Sustainable Building in Brazil

A four-year review and update

Report prepared for SB08, Melbourne

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Unique economic, social and natural problems differentiate Latin America and the Caribbean (LAC) from other regions and include poverty reduction, maintaining the economy, enhancing income distribution and coping with unplanned growth of cities.

Implementation of SBC principles in the Latin American context strongly depends on a set of factors that include:

- an optimum balance between expectations of building quality with low environmental impact and the need to rapidly confront poverty and satisfy basic needs of a large proportion of the population
- education to increase awareness at all levels of society and to foster capacity building at all professional levels;
- governmental involvement implement policy frameworks and public procurement to boost sustainability
- development of SBC regional parameters, related to local materials, climate, cultural factors and living conditions
- strategies to recognize both the formal and informal construction sectors

An encompassing background review on the regional context was provided by SILVA;SILVA (2005). In that paper, authors provide an overview on how sustainability relates to context specificities, highlight the importance of a regional approach and suggest the courses of action needed from major actors to accelerate progress towards SBC implementation in the region.

This report provides an update on SB04 findings and current status of:

- National or regional development of performance targets for SB;
- Adoption of policies (tax, programs, regulations etc) that will further SB;
- Adoption of SB by the investor community;
- Education and training in SB;
- Adoption of new SB technologies and techniques;
- Adoption of SB whole-building performance rating systems.

Introduction

Latin America played a leading economic role among the emerging markets in the past years (Figure 1) and this position is not expected to change in the upcoming decades. Participation of building and construction activities in the regional GDP fluctuates between 11 and 12%, higher than high-income countries average[1]. Mexico, Brazil and Chile are examples of how the construction industry is benefiting from a solid business climate (SILVA;SILVA, 2005).

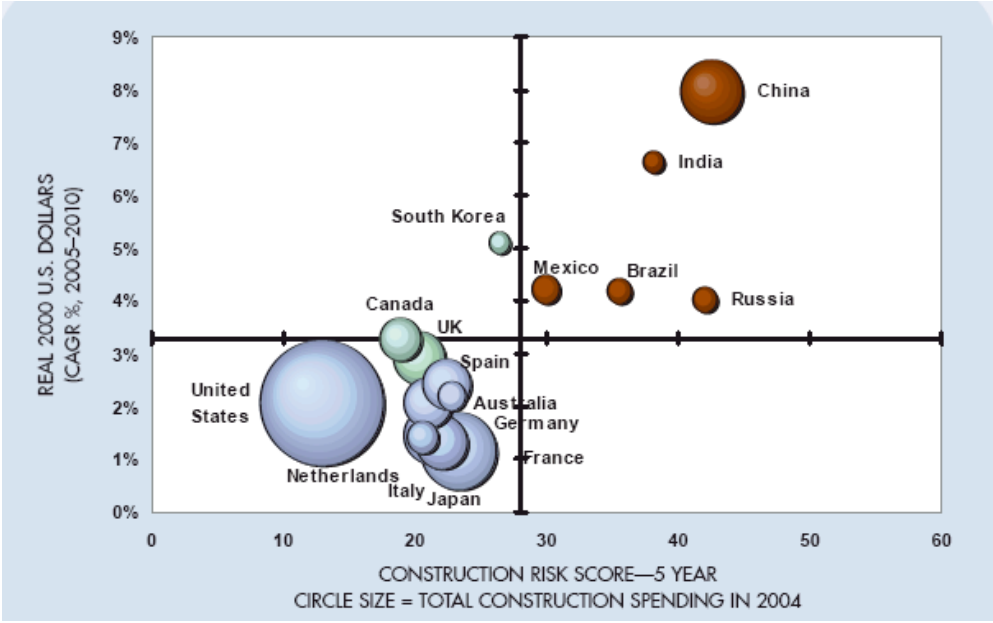


Figure 1 – Market potential: opportunity x risk (Source: Global Construction Outlook 2005, Global Insight, Inc)

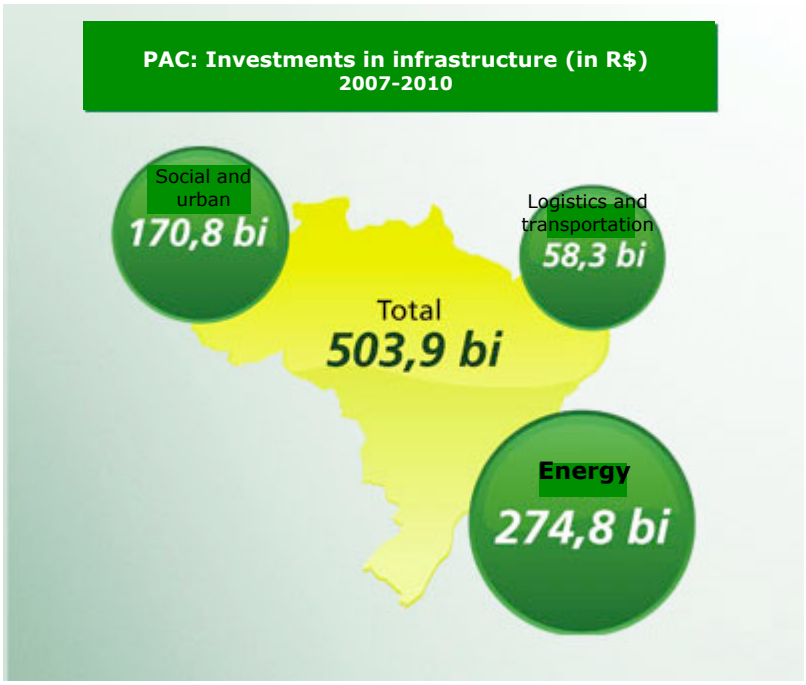
In April 30th this year, Brazil has been upgraded to an investment-grade credit rating by the risk rating agency Standard & Poor's,, meaning that Brazilian debt titles are from that point on considered as low credit risk. This announcement boosted Brazil's financial markets, sending benchmark stock market index to a new record high and yields on dollar bonds to an all-time low, tightening the bonds even further. According to S&P, Brazil, whose economy grew in 2007 at the fastest pace since 2004, should be able to maintain annual growth of as much as 4.5 percent. Foreign direct investment, which reached a record of $34.6 billion last year, is likely to cover the country's current account deficit this year, the ratings company said.

Brazil clearly undergoes transformation through construction. More construction is needed to provide prosperity, social equalization and minimum standards of living. This

[1] For reference purposes, according to the European Commission (2004), investment in construction across the EU-15 countries in 2003 was around 10%.

creates a potential tension between sustainable development principles with overall consumption reduction and increased construction. Together with Argentina and Mexico, Brazil has been included in the US Commerce Department's list of "Big Emerging Markets" during the next two decades, which confirmed the anticipated volume of new building and construction activities (SILVA;SILVA, 2005).

In parallel, improvements or upgrades in national road networks, and privatization of services in transportation, telecommunications and energy sectors and the development of several infrastructure projects are heating the regional construction market; the residential sector shows an equal growth trend. A fresh breath to the national construction industry followed the Federal Growth Acceleration Program (PAC 2007-2010), a package of federal investment policies that, based on the current positive macroeconomic and social indicators intends to boost national growth through substantial investments in energy, transportation logistics and social/urban infrastructures to stimulate productive sectors and deliver social benefits to all regions of the country. This explosive investment injection virtually caused an unprecedented shortage of construction equipment, human resources and supply ability to cope with the vigorous construction activity across the country in 2008.



The Latin American SB'04 and a four-year update on SB status in Brazil

The Latin American SB'04 (claCS'04) was held in São Paulo in July 2004 as a preparation for the global SB'05. Pursuing the ultimate objective of promoting and implementing SBC in Latin America, the conference aimed to **provide regional input** to formulation of cross-border needs and targets for policies and research, to be then brought

to the global platform. Another objective was to **facilitate development of a detailed action plan** to advance the sustainable building agenda in the region, whose adoption or rejection by national and international financial institutions is to be announced in SB'05. To accomplish these goals, the conference specifically aimed:

- To learn about the context and conditions for implementation of SBC in the region
- To exchange lessons and experiences among actors on mechanisms to address key areas in SBC
- To explore opportunities for key stakeholders to assume a more effective role in advancing the mechanisms for SBC
- To foster the definition of a research agenda for SBC within the region
- To identify the most important sustainability challenges which require international aid or assistance Research and practical areas of collaboration with the wider international research community; Lessons on sustainable built environment that the region can offer to the wider international community

A variety of definitions and understandings of sustainable building were posed by speakers and delegates. Some of these differed from the common global understanding (as given by the Bruntland report or subsequent reports). Others were seen as not being broad enough or even incorrect. Energy conservation was often used to refer to sustainability generally, along with water conservation, waste reduction, and poverty alleviation.

Social responsibility was an incipient responsibility among contractors as no government or client demand exist to drive sustainable construction. Delegates and panellists emphasised the leading role of the government in promoting sustainability. Apart from specific energy- and waste-oriented resolutions supported by a few governments, there are no robust regional examples of a **committed policy, strategy, or programme promoting buildings towards sustainability** so far. The built environment had only a moderate role in the country agenda. A certain inability to capture environmental, social and economic benefits of sustainable building and construction is combined with the business as usual short vision trend to make decisions exclusively based on initial investment, average costs and payback period. As a result, an attempt has been made to promote the concept of sustainability by itself - which is not clearly understood and undervalued - instead of the inherent benefits it brings for all.

Current application of sustainable development in the region was still restricted to academia, science and research. Existing networks nevertheless do not currently bridge the gap between research and practice due to lack of political support.

The most effective drivers for change, as pointed out by delegates, appear to be:

- Law, regulations and policies, (especially aimed at high energy building consumers)
- Science and research
- Education and SBC demonstration projects
- Design guidelines and strategies by both the building industry and academic bodies to raise awareness
- Financial penalties and incentives

Poverty was consistently pointed out as the major barrier for development. Another limitation was seen to be the lack of low impact materials and technologies for SBC. However, it became clear that sustainability in the regional construction sector extends far beyond mere access to technology from developed-nations. *Regional characteristics* (e.g., climate, poverty and social exclusion, rapid urbanization and construction informality) require a unique approach for tackling underlying LAC difficulties. Some of these issues are not expected to find parallels in developed nations and must necessarily seek solutions amongst other developing regions.

Across the region, SBC-related barriers, challenges, research agenda and **practical needs** requiring **further international collaboration** and assistance build a consensus around four major themes:

- *research and data collection* for regionalization of sustainability assessment
- *education and training*
- development and *implementation of public and private sector policies*
- financing for acceleration of SBC implementation and innovative solutions development.

Actions pointed out for construction sector's major stakeholders were detailed by SILVA;SILVA (2005).

Research and data collection

Role of regional research community

Among all the challenges posed for the regional research community, the greatest is the coordination of research activities to gain momentum and accelerate progress in SBC implementation in the region. Little has changed since 2004, when major challenges identified for Brazilian research community were related to:

1. creation of reliable life-cycle analysis (LCA) national database to be applied to building design and allow for specifying materials, components and assemblies based on their environmental impact.
2. regionalization of sustainability assessment/reporting, and
3. definition of regional performance benchmarks and indicators.

LCA database for construction products

UNEP Task Force 5, a partnership between UNEP and SETAC, could be an opportunity to overcome this barrier, but does not seem to have advanced much in Brazil so far. Another initiative, led by IBICT (Brazilian Institute for Information on Science and Technology), organ maintained by the Ministry of Science and Technology, seems promising for the upcoming year as it considers development of an specific construction products branch for a national LCA database.

Two environmental labels for building materials were established in the past year. One of them was specifically created to streamline specification for LEED certification, while the other one - still at an embryonic status – is expected to be LCA-based and applicable to products, components and systems.

Regionalization of sustainability assessment/reporting, and definition of regional performance benchmarks and indicators.

Reports on sustainability performance of the built environment are fundamental for regionally meaningful database construction. Advancement in this field requires quantitative, cost and performance data, as well as definition of local targets and indicators. Good benchmarking provides real value result measurement, orients the establishment of priorities and its related research needs. On the other hand, quantified performance targets are necessary to change the mindset and make political commitments meaningful. ***Sustainability indicators*** and ***performance assessment systems*** can support both (SILVA;SILVA, 2005).

Sustainability indicators

Indicators are sought to clarify national and international trends of social, economic and environmental development and to closely chart progress towards sustainable life patterns. Performance indicators are also used by environmental assessment methods to demonstrate improvement in – and allow for comparisons among – individual buildings.

There are fundamental distinctions between the pure concept of sustainability indicators and the indicators used – or possible to be presently used – in building assessment systems. Assessment methods currently available typically do not consider social and economic aspects of sustainability and are directed to individual buildings, while the broad discussion on sustainability indicators refers to more general measures of society, that are not easily related to the scales of organizations or buildings (SILVA, 2003; COLE, 2002; TODD;JOHN, 2001). A last significant difference in approaches is the crescent trend of assessment methods aggregate performance metrics to summarize a building's global performance, while sustainability indicators are usually kept as discrete entities (COLE, 2002). COLE (2002) also points out the limitations imposed by time,

first, because of the different time scales as sustainability is a concept based on equilibrium on the long-term and building effects are perceived in a much shorter timeframe; secondly because assessments are valid only for the particular point in time in which they were carried out, as environmental performance of buildings is – explicitly or not - relative to a typical performance level and are not able to capture continuous improvements on individual buildings and both cutting-edge and typical practices.

Most metrics found in the review of international initiatives for development of sustainability indicators focus on the environmental dimension of sustainability and can not be applied to the building scale, or is effects, as they do not distinguish between the relative contribution of buildings or the built environment to health and sustainability of a certain ecosystem, community or environmental component of interest (TODD; JOHN, 2001). Extraction of relevant indicators for buildings, even though their immediate aggregation is not yet possible to form a global metric of society, indicate the path for cooperation in compliance with sectorial or national goals of producing a built environment driven by more responsible attitudes, based on the reflection on their long term effects (COLE, 2002).

In Brazil, several efforts are noticeable for definition of indicators of sustainability of the built environment that, however, vary largely and are defined according criteria and methodologies not necessarily replicable. In order to advance in the development of sustainability indicators of the built environment, it is paramount that the country defines consensual framework to structure indicators, and methods for data gathering, definition of national indicators (aligned to international trends and experience) as well as of a core of local indicators relevant for each case and typology; value measurement or attribution, and for interpretation and aggregation of indicators. A robust database should be created and kept updated and broadly accessible.

SILVA;SILVA (2008) suggest six steps to methodological development for creation and validation of sustainability indicators of the Brazilian built environment:

1) Delineation of the state-of-the-art on sustainability indicators of the built environment

CIB W82 Construction Related Sustainability Indicators (CRISP) Network carried out a unique work on identification and systematization of sustainability indicators for the European construction industry, including some non-European methods. SILVA (2003) carefully reviewed existing sustainability indicators and added some reflection as to their applicability in the peculiar Brazilian context. Such initiatives configure an encompassing state-of-the-art and lay the foundations for future development.

2) Definition of a methodology for data collection and organization

Even more important than the numbers attributed to indicators is to have accurate control over what the indicator effectively describes and the circumstances in which the values

were obtained or attributed. This control provides traceability and reproducibility and allows for value adjustment or refinement according to scenario alterations and available data across time.

To build upon previous research efforts, and for international comparability purposes, it is suggested that the indicators characterization charts developed under CRISP's auspices are tested, at the possible extent and at the different scales, observing eventual data availability limitations in Brazil.

3) Creation of a sustainability indicators database applicable to the built environment

Besides describing the nature of the different sustainability indicators of the built environment, the approach given by ISO presents four main requirements for indicators systems:

- Sustainability should be described based on an encompassing set of indicators expressing environmental, social and economic aspects, as well as their relationship;
- Selected indicators should describe essential (environmental, social and economic) building impacts;
- Relevance of selected indicators should be justified and, when necessary, validated;
- Indicators development and application processes should be transparently reported.

Consideration of potential final users' feedback is a powerful instrument for validating indicators. Selection of most relevant indicators from cited reference lists should be therefore done considering compliance with the essential requisites that validate a good indicator (relevance, objectivity, accessibility, range, measurability, sensibility and traceability) and aiming at answering questions such as the following:

- Who are the final users?
- For which purpose will the indicator be used?
- How to proceed in relation to contradictory indicators?
- How to use the indicators?
- Is it possible to measure? If not, how to attribute a value for the indicator?

As indicators are needed in decision-making processes of several agents, the starting point for their development is the identification of the main users, their information expectancies and needs. The intended use for an assessment system

may therefore vary according to the life-cycle stage it is intended to be applied in. Information character, quality and availability also depend of the project life-cycle stage. Indicators that describe the same aspects can be initially related to values estimated in design stage that, during operation, would be replaced by real-time measurements, satisfaction surveys or other performance evaluation instruments. Consequently, indicators used to characterize building performance in each application should be adjusted to the proposed end use.

While individual indicators should be the most independent possible, practice has shown that it is more efficient to employ indicators sets, on their turn dependent of the user's perspective and of a certain life-cycle stage, able to include a broad representation of sustainability aspects.

4) Definition of a set of indicators for national monitoring, complemented by core set of relevant local indicators

Assessment methods of buildings intend, at the extent possible, to link the building contribution for achievement of broader sectorial and national targets. Definition of an agenda for the Brazilian construction sector is, therefore, the initial basis for proposition of a sustainability assessment framework, finely tuned to national context and aspirations.

JOHN et al. (2000) and JOHN;SILVA;AGOPYAN (2001) initiated the discussion on an Agenda 21 for the Brazilian civil construction, pretty much like the original structure used by CIB (1999). In posterior contributions SILVA et al. (2002) e SILVA (2003) proposed a sectorial agenda organized according to the international molds for sustainability reporting, given by UN's Agenda 21, in which the triple bottom line is complemented by an institutional dimension, related to provision and strengthening of intra and cross-sectorial platforms. The institutional agenda was proposed due to the lack of sufficient normative instruments, governmental policies, articulation of sectorial strategies pro sustainability and or sustainability report of construction-related organizations and products.

The indicators list proposed by SILVA (2003) follows CRISP's format general lines. ISO TS 21.929 recommendations (ISO, 2005b) could be used for screening and selecting the set of national indicators.

5) Creation of a database of indicator values (local, but able to be regionally and nationally aggregated)

Database construction is a labor-intensive, long-term work. It is important to highlight that, the CRISP network, taken here as a methodological reference, had the goal to systematically register currently used construction industry-related sustainability indicators, but not the values measured or attributed to them. The creation of a benchmark database for each relevant indicator is fundamental to provide meaningful assessment

results and to drive establishment and updating of sustainability goals. In the Brazilian case, this gap that can only be bridged through gradual refining or substitution of the values initially extracted from literature and research, as a considerable number of assessments and measurements are carried out and following a consensual, replicable methodology.

6) Continuous update and broad data dissemination

As assessments only make sense when the performance reference is explicitly defined, it is necessary to keep the database continuously updated, to lead to more reliable numbers and evaluations and more realistic target setting. Dissemination of reference values is important to make the assessment procedure replicable within the country, while recognizing regional peculiarities that interfere in result interpretation.

DAC/FEC/UNICAMP began the creation of an environment for housing and monitoring of indicators of sustainability of the built environment. First figures available at the database refer to office buildings. School buildings will be added across the next two years. Part of them are applicable to other parts of the country, but it should be kept in mind that some of these data are unavoidably regional in essence (parts of the State of São Paulo) and could result in misleading conclusion without previous definition of equivalent figures for other regions. An effort with national range is needed and should be carefully considered by research funding agencies.

Performance assessment systems

Attainment of benchmarking information is useful for informing and creating a consensus on a sustainability assessment that is calibrated to regional issues and scenarios. Brazilian and other developing-countries' contexts require an increased emphasis on social aspects - (occupant comfort, space quality and labor conditions), economic feasibility, durability and upgradeability of the solutions, and for less dependency on accurate data, as reliable data is scarce or even unavailable (SILVA;SILVA, 2005).

Brazil has a history of involvement with the Green Building Challenge and participation in the international debate on building environmental assessment, particularly as they relate to different cultural contexts. However, a domestic market-place building assessment method has yet to be developed and implemented.

The first approach to develop a sustainability assessment system was carried out between 2001 and 2003, starting with office buildings (SILVA, 2003). The development of a sustainability assessment method for social housing began in 2005. The proposed methodology (to be officially publicized by 2009) is intended to be used as part of screening criteria by a national financing agency (SILVA, 2007). In both cases (office and residential) strong emphasis was placed on social issues and economic feasibility, to consistently suit a developing nation context. As all these initiatives unfold, they may provide the context for a family of national assessment tools.

In the 2004 survey, tools to perform building assessments were perceived as powerful vehicles for knowledge dissemination that might also become an important driver for market creation for sustainable buildings and products, and contractors saw an opportunity in using foreign-developed tools while a national was not available (SILVA;SILVA, 2005).

There are currently two rating/certification systems in use in Brazil: the American LEED™, which in 2007 certified its first Brazilian building, and the AQUA Process, derived from the French HQE approach, launched in early April 2008 (Figure 2). Use of such methods brings up the discussion regarding validity and interest in using international tools in the domestic market. Green Building Council do Brasil announced a local version of LEED in mid 2007, but it is yet to be publicized, while the AQUA Process has undergone a national adaptation before official launching.

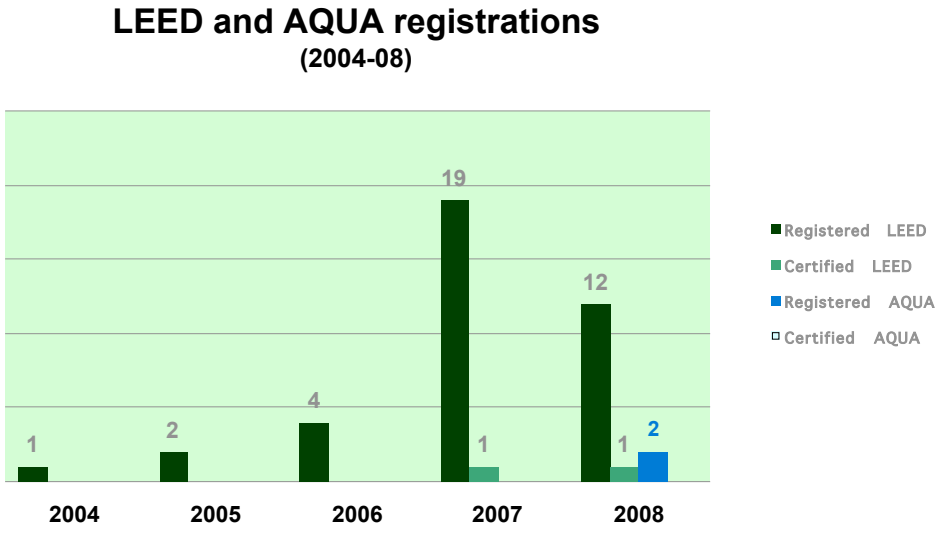


Figure 2 - LEED and AQUA registrations in Brazil (2004-08).

Use of rating/certification tools in Brazil has predominantly followed an ***international-to-local mode*** so far. The two most common drivers for rating buildings in the earliest adoption examples derived from multinational companies' demands, either from companies which have adopted higher environmental standards for their own premises internationally or from American construction/development companies that specifically established minimum standards for their output delivery in terms of LEED certification. In the case of AQUA, the first development undergoing certification is a mixed-use condominium targeting European buyers of a second residence, which appealed to targeted clients higher environmental awareness. In all these situations, a clear interest on a certificate for market distinction is the most powerful driver. Very few exceptions to this approach apply.

More recently, construction and development companies seem to have identified business opportunities to apply LEED Core & Shell rating system in speculatively developed buildings (Figure 3), which represents roughly half of annual registrations. Despite the market effervescence and curiosity on SB-related themes and regarding certification in specific, the actual demand for certified projects is undeniably concentrated in the country's business artery: the City of São Paulo, which holds 25 out of the total 29 projects registered in the State (Figure 4).

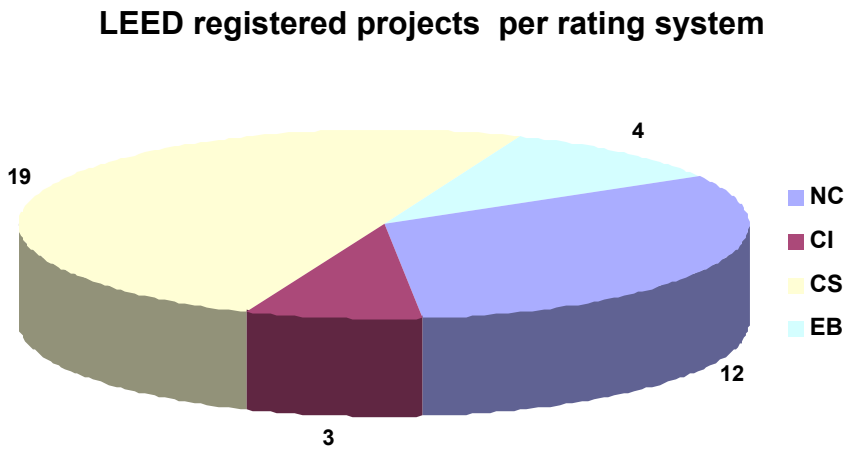


Figure 3 – LEED™ registration in Brazil per rating system (source: USGBC Website, as per August 24th, 2008).

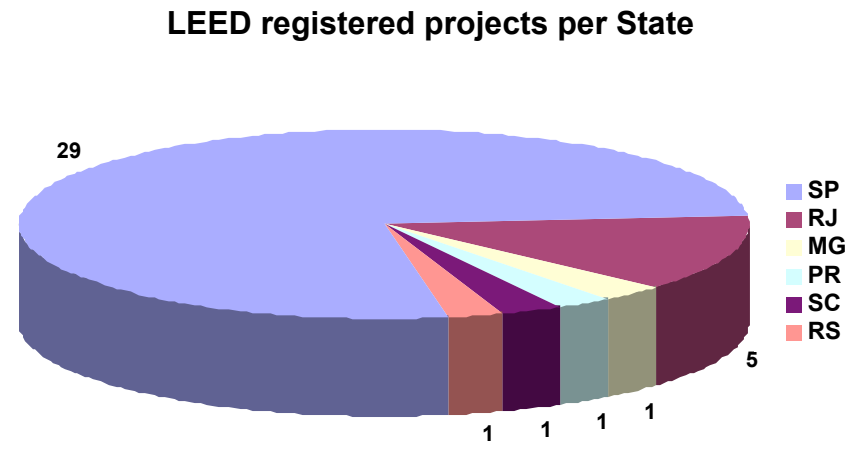


Figure 4 – LEED™ registered projects in Brazil, broken down by State (source: USGBC Website, as per August 24th, 2008).

The Brazilian Council for Sustainable Building (CBCS)

The Brazilian Council for Sustainable Building (CBCS), launched in August 2006, is an initiative led by academia, key market players and leaderships to foster SB across the national construction sector.

CBCS has been working on the establishment of strategic partnerships and networks to generate and disseminate knowledge and best practices; to promote innovation; to integrate the construction sector to other society sectors; to elaborate guidelines; to discuss public and sectorial policies; to coordinate cross-sector integrated solutions and actions. For these purposes, CBCS is partnering with relevant national and international relevant organizations dedicated to the subject based on different perspectives of environmental, social and business responsibility. Thematic committees were created to debate and point out better and best practices in paramount fields, such as energy, water, materials, design, sustainability assessment and finance.

International research community

Current research barriers in LAC can be overcome through network strengthening, international integration and subsequent local dissemination of new ideas, including education and training programmes. Framework programmes have been used by the European Union, Japan and other OECD countries to notably support several SBC-related research, networks and initiatives, as such structures foster development of research and collaboration.

Wider international collaboration was suggested through iiSBE, CIB, UNEP or other strong construction-related research institutions' programmes.

The work carried out by ISO Technical Committee 59 *(Building Construction)*/Sub-Committee 17 (*Sustainability in Building Construction)*, Green Building Challenge and others were acknowledged as feasible international efforts towards harmonisation of approaches to sustainability indicators, environmental assessment of building products and buildings. Still, participation in such efforts is limited.

There was a call for more emphasis on the adhesion to iiSBE's public policies network, and for special funding programmes to help overcoming limited local investment capacity and fund demonstration projects. The past four years witnessed no significant advances in either case.

Brazilian participation in public policies networks and initiatives is still hampered by the lack of governments´ determination to finance participation and to support policy implementation later on. Due to the peculiarities of the Brazilian tax structure, city and State taxes and benefits delivery are disconnected. Moreover, taxes are a substantial resource almost integrally compromised by daily administration and existing programs expenses; hence public administration at both levels is more than reluctant to apply tax reduction mechanisms to encourage SB implementation or to fund demonstration and

dissemination programs. Funding expectations for such programs rely solely on federal sources so far.

World Business Council for Sustainable Development (WBCSD)´s effort towards Zero net energy buildings by 2050 requires a combination of onsite power generation and ultra-efficient building materials and equipment. It includes Brazil among the target countries for a unified industry strategy for realizing those opportunities as, together with China, India, the U.S. and the E.U, is responsible for two-thirds of world energy demand. This is an daunting task, particularly in the Brazilian case, considering that, despite national vast solar availability, current use scenario is composed by inflated costs for solar and other onsite generation technologies that go beyond (regular solar) water heating.

A promising alliance between CBCS (Brazilian council for Sustainable Building) and UNEP SBCI is underway, starting with energy-related collaboration in 2008.

Education and training

Structure development for SB education and training has not followed the steady growth of interest within the construction community on the theme. Setting aside environmental management topics in specific careers, sustainability issues are seldom inserted in pedagogic structures of undergraduate courses and at both *latu* and *strictu sensu* graduate programs in engineering architecture, urban design and related areas. Given the little awareness among construction stakeholders and virtually inexistent qualification for designers, planners and workers, conclusions from several design and construction meetings and round tables on the subject have consistently pointed out capacity building for knowledge multipliers as the most challenging barrier to be overcome for consolidation of sustainability as strategy for the Brazilian construction sector.

According to the survey conducted for this paper (as per August 2008), in general terms, introduction of SB at undergraduate level is embryonic and, when exists, it is mostly concentrated in the State of São Paulo. Status at graduate level does not differ much, but a deeper approach to the theme is more perceptible. University of Campinas (UNICAMP) and University of São Paulo (USP) remain as Southeast region and national references. Undergraduate courses are most frequently related to indoor comfort, building physics and generic courses on building and the environment. At USP's Architecture and Urbanism school, besides the traditional courses on indoor comfort and building physics, two other courses were inserted: "built environment and sustainable development" and "architecture, environment and sustainable development". At graduate level, a Sustainable Design course was inserted in the Architectural Design stream, while the Architecture Technology stream has a long tradition in indoor comfort and low energy building subjects.

At graduate level, USP's Polytechnic School offers building simulation, waste recycling as building materials and sustainability of the built environment, as well as an MBA on facilities management which includes a course on "environmental management of buildings".

At UNICAMP's Civil Engineering and Architecture School, a specific "sustainable design and construction" course was created at graduate level in 2004. A similar course at graduate level will be offered for the first time in 2010, after curriculum reformulation. In the meantime, the content is offered as an elective course. Due to characteristics of faculty members, both undergraduate courses have a strong focus on indoor comfort, bioclimatic and low-energy buildings, and water management in buildings.

In other universities, SB-related courses are predominantly elective courses, suggesting this might have been the path found to insert new content without requiring dramatic (and interminable) curriculum reformulations. Table 1 below summarizes most relevant initiatives in selected universities, leaders in SB-related research and teaching in Brazil. Reference centers specifically on bioclimatic design and indoor comfort were not included here, as these contents were considered part of conventional curriculum.

Table 1 - Relevant initiatives in selected universities, leaders in SB-related research and teaching in Brazil

University/school	Undergrad/ Graduate	Course title (AU – architecture/ CE – civil engineering)
FAU USP	U	(AU) Conventional curriculum + Built environment and sustainable development Architecture, environment and sustainable development
	G	Sustainable Design course (Architectural Design stream)
EPUSP	U	(CE) Conventional curriculum
	G	building simulation waste recycling as building materials sustainability of the built environment environmental management of buildings (MBA on facilities management)
UNICAMP	U	(AU/CE) Conventional curriculum + elective
	G	Sustainable design and construction
UFRJ	U	(AU) Conventional curriculum + elective
	G	Energy efficiency Indoor Comfort
UFRGS	U	(AU) Conventional curriculum (EC) elective
	G	(AU) bioclimatic architecture; automation and sustainability, housing and the environment, daylighting, and waste recycling (Building and urban technology stream)

		(EC) waste recycling in civil construction Sustainable communities Sustainable landscaping Environmental perception in the built environment
UFRJ	U	Conventional curriculum
	G	(EC) - waste recycling in civil construction Energy efficiency Indoor Comfort Alternative energy sources
UNB	U	(AU/EC) Conventional curriculum
	G	(AU) Rehabilitation, sustainable environment, architecture and urbanism (specialization program, distance learning mode)

No common set of guidelines for planning, design, construction and operation of a more sustainable built environment are available for local conditions and committed professionals must overcome the language and technological barriers while analysing foreign recommendations and standards under the light of local climate and peculiarities.

Knowledge transfer and education on the client side can break a vicious circle and creates a virtuous one instead as future users/occupants are slowly becoming aware of building impacts and the meaning of sustainable building. Sustainable practices that are already part of the building culture and traditions are still not perceived as such and the idea of a sustainable building is currently linked to presence of technology and somewhat limited to a combination of odorless paints, green roof, water sub-metering and solar panels for water heating.

Considering the explanations above, same recommendations made in 2004 apply for today's scenario in Brazil, meaning that **education and training (E&T)** at all levels and for all stakeholders are important drivers for change and **strategic initiatives to foster SBC implementation include:**

- Introducing concepts in programmes at all complexity and formality levels, **awareness raising** of market actors, civil society and government spheres, amplify formation of specialists;
- Introducing sustainability assessment of the built environment into regular design practice;
- Formatting and implementing training through close synergy between local and international specialists.

- Reinforcing regional research network, by establishing centres of excellence and increasing international collaboration;
- Creating Demonstration Projects;
- Creating and enhancing knowledge transfer opportunities, by training architects and planners on one side, and adjusting developers and decision makers towards SBC on the other.

Policy implementation

Businesses in the building industry need a supportive policy and regulatory framework to achieve dramatic improvements as those required for a sound, consistent SBC imlementation in Brazil.

Continuous and active government involvement is essential for the establishment of a sustainable built environment. Public procurement is a basic and important instrument for SBC implementation in any economy. SBC is not a priority in the governmental agenda in Brazil yet. Without government leadership, lack of funding and the creation of appropriate building regulations are major difficulties (Silva *et al*., 2003).

The lack of effective power within the official environmental institutions, and the low degree of environmental concern among citizens pointed out a decade ago the two major barriers for sustainability in the UN LAC diagnostic on policies and governmental institutions (ECLAC, 1999) were softened through the years, but are maintained.

A paramount step is to increase awareness at all government levels and coordination among academia, financing institutions, private sector, so that an integrated and comprehensive call for proposals for public policy implementation breaks the inertia, supported by robust technical knowledge and financing programs (SILVA;SILVA, 2005).

From the most effective actions to foster implementation of SBC principles in Brazil presented by SILVA;SILVA (2005), the most relevant advances are listed in Table 2. Apart from the energy efficiency regulation, public efforts are clearly isolated in the city/State of São Paulo.

Table 2 – Status and advancements in suggested public policies and actions to foster implementation of SBC principles in Brazil.

Actions	Status	Reach
Governments championing SBC and leading by example through enhancement of their own facilities and incorporation of SBC concepts in public tendering processes and procurement	Proposal for Inclusion of environmental criteria in city of São Paulo Purchasing Act (Lei 13.278, de 7 de janeiro de 2002	City of São Paulo
	Proposal for introduction of environmental criteria in National Purchasing Act	State of São Paulo
Incorporation of sustainability recommendations into national building codes, laws and regulations	Energy efficiency regulation for public, commercial and service buildings (2007). Mandatory after 5 years.	Federal
	Solar water heating. Mandatory	City of São Paulo
Development and implementation of subsidies and tax incentive granting according to sustainability performance demonstration	City of São Paulo policy on climate change (performance demonstration required, but not at whole-building level)	City of São Paulo
Public financing of more sustainable buildings and construction works	-	-
Importation facilitation (short term) and financing local, low cost development of non-available or prohibitively high cost products and technologies (medium term)	-	-

City of São Paulo policy on climate change (2008)

In a pioneering example, after taking part of the C40 – Cities climate leadership group 2007 summit, that gathersed mayors of the world's largest cities committed to tackling climate change, the city of São Paulo commissioned its Environmental secretary coordinate formulation of a justification and preliminary act on Climate Change, partnering with ICLEI and the reputed Fundação Getúlio Vargas, with PNUMA/UNEP's support. Elaboration of the municipal act project involved consultants in different fields like transportation, energy, health and environment, and was submitted for public consultation in September 2007, before proceeding to the Mayor's Office for subsequent forwarding for voting by the municipal representatives.

The Municipal Policy on Climate Change established by Act project 0530/2008 was presented to the Municipal chamber of representatives on August 18th, after a six-month course across the executive legal channel. The document establishes a 30% reduction of greenhouse gas (GHG) emissions by 2012 in relation to 2005 values. For that, it gathers proposals in six areas: transportation energy generation, waste management, health, sustainable construction and contracting. New developments, retrofits and rehabilitations will have to comply with energy efficiency, environmental sustainability, materials quality and efficiency criteria, to be defined in specific regulations not yet disclosed. Selective waste collection will also be mandatory for attaining construction or occupancy permits for larger residential and commercial condominiums and shopping malls. On the other hand, the municipality is obliged to install the so-called *"ecopoints"* in every city district within two years of Law enforcement. Environmental criteria will also be prioritized in municipal purchasing processes, including origin proof documentation for wood products. Developments licensing is also conditioned to a certain permeable area on the natural terrain.

With implementation of this measure, the construction industry would receive two-fold benefits: the municipality will define reduction factor for the *"outorga onerosa de potencial construtivo adicional"*[2] for developments that use renewable energy sources, equipment or technologies that substantially reduce GHG emissions or enlarge their absorption or storage; and (2) environmental licenses of developments with significant GHG emissions would be conditioned by presentation of a GHG emission reduction and compensation measures plan, according to patterns also to be defined.

It is expected that this act Project Will be voted by the end of the year, what would position the city of São Paulo as the first Brazilian city to have a plan to cope with climate change, even before the federal government, which has a similar agenda on this topic.

Energy efficiency regulation (2007)

Energy supply capacity has increased roughly half of the consumption growth experienced in Brazil between 1990 and 2000. Such growth is noticeable in all sectors and shows a clear trend to further increase in the upcoming years. Buildings are major players in this scenario, as residential and commercial building stocks are responsible for 48% of electricity consumption in Brazil (SILVA; ILHA, SILVA, 2008).

[2] Construction right beyond limit allowed by basic and maximum construction coefficient up to limit established by maximum construction coefficient, against financial counterpart.

Brazil is among the few countries with severe deficiencies in energy efficiency (EE) standardization for buildings, and local buildings waste significant opportunities for energy costs savings for not appropriately considering bioclimatic principles or energy efficient technologies. Earlier studies made evident the huge conservation potential (30% in existing buildings and 50% in new ones) resultant of this poor combination of design/construction decision-making.

The national energy conservation programme (PROCEL) was created in 1985. Between 1986 and 2004, it saved (avoided energy generation) around 20.000 GWh. A labeling system for energy efficient appliances was established through a Federal Act in late 1993. Ten years later, PROCEL launched a building-specific action (Procel-Edifica), with an action plan that encompasses six major activities, including bioclimatic requirements, regulation/legislation procedures and energy efficiency indicators for several building typologies. After public comment, the regulation entered into force in late 2007, being initially voluntary in character and compulsory after five years.

The regulation applies for totally, partially or non-conditioned buildings, aiming at enabling energy-labeling of office, commercial and public buildings with net area over 500 m^2 or supply tension over 2,3 Kv.

Five efficiency levels (form A to E, being "A" the most efficient) are specified for envelope, lighting systems and air conditioning. Research to fundament the regulation requirements concluded that lighting responds for 12-57% of energy consumption, and together with HVAC systems (25-75%) and equipment (6-38%) are the major players to close the energy consumption equation for office buildings in Brazil. Weights for lighting, HVAC and envelope were initially established as, respectively, 30%, 40% and 30%. Non-conditioned areas have to be simulated to demonstrate that comfort conditions are maintained for at least 95% of the occupied period. As a requirement for certification eligibility, the building must count on a sub-metering system by energy end use. Minimum requirements for certification at the highest level are also defined and other initiatives that might contribute to increase the building's global energy efficiency are recognized by a bonus point.

Energy efficiency regulations usually provide at least one of three compliance paths: prescriptive, tradeoff and performance demonstration, being the two latter ones usually a comparison between design and reference cases (Lamberts; Carlo, 2006). While the prescriptive approach limits physical properties of the building envelope materials and assemblies, the performance demonstration option requires use of building simulation tools. The Brazilian proposed regulation includes both compliance paths. For the performance compliance path, minimum functions for building simulation software are presented (MME et al, 2006).

Gathering the energy use data, and constructive, materials and components characteristics that could be considered representative of major building typologies (reference

prototypes) is a daunting task, particularly considering that Brazil does not count on reference databases like RECS (for residential buildings) or CBECS (for commercial buildings) available in the United States, or similar sources in other countries. Only based on these reference performance levels, tied to the national building context, it will be possible to establish minimum efficiency requirements. The reference prototypes as the starting point that set alignment for the energy conservation measures (ECMs) to be applied for theoretically more efficient alternatives. The progressive application of ECMs tends to increase a certain building's efficiency level and their effectiveness is evaluated through simulation of thermal-energy performance. Several pieces of software are available and through cross-referencing simulation results with prototypes and possible alternatives, an energy consumption scale will be gradually delineated and allow for initial classification of buildings and to relate scale intervals to ECMs applied in each alternative. As energy efficiency is not given by energy consumption alone (LAMBERTS; CARLO, 2006), the proposed EE regulation combines consumption to life-cycle energy costs analyses (LAMBERTS et al, 2007).

Voluntary labeling schemes have been applied in Brazil for more than 20 years when the National Labeling Program was created in 1984. This voluntary program made possible the reduction in electricity consumption of the models available to the Brazilian consumers. Besides this mechanism, since 1994 the PROCEL Label (Selo PROCEL) is issued annually to the more energy efficient appliances and equipment within their categories. It aims to stimulate the national manufacturing of more energy-efficient equipment and to enable consumers to compare the energy use of the models they are considering. In 2006 the introduction of a mandatory minimum energy efficiency standard for residential refrigerators started to be discussed, which should be implemented early in 2007.

It is however unlikely that energy efficiency (EE) and energy R&D initiatives in Brazil would have taken place without the regulators' enforcement of compulsory programs in 1998 and later with the implementation of Law 9.991/00 by the National Congress. Power sector reforms in Brazil provided the opportunity to enhance support and in fact increase significantly the level of funding in these areas. The regulatory requirement introduced since 1998 has increased by several times the amount of investments in energy efficiency through PROCEL (Brazilian Program for Electricity conservation). Whilst PROCEL, the national electricity conservation program initiated in 1985, invested an annual average of US$ 14 million during 1994-2003, utilities' compulsory investments averaged US$ 57 million per year during 1998-2004 (JANNUZZI, 2005).

However, legislative acts alone are not a sufficient condition to ensure that resources are being used efficaciously to maximize the public interest in energy-related services. In spite of the increased investments, no independent ex-post evaluation of the programs

implemented has been carried out as yet to determine impacts in terms of avoided capacity and energy savings.

Significant experience has been acquired by the regulator and utilities in terms of managing EE and R&D portfolios, there are, however, three main areas that require attention to improve the performance of the Brazilian "1% obligation": 1) the administration, governance and coordination of the resources and efforts (amongst utilities and CTEnerg); 2) the need to improve collaboration and pooling of more resources into the compulsory EE and R&D activities; and 3) program monitoring and ex-post independent evaluation (JANNUZZI, 2005).

During the initial years of the "1% regulation" (1998-2005) ex-ante evaluation of EE programs was done by PROCEL. ANEEL then transferred this evaluation to some State regulators, to bring this activity back to its own staff later on. In 2005 ANEEL contracted external consultants to evaluate the proposed utilities' annual EE programs. The ex-ante evaluation of utilities' R&D programs was initially done by ANEEL staff. In a second phase ANEEL contracted the National Research Council (CNPq) to review the R&D proposals. More recently (2003), ANEEL contracted Universities and Research Centers for this task (JANNUZZI, 2005).

Despite Brazil's mature and comprehensive programs and favorable legislation, there is still a huge, unexplored potential for energy efficiency and a clear need for new, complementary instruments. Barriers perceived at the time of efficiency programs implementation (e.g. low, subsidized tariffs; lack of information; incipient technology; inadequate legal structure; depleted resources; lack of qualified professionals; resistance from utilities companies…) are now mostly overcome and no longer impeditive. On the contrary, market transformation gained momentum and market is now clearly driven by motivators such as cost reduction (for consumers, producers and distributors); increase in economic efficiency (reduction of energy intensity); improvement in commercial balance (reduction of diesel oil and LPG importation); and reduction of environmental impacts (PORTO, 2006).

Energy efficiency poses a series of challenges in the broader Brazilian context:

- Define and align governmental action instruments (PBE, Procel, Conpet)
- Orient application of available resources (PEE, Sectoral funds)
- Orient refinement of the legal and regulation system;
- Facilitate constitution of a sustainable market for energy efficiency;
- Promote permanent mobilization of the society

Finally, transformation of the energy efficiency market demands:

- encouragement to energy efficient equipment, buildings, systems and production processes;

- support for energy sources replacement;
- orientation of governmental purchasing power;
- support for technical losses reduction;
- incorporation of energy efficiency in energy sector planning.

Regarding the building sector, specifically, the EE regulation, constitutes the major achievement. Even though it was included in the EE law issued in 2001, it took six years to have the regulation's first draft, launched in the end of 2006 and already altered twice before the consultation started. The proposed regulation is dedicated to commercial and public buildings, which sum up to 22% of total electricity consumption in buildings. Ex-ante projections of savings are not available yet, but are expected to be around 15 to 20%. The next step is to develop a version for the residential sub-sector, responsible for other 22% of electric energy consumed in Brazilian buildings and that, together with commercial building, has shown the steepest growth curves after the rationing in 2001.

Role of the private sector

Though industry is starting to consider the concept and awareness among designers and contractors is rising, sustainability is far from being part of mainstream business across the country. A clear gap remains, which increases the private sector's potential contribution.

Special products and technologies still require importation, resulting in higher costs and perceived risks due to the lack of local technical support. However, availability of appropriate products in the market has clearly increased in the past four years or so. A great deal of such improvement is related to insertion of certification schemes in the market. LEED rating system in particular states clear requirements for materials attributes. Some required products were already available in the Brazilian market for decades, but not marketed based on their sustainability profile. Such attributes were gradually included in suppliers technical literature. Consultancy work developed their own information collection approach and suppliers' declarations now abound. Taking the concept to the extreme, a certification scheme was even created to ratify suppliers declarations developed for LEED certification purposes.

When it comes to product performance demonstration of newcomers to the market, many of them do not offer a historic performance data set, are not familiar to designers and practitioners, and/or demand substantial cultural or technological assimilation. This demands intense coordination among local/foreign manufacturers' to promote the use and virtues of sustainable materials, products and technologies.

The call for a market shift from a product oriented process to a service oriented process is yet to be answered. Closing all circles throughout the construction sector production chain is a fundamental condition for SBC and shape clear action opportunities for SBC

organizations dedicated to successfully connect practitioners, scientific/technical knowledge development and the market.

Ethics for sustainability goes hand in hand with supplier selection, which, in Brazil, may be as fundamental as materials selection by both public and private clients and can force adjustment of market players in the short run. CBCS, FGV, Instituto Akatu are among the non-governmental and educational institutions working on responsible consumption as an inducer of sustainable building and construction industry.

Architectural design plays a very important role as inducer of SBC. The Brazilian Association of Architectural Practices (AsBEA) is responsible for over 65% of all development design approved in the city of São Paulo. AsBEA has created a sustainability structure based on work groups replicated throughout its network of regional members and is working on a series of proposals for public policies, which include:

- Alteration of existing definitions and procedures in legislation that regulates the Municipal Master Plan and land use restrictions (e.g. regarding ground level plan, retention boxes/cisterns, water reuse, green roofs, permeable sidewalks, water sub-metering, Procel Edifica label, waste collection and diversion etc)
- Design approval by performance assessment and criteria: through regulation of labels and efficiency performance and certificates (e.g. Procel label for buildings created by the 2007 Energy Efficiency Regulation) to allow for sustainable assessment of design by municipality officials.
- Acceleration of design approval procedures for developments that incorporate sustainable technologies and solutions.
- Progressive tax reduction or proportional to investment factor made in a project as a counterpart of incorporation of sustainable solutions and technologies. As justification, public administration would be able to reduce correspondent investment needed in urban infra-structure.

Financing implementation and innovation

The cost for changing current development directions was frequently pointed out as the major barrier for SBC implementation within the region.

At one's hand, there is evidence that a more sustainable building can command a premium, and this may increase as awareness of climate change and expectations of rising energy costs leads people and organizations to attach more value to eco- efficiency. A McGraw-Hill (2005) study reported that professionals expect "greener buildings" to achieve an average increase in value of 7.5% over comparable standard buildings, together with a 6.6% improved return on investment. WBCSD Energy Efficiency in Buildings initiative recent report (2007) found out that the perceived cost premium for SB

in Brazil is 22%, the second highest figure among surveyed countries. Available real cost data do not allow for extrapolation, as benchmark values vary widely, accordingly to building typology and construction standard. Figures arisen from certification experience, though still very limited, show that cost premiums are somewhere between 30% (small, regular commercial building) and 2%[3] (for world class, triple A commercial towers).
On the other hand, it is frequently argued that, in the Brazilian and other developing nations contexts, sustainable building simply cannot cost more than regular building.
Government strategies suggested by SILVA;SILVA (2005) should seek to provide a pro-active focus on:

- Mentoring sustainability enterprises.
- Promoting investment financing and venture capital;
- Providing innovation incentives; and
- Increasing financing and securities offerings.

Owner-occupiers will tend to have a longer term perspective and stand to benefit directly from energy savings. On the other hand, in speculative developments, investors' time horizons are shorter. This increases the importance for their investment calculations of the property's residual value when they sell compared with operational returns during their ownership. In any case, operational costs are often not properly considered by most investors. Construction sector is acknowledged for being conservative. Decision-making is frequently based in terms of short payback periods, framed by a usual five year attractiveness horizon. Sustainablity is a long term though, which claims for long term solutions, planning and reflection Brazilian developers are no willing to absorb increased capital costs and the immediate reaction is to transfer such costs to the final owner, contributing to consolidate a negative cost perception around SB. In some countries, this equation has been balanced by government subsidies and incentive policies and, more recently, establishment (or increase in requirements) of mandatory requirements.

CBCS' Economic and Financial (E&F) Committee was created to stimulate, through financial institutions, good practices of sustainability in the civil construction sector and establish mechanisms for identification of non-economic risks in real estate sector, especially, environmental, social and market risks. E&F Committee will act on three dimensions:

Training

- Provide training for the financial system to do financial credit analyses that contemplate aspects of sustainability in their analyses;
- Establish a baseline for sustainability analysis, to ensure a minimum standarts of sustainability in buildings, according to its relevance and impact on society and the environment;

[3] 8%, after LEED energy minimum requirements were tightened in June 2006.

- Establish a mechanism to stimulate sustainability on the construction sector, by indirect induction of best practices, combating non-compliance of products and the informal construction.

Recommendations and mechanisms to stimulate the sustainability

- In considering a real estate venture, include in the analysis phases of the operation and upgrade performance of the building;
- Establish minimum protocols for granting "Green credit", including the entire chain of construction as the industries that produce materials and equipment;
- Establish recommendations (like Basel II) to the financial system, as it permits to establish credit analysis to real estate ventures, according to best practices of the market that contemplate environmental and social issues;

Risk Management

- Consider the analysis of non-financial risks that address the market, social and environmental aspects;
- Consider parameters for sustainable growth of the civil construction sector; and
- Stimulate the Rating Agencies (Moodys, Standard & Poor's, Fitch) to classify the risks inherent in sustainability aspects of buildings.

International sources can also help to create momentum for subsequent local actions not only in terms of cross-border capital flows to finance infrastructure development but also of technical assistance, information exchange and capacity building.

Conclusions

The most noticeable advances in public polices in this period were the related to the national energy efficiency regulation, that finally upgraded Brazil from the critical non-regulated countries group; the green purchasing programs at city, state (São Paulo) and federal levels; and the City of São Paulo's policy for climate change, that includes several interfaces with SBC.

Though acknowledging the effort input in all these initiatives, there is still a long way to go. Also the rhythm of change must be speed up. From the private side, introduction of rating and certification schemes is incipient but had already slightly increased the range

of available products. A huge wave of greenwashing has accompanied the certification euphoria, and meaningless labels are cascading and being multiplied in short periods of time.

A prominent bottle neck is education and training. Change in the past four years is nearly imperceptible and the lack of professionals capable to not only know what to do, but be confident enough to use their knowledge to actually solve problems at best benefit for the environment and society at affordable costs is among the strongest candidates to, hamper SB uptake in Brazil if a coordinated strategy is not established and adopted in the near future.

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