).

A frequently heard counter-argument is that energy efficiency requirements increase the cost of construction. A recent example documented by the International Energy Agency (IEA) shows that, when using passive house technology, the extra costs can be 3–5 per cent of the total costs, with a payback period of 9–10 years. Measures increasing the energy efficiency of buildings have the potential for a negative net cost over time, as the initial investment pays itself back and can be reinvested back into the community. Energy efficiency programs may also lead to positive economic and employment growth.

With existing technology we can build and retrofit buildings to achieve energy savings of 60–90 per cent, as compared to standard practices in all climate zones, while providing similar or increased service levels. It has been estimated that a worldwide transition to energy-efficient buildings would create millions of jobs as well as "green" existing employment for many of the estimated 111 million people already working in the construction sector. Investments in improved energy efficiency in buildings could generate an additional 2–3.5 million green jobs in Europe and the United States alone, with a much higher potential in developing countries.

Construction materials. The production of building materials is often highly energy intensive. However, during the life cycle of a building, energy used in construction and making construction materials varies between 10 and 20 per cent of total energy use of the building. Thus, as far as energy consumption of

Box 3

Nationally Appropriate Mitigation Actions, NAMAs

The buildings and construction sectors, as represented by the UNEP SBCI and their various networks, have four recommendations for the policymakers involved in climate change negotiations:

- **Prioritize the buildings sector as a means of achieving national GHG emission reduction targets**
- **Recognize energy efficiency and GHG emission reduction programmes in the built environment as Nationally Appropriate Mitigation Actions (NAMAs)**
- **Reform the Clean Development Mechanism to support investment in energy efficient building programmes in developing countries**
- **Develop baselines for building-related GHG emissions using a consistent international approach to performance monitoring and reporting.**

The above-mentioned carbon metrics provides a framework for measuring emission reductions in buildings, so as to support also the formulation of NAMAs.

buildings is concerned, the use and operational phase will consume the major share of energy. This, however, does not mean that the resource consumption of the production and transport of construction materials should not be analysed and taken into account.

Principles for increasing the energy efficiency of and reducing the emissions from production include technological improvements of production processes, use of recycled or alternative materials, and use of alternative fuels, such as waste materials. Among the most energy intensive basic materials are aluminium, iron, steel and cement. The cement industry contributes about 5% to global anthropogenic CO_2 emissions. Polymers such as plastics and bitumen have a large carbon footprint. Construction materials like glass, ceramic tiles and brick also require high temperatures in the production process. In 2007, the Chinese government released new standards for the cement industry. Producers are expected to reduce energy use by up to 15 per cent by 2010. Similar initiatives have been undertaken by the three largest cement companies: Cemex, LaFarge, and Holcim. Cemex plans to reduce its emissions by 25 per cent by 2015, while LaFarge and Holcim aim to reduce their emissions by 20 per cent each by 2010.

Common Carbon Metric. A broad group of experts and organizations agreed that the following metrics, taken from building performance data, should be used to compile consistent and comparable data: energy intensity is measured as kWh/m^2 per year and kWh/occupant per year; carbon intensity is measured as $kgCO_2e/m^2$ per year and $kgCO_2e$/occupant per year.

A report published by UNEP SBCI, *Common Carbon Metric for Measuring Energy Use & Reporting Greenhouse Gas Emissions from Building Operations* (2009), now provides a consistent and verifiable methodology to measure the climate footprint from buildings that had been missing until now. It is accompanied by a globally consistent common carbon metric for buildings which provides the required common language for measuring greenhouse gas emissions and energy efficiency of buildings. The globally harmonized method for measuring, reporting and verifying energy use and carbon dioxide emissions provides the basis for establishing baselines, performance benchmarking, and monitoring improvements in building performance. These activities are in turn fundamental to informing international mechanisms for carbon trading, policy development and analysis, and progress reporting on the mitigation of CO_2 emissions from buildings. Policy- and decision-makers can produce reports from the data collected through these metrics for jurisdictions, regions, owners of large building stock, and cities. Additionally, the data can be used at a national level to form baselines that can be used to set targets and show improvements in carbon mitigation in the building sector (**Box 3**).

Policy priorities for SBC

The implementation of sustainability in the built environment can be supported by a mix of policy measures, targeting both the consumer and citizen, and producers. Until recently, public awareness of buildings' sustainability was low. Not only policy-makers but also professional and industry associations and trade unions have a vital part to play in formulating visions, taking care of capacity building and disseminating information about their particular roles in sustainable construction. As people's awareness grows, they will be able to make more educated choices. As a result, producers will have to react to consumer demand. The market also can be a driver for the most innovative companies that want to become front runners in their fields. These are the ones who will develop their products and services based on future demand. At the same time, the public sector can push development with regulatory policies and with various financial and taxation tools. One process with a major potential to shift the market to more sustainable production patterns is public procurement.

This is as true for buildings and construction as for other products or services.

The goals of and political arguments for the policy priorities outlined below are the need to combat climate change; the need to save money in new construction, maintenance, use of buildings and refurbishment; and the need to combat poverty, raise living standards and secure healthy living environments. The UNEP SBCI report *Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from Buildings* (2007) compared different tools, analyzed barriers and made recommendations for effective combinations of policy instruments. Policies are also discussed in UNEP SBCI's report *Buildings and Climate Change. Summary for Decision Makers* (2009).

One key area where policies need to focus is **energy efficiency**. Being directly linked with climate change mitigation, improvements in the energy efficiency of buildings should be included in international discussions on climate change. Reducing energy consumption in buildings, and in particular energy from fossil fuels, is the key priority. Increasing the share of renewable energy in heating, cooling and provision of electricity is one part of the equation. In many countries, recently also in China, the introduction of Feed-In-Tariff legislation has supported a significant expansion of renewable energy supply. The final goal should be to have buildings that produce all the energy they need. In its recommendations for the buildings sector, the IPCC listed the following key mitigation technologies and practices currently commercially available: efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycling of fluorinated gases; integrated design of commercial buildings, including technologies such as intelligent meters that provide feedback and control; solar photovoltaics

Box 4

Sustainable Cities: Masdar City, UAE

The Masdar Initiative is currently building Masdar City in Abu Dhabi, UAE, a community designed for 40 000 inhabitants and 50 000 jobs. The city is going to be the first to be designed and developed in a completely integrated way inspired by sustainable development principles. It will be a carbon-neutral, zero-waste city powered entirely by renewable energy. The Initiative is also investing in new energy technologies and establishing a global centre for renewable energy research, development and innovation.

The Masdar approach gives an overview of the various aspects and scales that are needed to build sustainable cities:

1. **The overarching philosophy for the city follows the 10 core principles of One Planet Living, promoted by the World Wildlife Fund (WWF).**
2. **A Master plan guides the philosophy at the site level, plot level and building level.**
3. **Masdar City is designed to give an important role to walking for everyday transportation. In addition, integrated transport systems, completely fossil fuel-free, will mix personal and freight rapid transit electric vehicles, linked to a higher-speed and longer route light rail system.**
4. **Achieving a high quality of life for residents has been integrated into the city design, through an easily walkable city, architectural choices and building design, provision of public space, shopping spaces and cultural facilities.**
5. **Plot design guidelines guide building design, interior fit-out and energy performance with specific targets. Key performance indicators are divided between design, construction, and operation. Masdar specifications outline performance requirements for buildings, building structure, components, systems, materials, finishes and supply chains. A restricted materials list specifies materials with negative environmental impacts whose use should be avoided. Consultants are required to optimise local materials use to avoid large carbon footprints associated with materials transport.**

Source: Masdar Initiative website.

integrated in buildings. A tool that gets the attention of real estate owners is an energy audit which includes recommendations on how to refurbish the building. It is also useful to remind house owners that, since buildings have to be renovated from time to time, it makes economic and environmental sense to improve their energy performance at the same time.

For new construction, the priority should be given to optimizing energy efficiency during use and in maintenance, by strengthening focus on *maintenance and operation* of buildings, mainstreaming low-energy and zero-energy construction, including passive technologies, and supporting housing schemes that raise the standard of living and are based on energy efficient technologies and renewables, local materials and local labour.

For refurbishment, efforts should focus on raising awareness about the need to refurbish existing buildings for energy efficiency, and designing industrial solutions for "mass implementation" of the retrofit of existing buildings, including housing, to make them more energy efficient and convert them to the use of renewables.

Tools to facilitate these goals include **awareness raising** about the added value that can be gained through increased energy efficiency. This encompasses using energy certificates as tools, conducting public awareness campaigns to influence human behaviour in energy consumption, and including health externalities into economic calculations for improving indoor air quality.

Building codes need to be universal and fully implemented. Codes need to cover major retrofits as well, not only new buildings. The most advanced low-cost know-how needs to be mandated. The construction industry needs to gear up to be able to meet the new standards. Mandatory regulations are needed to guarantee a minimum level of performance in areas like structural safety, fire safety, accessibility and energy performance.

Urban planning. Even if a building fulfilled every conceivable energy efficiency requirement, but was located in a place that can only be reached by private car, most of the "greening" efforts would be in vain. Land use and transport solutions are crucial for climate change mitigation. Every effort to improve the energy efficiency of the built environment has to confront the challenges of urban sprawl and mobility, which also have profound social and economic implications. One of many interesting pilot projects is Masdar City, UAE, a community which is going to be powered entirely by renewable energy and should become a carbon-neutral, zero-waste city (**Box 4**).

Financing is also important, including developing and mainstreaming models and funding mechanisms for sustainable and affordable housing. Also important are financial and fiscal incentives. These may include government grants, tax credits and low-interest loans for retrofitting existing buildings to conserve energy, and for local energy production from renewable energy sources integrated into buildings. Loan servicing can be linked to payment of utility bills or property taxes and can come out of energy savings. The level of real estate tax can be linked with the performance of the building.

Fighting corruption. The implementation of PACS or similar anti-corruption mechanisms could be required by governments as a prerequisite for project approval, by funders as part of the funding package, or by public or private sector project owners as a condition for participation in a project. The use of PACS will not only help governments, funders and project owners to ensure that projects are properly identified and executed, but also to ensure that funds are properly spent. Additionally, it will demonstrate their commitment to the prevention of corruption.

The **public sector** plays a central part in setting building policies and guidelines. Its roles are multiple and include: to set an example in energy issues and create markets by encouraging all government agencies and public organizations to initiate and implement energy savings, energy efficiency and renewable energy programmes; to initiate and implement programmes that secure access to clean energy for those who lack modern energy services; to introduce energy efficiency criteria into the public procurement of construction work and buildings, and the maintenance and refurbishment of buildings; to integrate climate change and energy efficiency aspects in urban development policies; to structure financial incentives to support building activities that take a long-term energy efficiency perspective and facilitate the transition to renewable energy sources, including through feed-in tariffs; and to collect data and establish baseline information on energy consumption and production in order to assess the impact of policies.

Governments — local, national and federal — have to lead by example. They can do this by introducing sustainability criteria into the management of their real estate portfolios and construction and refurbishment of buildings that are built with public money or used for public purposes, be they offices, schools, hospitals, public housing, museums, sports facilities, roads, bridges, or energy and water utilities, for example. This means introducing the appropriate sustainability criteria into procurement of space, commissioning of construction of new buildings, and provision for their operation and refurbishment. If the public sector does not implement sustainability targets in construction and in the management of its own spaces, who will?

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Further reading, Sources

Global Reporting Initiative (GRI) <*www.globalreporting.org/ReportingFramework/SectorSupplements/Constructionand-RealEstate*>

GRIHA, Green Rating for Integrated Habitat Assessment, and the Green Pledge, India. <*www.grihaindia.org/*>.

Hermelink, Andreas (2006). A Retrofit for Sustainability: Meeting Occupants' Needs within Environmental Limits. *http://www.solanova.org/resources/SOLANOVA_Paper_Pacific_Grove_08-2006_Hermelink_web.pdf*

Intergovernmental Panel on Climate Change (IPCC) (2007). Fourth Assessment Report, Climate Change 2007: Synthesis Report. Summary for Policymakers. <*www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf*>

International Energy Agency (IEA). Laustsen, Jens (2008). Energy efficiency requirements in building codes, energy efficiency policies for new buildings. <*www.iea.org/g8/2008/Building_Codes.pdf*>.

International Initiative for a Sustainable Built Environment (iiSBE). <*www.iisbe.org*>.

Marrakech Task Force on Sustainable Buildings and Construction <*www.environment.fi/sbc*>.

Marrakech Task Force on Sustainable Public Procurement. <*www.unep.fr/scp/marrakech/taskforces/procurement.htm*>.

Masdar City, Abu Dhabi, UAE. <*www.masdarcity.ae/*>.

Transparency International (TI). <*www.transparency.org/tools/contracting/construction_projects*>.

UNEP FI Property Working Group. <*www.unepfi.org/work_streams/property/index.html*>.

UNEP FI and the UN Global Compact: Principles for responsible investments <*www.unepfi.org/work_streams/investment/principles/index.html*>.

UNEP SBCI, all publications available at <*www.unep.org/sbci*>.

UNEP/ILO/IOE/ITUC (2008) Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World. Report Produced By Worldwach Institute.

Ürge-Vorsatz, Diana (2009) Buildings: How far can they take us in mitigating climate change? Presentation at COP15, *http://3csep.ceu.hu/sites/default/files/field_attachment/page/node-3234/11decpoliciesforalowcarbonbuiltenvironmentdianaurgevorsatz.pdf.*

WWF, One Planet Living. A global initiative based on 10 principles of sustainability. <*www.oneplanetliving.org/index.html*>.

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