Newsletter
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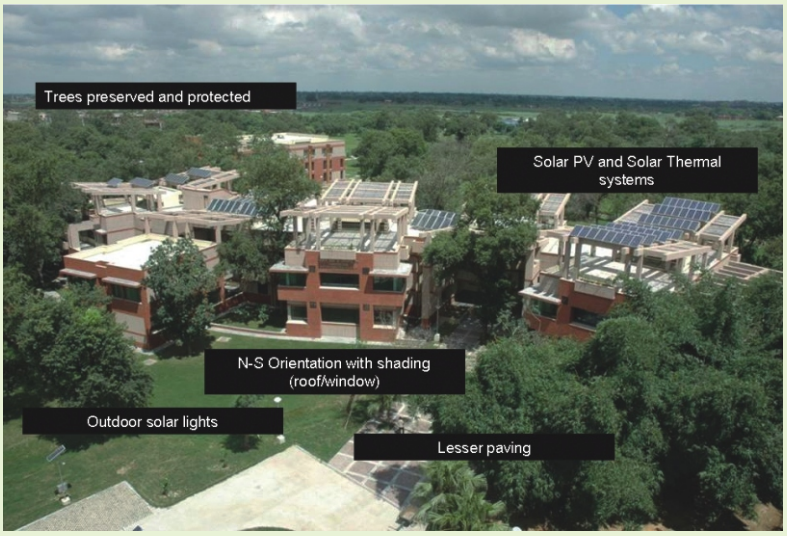
Editorial

The sustainability of the building industry in India is crucial to the economic, social and human development of our country. The annual growth rate of our construction industry is far higher than the global average. Further, it contributes significantly to our GDP (5 - 10%). Direct employment generated is second only to agriculture; with indirect employment generation in ancillary industries, as high as 5 -10%. More than 70% of the infrastructure needed for a developed India is yet to be built and that gives great opportunity to build green. The scale and pace of construction in India is unparalleled and requires every one of us to rise to the occasion and help in enabling transition to a clean and green economy. At this scale, cost of green building materials, renewable energy systems and design services can all be brought down for everyone's benefit. Given the scenario, in this issue of ENVISAGE newsletter we focus on the theme "Green Buildings".

In the lead articles, Dr. Brinda Viswanathan and Ms. B. Ishwarya explains the concept of green building in the context of climate change; and explore cost, benefit barriers along with other crucial things which would scale up the program to promote sustainable construction practices throughout the country. Dr. I. Zareena Begum elaborates the Sustainable Building Rating System emerged in various countries and later on the GRIHA – green building rating system followed in India.



First 5 Star rated GRIHA building in IIT Kanpur

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GREEN BUILDINGS

(When we build, let us think that we build forever)

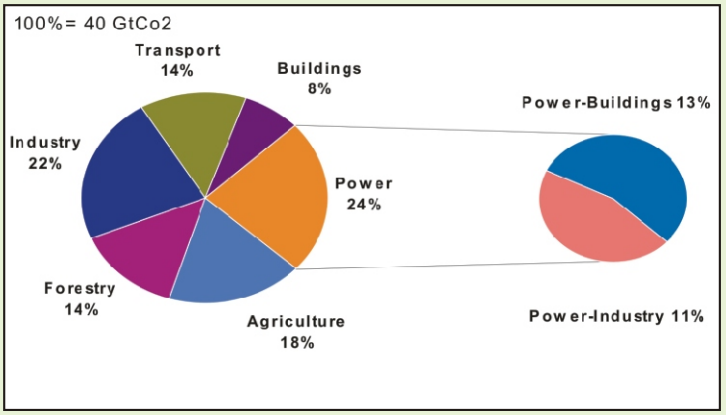
Green buildings - context:

The emissions of Green House Gases (GHGs) have risen steeply since the industrial revolution and are believed to be contributing to changes in climate. There is now strong evidence of a change in greenhouse gas (GHG) concentrations. The atmospheric concentration of CO_2, CH_4, N_2O – primary GHGs – has increased by 31%, 151% and 17% respectively since 1750. As a result, the global average surface temperature has increased by 0.6± 0.2, precipitation has increased by 0.5 to 1% per decade and global average sea level rose between 0.1 and 0.2 meters (Solomon et al., 2007). IPCC scenarios project long term emissions to grow by 39 to 89 percent by 2025 and 63 to 235 percent by 2050 which could be disastrous. For most countries that have recognized the reality of the threat of climate change, sustainable development has assumed center stage as never before with energy and resource conservation and reduction of green house gas emissions becoming the primary target. The global focus is now firmly on green investment in agriculture, forests, cities, transport, waste management, buildings and so on to mitigate green house gas emissions.

Among these sectors, buildings are identified as major sector that needs green investments because of two main features: a large environmental footprint and the huge potential to significantly reduce emissions.

In 2006, the building sector consumed about 145.6 Qbtu (quadrillion British Thermal Units) of energy which is about 38 percent of total energy use worldwide (Mc.Kinsey 2009). As a result, the contribution of the building sector to emissions has also been significant. Price et al (2006) estimate the energy-related CO_2 emissions in the building sector including electricity use at about 8.6 Giga tons (GT) per year in 2004 .The buildings sector accounts for 8% of the emissions in terms of primary energy and an additional 13% in terms of indirect usage of energy that is from the power sector as shown in Figure 1. In a Business-As-Usual scenario, IPCC projections show that the building emissions, expressed in $GtCO_2e$ (gigatons of carbon dioxide equivalent) could be between 11.4(in a low growth scenario) to 15.6 (high growth scenario) in 2030 and this could result in irreversible changes in climate.

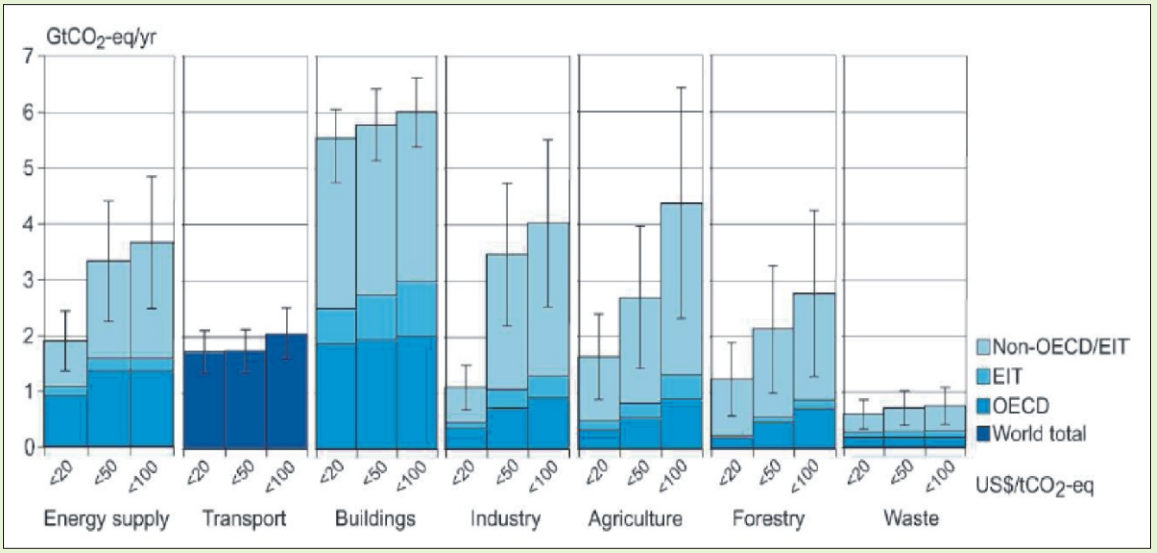
Figure 1: Sources of Green house Gases: 2002



Source: Data from Vattenfall AB (2007)

Buildings also come with a huge potential to significantly reduce emissions. IPCC fourth assessment report (Levine et al., 2007) has identified the buildings and construction sector as the single largest potential sector which has the capacity to reduce emissions significantly – a 29 percent reduction in the projected baseline emissions by 2020 at zero cost. The report also highlights that the building sector has the greatest energy-saving potential among all the other sectors, in all countries and at all cost levels.

Figure 2: IPCC Projections of CO_2 mitigation potential in 2030



Source: Cheng at al (2008)

It is in this context that green buildings have evolved as an important mitigation tool to realize the huge mitigation potential of the building sector. Green buildings are buildings that are more sustainable which focuses on reducing building impacts on human health and the environment during the building's lifecycle, through better design, construction operation and maintenance. The following figure shows what a green building is and what benefits it will lead to.

Web sources on Green Building

United States Green Building Council
http://www.usgbc.org/

Building for Environmental and Economic Sustainability
http://www.bfrl.nist.gov/oae/bees.html

Environmental Building News - Guide to Green Building
http://www.buildinggreen.com/

Green Building Concepts - Contains tools to build more energy and resource-efficient homes
http://www.greenconcepts.com

Green Building Resource Guide - A database on green building materials and products
http://www.greenguide.com

Green Building Alliance - A non-profit organization that educates the development community on benefits and techniques of green building
http://www.gbapgh.org/

The EcoGateway - Guide to Sustainability
http://www.ecoiq.com/onlineresources/

Green Building Resource Center - Green Design Network
http://www.greendesign.net/

Oikos - An extensive index of green building products
http://oikos.com

Green Building Information Council - Canadian organization that promotes energy-efficient and resource-efficient buildings http://greenbuilding.ca/

Austin Energy's Green Building Program
http://www.ci.austin.tx.us/greenbuilder/

The Sustainable Building Coalition - A network of individuals interested in sustainable and ecological building, design and development
http://www.greenbuilder.com/

The Global Development Research Center - Virtual Library on Urban Environmental Management
http://www.gdrc.org/uem/

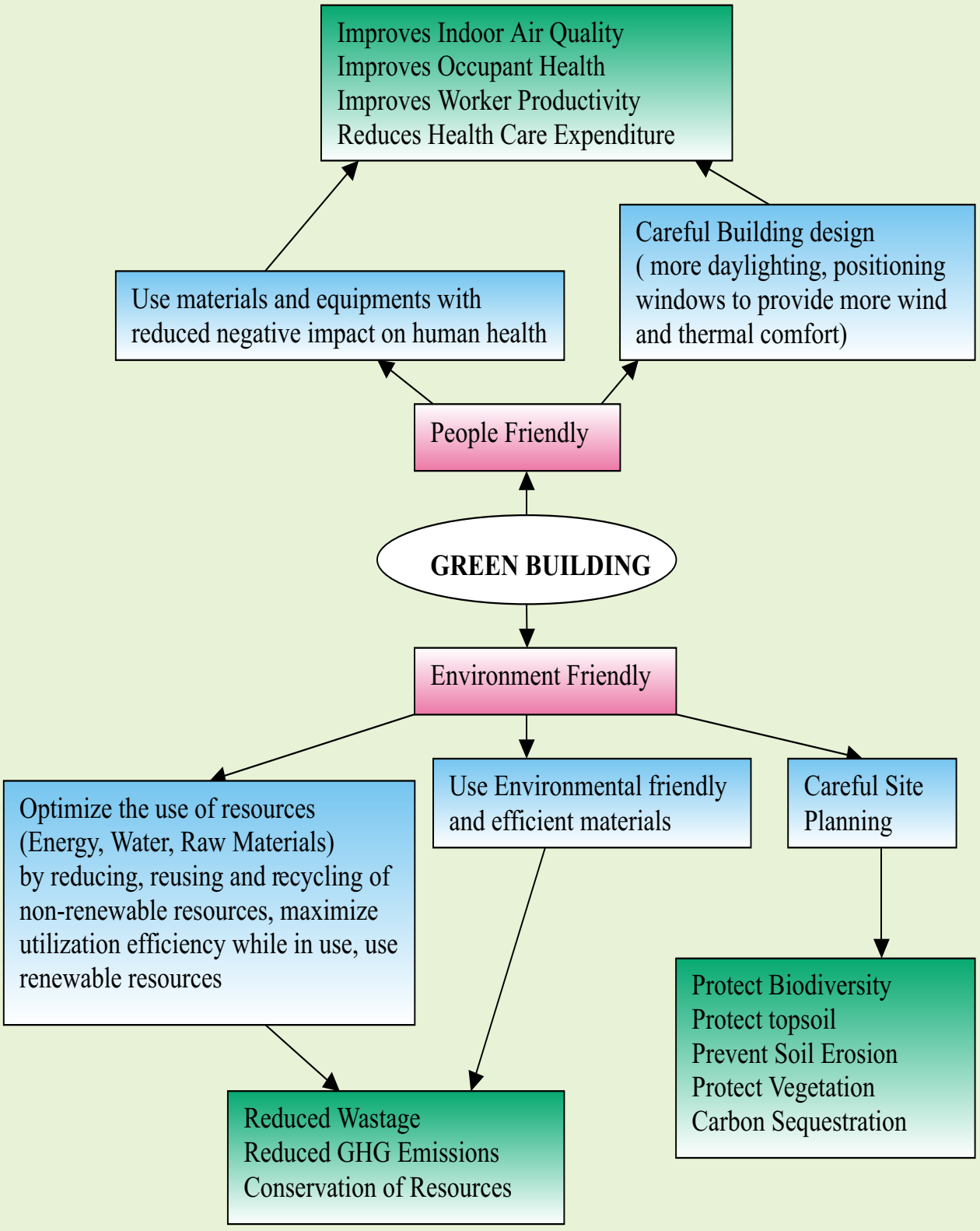
Energy Efficient Building Association - Promotes awareness, education, and development of green buildings and communities http://www.eeba.org

Austin Chronicle's Green Building Guide
http://www.auschron.com/issues/spec/greenbuild/ .

Building for Health Materials Center - Central supplier for healthy and environmentally friendly building products and provides many services including consulting for green and healthier residential and commercial projects
http://www.buildingforhealth.com

Ministry of New and Renewable Energy, Government of India
http://www.mnes.ni

Figure 3: Green Building: What and Why?



Green Building Footprint:

It is difficult to estimate the exact number of green buildings as there is no clear definition of 'what is green'. There may be several buildings which may have incorporated some green aspects but are not fully green. The green building footprint achieved today is estimated to be 272 million sq.ft and 400 buildings worldwide. Currently, there are about 11 countries which are members of World Green Building Council and several other emerging economies are in the process of forming green building councils. These councils use several energy efficiency standards such as LEED, BREEAM, Green Star and so on which provides credits based on several criteria.(UNEP_ILO)

The Indian Green Building Council (IGBC) adopted the LEED green building rating system in 2001 and since then, the green building movement has gained tremendous momentum in India. The green footprint in the country has increased from a humble 20,000 sq.ft in 2003 to about 10 million sq.ft in 2008 (Srinivas). Currently, there are about 436 LEED registered green buildings and 54 LEED certified green buildings in India spread in about 312 million sq.ft.(www.igbc.in). With growing awareness of the benefits of going green, the demand for green buildings is increasing from both building owners and developers. The prospects for a booming green building industry in the country seems favorable and is poised to reach scalar heights.

Costs, Benefits, Barriers:

Green buildings lead to a wide range of environmental, financial, health, social and economic benefits as is seen in the table below. In spite of the wide range of benefits, the adoption of green buildings has not been so rapid on account of several barriers from all the agents involved as shown in the table. The cost of transforming the building sector will be substantial reflecting the transaction costs and the costs to overcome the real market failures and barriers arising from all the stakeholders involved. However, the cost of inaction is much higher and would represent enormous risks for all those stakeholders.

Cost Benefits and Barriers for the adoption Green Buildings

Stakeholder	Costs	Benefits	Barriers
Construction firm	Incremental cost towards Architectural and Engineering design	New business opportunity	1)Information asymmetry regarding green practices, codes and standards and green guidelines 2) Lack of Incentives: developers may not find it profitable to increase energy efficiency 3)Conservative nature of construction industry: voluntary adoption of new technologies is low
Owner	Bears the incremental cost	Financial Benefits Huge operational and maintenance savings due to 1)Energy savings (40-45% less energy) 2)Water savings(20-30% less water)	1)Lack of incentives-low priority for energy-efficiency 2)Split Incentives 3)High Upfront Costs 4)Lack of access to capital 5)Information asymmetry regarding where to turn, whom to trust and what to buy 6) High Transaction Costs 7)Short planning horizons but long pay-back periods 8)Risk aversion: uncertainty about green property value 9)Framing and discounting problems 10)Serving the loans as there is no direct return
Occupant		Health benefits Reduces deaths due to poor indoor air quality Reduces illness rate by providing better interior quality Productivity benefits	1)Inadequate information on current energy consumption 2)Lack of awareness about benefits of energy efficiency

Stakeholder	Costs	Benefits	Barriers
		Improved indoor environmental quality(more fresh air, daylight) enhances productivity	
Society		Environmental Benefits Value of Emissions Reduction (Highest mitigation potential at low cost) Resource Conservation Value of reduced waste generation Social benefits Increase Adaptive capacity Alleviate living conditions of poor and slum inhabitants Energy Security Decrease Energy Poverty	1)Lifestyle and behavioral status-quo 2)Lack of awareness that green buildings will enhance quality of life 3)Externalities: no one internalizes the consequences of their actions
Government	-Incremental cost in enforcing green techniques -Cost of implementing policies, enabling financing environment and capacity building -Cost of technology transfer, development and dissemination	-Combating climate change – achieving emission reduction targets -Achievement of MDG : slum clearance -Reduction of operational costs and subsidy costs	1) No incentives for the property owner, businesses and financial institutions 2) Lack of appropriate instruments (like tax rebates) 2)Lack of appropriate Policies, Legislations and Laws 3)Weak Monitoring Mechanisms 4)Lack of institutions that oversee the market and coordinate transactions among different actors 5)Lack of investment and financial support from the government
Workforce	Cost of undergoing training to acquire new 'green skills'	Economic Benefits Huge Employment effects : Direct, Indirect and Induced jobs	1)Lack of 'green skilled' workforce 2)No proper training institutes and guidelines 3)Absence of certification mechanisms which distinguishes skilled from non-skilled workers is a disincentive to undergo training
Other Businesses	Increased expenditure on R&D, product development and promotion	-New business opportunity -Positive impact on research, innovation and business development	1)Green Products Industry: unwilling to invest in R& D to develop energy-efficient appliances simply because there is no demand and they are uncertain about market conditions 2) Businesses lack expertise and know-how regarding the science and techniques of energy-efficiency 3) Utilities: operating under outdated regulatory system creates disincentives to pursue cost-effective energy eficiency
Funding institutions (FIs/Banks/ International Aid agencies)			1)Reluctance to fund individual building projects -Risk-averseness attitude: uncertainty regarding how the customer will pay back the loan as there are no direct returns for the customer(only indirect returns in the form of energy savings) -High risks and low returns 2)Reluctance to fund large-scale building projects because of building specific challenges: -'long tail' of building projects: large no of small opportunities -Multiple Stakeholders, Building diversity leading to high transaction costs -economically not attractive: Low CER yields (for CDM funding)

Source: Author's own compilation

Integrating the Climate Agenda and Development Agenda

In spite of the growing urgency in dealing with climate change, most developing countries have far more pressing problems and development concerns to address, that they would prefer to ignore climate change for a while. Additionally the developing countries have had a very little share in historical contributions in Green House Gas emissions and would not be willing to reduce emissions now when they are on a development path. However, countries need not choose between addressing development and climate change but can address both simultaneously.

In most developing countries, a large percentage of buildings or dwelling structures are made of materials which are not durable and housing supply is far short of the housing demand. Alleviation of slums as one of the Millennium Development Goals is gaining prominence. In such a situation, meeting the demand for improved housing conditions for the poor, associated with ripple effects is seen as an important development strategy. With a little more effort, policies and investment if directed in the right direction, most of these buildings can easily be made 'greener' thereby cost-effectively addressing climate change without having a separate agenda for GHG mitigation. For a developing country, this little extra effort to go green would not only reduce future emissions but more importantly build an adaptive capacity to withstand any adverse effects of a changing climate. Green buildings in the context of sustainable development needs to be interpreted as a tool for adaptation with mitigation as an important co-benefit.

From a policy perspective, politicians of developing countries would not prefer to project the fact their emissions are going down as a result of a fall in energy consumption. It is here, where the complementarities between mitigation and adaptation, needs to be stressed. Green buildings in developing countries should not be encouraged just as a mitigation tool but mainly as a development cum adaptation tool. The government should act as a major player in increasing investments and directing efforts to this end.

Enabling Green Buildings in India:

India has adopted a national green rating system called GRIHA (Green Rating for Integrated Habitat Assessment) tailored to her geographic and climatic conditions. It was conceived by TERI and developed jointly by the Ministry of New and Renewable Energy to help people access the environmental performance of a building over its lifecycle against certain nationally acceptable benchmarks.

However, as seen earlier there are still a lot of barriers in adopting green buildings coming from all the stakeholders involved: reluctance from home owners, risk-averse attitude and information asymmetry of construction firms, lack of financing from institutions and lack of incentives and investment from government. To strengthen the Green building movement, first and foremost, these different stakeholders should be brought together and these barriers should be addressed simultaneously. A top-down approach, where policies influence financing decisions and hence affect consumer decisions would work better in the case of buildings. The central and local government should play a key role in policy making, enacting legislations, and providing an enabling environment. Incentives should be given to financial institutions and property owners in such a way that more financing comes from the private sector and the property owners would prefer green buildings. This way, incentives from government should influence financing and consumer decisions, and enable the green movement.

A new initiative called Eco-Housing aided by the USAID and implemented by the International Institute for Energy Conservation (IIEC) is being adopted by the Pune Municipal Corporation (PMC). The program aims at promoting green building practices by demonstrating the benefits of sustainable construction to various stakeholders and by developing a five star rating mechanism based on several assessment criteria. Most importantly, the program design includes supporting policy changes, the engagement of stakeholders, financial and fiscal incentives, development of performance assessment tools and capacity building activities all of which are

crucial in enabling the adoption of green buildings. The project has successfully engaged several public and private sector housing finance institutions to develop specific housing mortgage products for Eco-housing. Bank of Maharashtra and ING Vysya are offering an interest-rate subsidy for eco houses and other financing institutions like HDFC and SBI also are set to launch similar products. The municipality has proposed upto 50% property tax rebate for consumers. The program has also resulted in a unique public-private partnership by setting up of the Sustainable Technology Building Center (STBC) which aims at training and capacity building of professionals and removing institutional and market barriers resulting in successful program expansion.

There are important lessons to be learnt from this program and the crucial thing would be to scale up the program to promote sustainable construction practices throughout the country. The government should also act as a leader in adopting green practices for constructing government buildings and also in social housing and slum rehabilitation schemes which would go a long way in inducing the private sector to go green.

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A project on 'Green Buildings' has been undertaken by Madras School of Economics as part of a United Nations Environmental Program(UNEP) initiative to launch a 'Green Economy Report'. Dr.Brinda Vishwanathan and Ms. Ishwarya Balasubramanian are contributing authors to the 'Economics and Employment' section of the 'Green Buildings' section of this report.

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Indian Green Building Council: www.igbc.in

GRIHA website http://grihaindia.org/

ECO Housing Website www.ecohousingindia.org

Sustainable Building Rating System

The market place of the design and construction of high performance buildings is dynamic and evolving. Professionals through out the building industry use assessment rating systems to evaluate and differentiate their product or design. World-wide there are hundreds of building evaluation tools that focus on different areas of sustainable development and are designed for different types of projects. These tools include life cycle assessment, life cycle costing, energy systems design, performance evaluation, productivity analysis, indoor environmental quality assessments, operations and maintenance optimization, whole building design and operations tools, and more.

'Sustainable building rating systems' are defined as tools that examine the performance or expected performance of a 'whole building' and translate that examination into an overall assessment that allows for comparison against other buildings. For a rating system to add value to the sustainable design and/or operation of a building, it must offer a credible, consistent basis for comparison, evaluate relevant technical aspects of sustainable design, and not be over-burdensome to implement and communicate.

Worldwide, a variety of assessment programs have been developed around environmental and energy impacts of buildings. The first environmental certification system was created in 1990 in the UK, The Building Research Environmental Assessment Method (BREEAM). In 1998 the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System was introduced based substantially on the BREEAM system. In 2005, the Green Building Initiative (GBI) launched Green Globes by adapting the Canadian version of BREEAM and distributing it in the U.S. market.

• Building Research Establishment Environmental Assessment Method (BREEAM):

BREEAM is the earliest building rating system for environmental performance assessment. This was developed by the British Research Establishment in 1990. In the past decade, BREEAM has evolved from a design checklist to a comprehensive assessment tool to be used in various stages of a building life cycle. BREEAM is recognized by the U.K. building industry as the benchmark for assessing environmental performance. Canada, Australia and several European countries have developed variations of BREEAM incorporating local environmental requirements in the rating scheme. BEPAC (Building Environmental Performance Assessment Criteria), BREEAM Canada and BREEAM GreenLeaf are examples of such efforts.

• Green Building Challenge Assessment Framework:

The Green Building Challenge is a collaborative of more 20 countries committed to developing a global standard for environmental assessment. The first draft of the assessment framework was completed in 1998 and a spreadsheet tool (GBTool) was developed for participating countries to adapt the framework by incorporating the regional energy and environmental priorities. Korea, Italy and Brazil are developing their national green building rating tools based on GBTool. Though GBTool is not a rating system used for certifying buildings, it is well researched and continually refined to provide the basis for developing regionally sensitive rating systems that could be administered by local green building programs.

• Leadership in Energy and Environmental Design (LEED):

In North America, the U.S. Green Building Council (USGBC) developed the LEED rating system with a market driven strategy to accelerate the adoption of green building practices. The LEED rating system has gained a lot of momentum since Version 2.0 was released in March 2000. As of August 2004, about 1,450 projects have been registered for LEED certification. LEED was originally developed as a rating system for new commercial buildings but has become a model for other building sectors and regulatory programs. The success of LEED has created demands for adapting the rating system for existing buildings, commercial interiors and residential buildings. LEED also is being adapted by federal agencies, states and local jurisdictions in the U.S. and Canada for implementing green building programs. An estimated $15 billion worth of green buildings are in design or under construction in the U.S., representing 12% to 15% of total public construction and 2% of private construction.

• Green Globes™

US was adapted from Green Globes Canada in 2004. Currently, the U.S. version is not available for all of the U.S. General Services Administration (GSA) project types; however, Green Globes™ US is developing tools that address the major renovation,

tenant build-out, and operations and maintenance applications. The Green Building Initiative received accreditation as a standards developer by American National Standards Institute (ANSI) and is working toward developing Green Globes™ US as an official ANSI standard. Although there has been much publicity around Green Globes™ US in recent years, according to data of the Green Building Initiative, only four buildings have received Green Globes ratings and 63 buildings have registered.

The development basis of each sustainable building rating system is tabulated in Table 1. A list of available building assessment tools are reported in column one and in column two the known development basis for each of those tools is mentioned.

Table 1. Green Building Rating Systems and Sources

Sustainable Building Rating Systems	Development Basis
BREEAM (Building Research Establishment's Environmental Assessment Method)	Original
BREEAM (Canada	BREEAM
BREEAM Gaeen Leaf	BREEAM, Green Leaf ™
CALABAAS LEED	LEED R
CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)	Original
CEPAS (Comprehensive Environmental Performance Assessment Scheme)	LEED, BREEAM, HK-BEAK, IBI
Earth Advantage Commerical Buildings (Oregon)	Undisclose
EkoProfile (Norway)	Undisclosed
ESCALE	Undisclosed
GBTool	Original
GEM (Global Environmental Method) For Existing Buildings (Green Globes) - UK	Green Globes Canada
GOBAS (Green Olympic Building Asessment System)	CASBEE LEED
Green Building Rating System - Korea	BREEAM LEED, BEPAC
Green Globes Canada	BREEAM Green Leaf
Green Globes™ US	Green Globes Canada
Green Leaf Eco-Rating Program	Original
Green Star Australia	BREEAM, LEED
HK BEAM (Hong Kong BUilding Environmental Assessment Method)	BREEAM
HQE (High Environmental Quality)	Undisclosed
iDP (Integrated Design Process)	Original
Labs21	Original
LEED (Leadership in energy and Environmental Design)	Original
LEED Canada	LEED
LEED India	LEED
LEED Mexico	LEED
MSBG (The State of Minnesota Sustainable Building Guidelines)	LEED Green Building Challenge 98, and BREEAM
NABERS (National Astralian Built Environment Rating System	Undiscosed
PromisE	Undisclosed
Protocol ITACA	GBTool
SBAT (Sustainable Buildings Assessment Tool)	Original
Scottsdale's Green Building Program	Undisclosed
SPiRiT (Sustainable Project Rating Tool)	LEED
TERI Green Rating for Integrated Habitat Assessment	Original
TQ Building Assessment System (Total Quality Building Assessment System)	Original

Source: Fowler and Rauch (2006), Summary of Sustainable Building Rating Systems

By simply putting all of the rating systems it appears to satisfy their stated audience in purpose and practice. A comparative analysis of the leading green building rating systems available in current practice is provided in Table 2. The focal comparison of the sustainable building rating systems with common roots and similar goals – paraphrased as providing a guiding principle and assessment system for more sustainably designed buildings – more similarities than differences exist

Table 2. Comparison of Green Building Rating Systems

Rating System and Governing Body	Green Building Design Criteria	Building Types Covered	Certification Process
Leadership in Energy and Environmental Design (**LEED**) Green Building Rating System™ Developed by United States Green Building Council (USGBC) Number of LEED Certified Projects Worldwide: Commercial buildings: 1,004/ Homes: 267 Source: http://www.usgbc.org	Sustainable site development. Water savings Energy efficiency Materials Selection Indoor environmental quality Innovation in Design	Specific LEED rating systems have been developed for: Homes (currently in pilot stage) New Commercial Construction and Major Renovations of Existing Building Commercial Interiors Core and Shell development Neighborhood Development Schools Retail Health Care is currently under development	USGBC conducts third party verification prior to awarding a certification. Cost of certification: $2,500 to $22,500 depending on member status, building type and size. Significant documentation required for submittal. Accredited Professional is recommended but not required to be part of the design team
EarthCraft House™ is a residential green building program of the Greater Atlanta Home Builders Association in partnership with Southface. To date: 4,000 EarthCraft House single family homes and over 1,500 EarthCraft Multifamily dwelling units have been certified: Source http://www.earthcrafthouse.com	Site Planning Energy Efficient Building Envelope and Systems Resource Efficient Design Resource Efficient Building Materials Waste Management Indoor Air Quality Water Conservation (Indoor and Outdoor) Homeowner Education Builder Operations Bonus/Innovation Points	New and renovated homes, including: Single family homes Multifamily homes Duplexes Townhouses Lowrise apartment Condominiums	Third party certification is conducted by Southface. Cost to builder for joining EarthCraft House program – $825 The EarthCraft House fee for each house is $0.10/sq.ft. (minimum $250). The builder is required to: Attend a oneday EarthCraft House training. Attend a design review with EarthCraft House staff to generate an individualized EarthCraft House scoring worksheet. And then participate in a walkthrough with EarthCraft House staff.
Green Globes an online auditing tool that lets designers, property owners and managers assess and rate buildings against best practices and standards. Run by the **Green Building Initiative™ (GBI)**. Source: http://www.thegbi.org	Project Management Site Energy Water Resources Emissions, Effluent and other Impacts Indoor Environment	New commercial building. Existing commercial buildings. The GBI works with NAHB to promote Green Home Building Guidelines which are designed to be a tool kit for the individual builder looking to engage in green building practices and home builder associations (HBAs) looking to launch their own local green building programs.	Third party certification is required to obtain certification but selfcertification is an option. $4,000- $6,000 per building for third party verification. On line questionnaire required to be completed by building owner.

Rating System and Governing Body	Green Building Design Criteria	Building Types Covered	Certification Process
ENERGY STAR Buildings that earn the ENERGY STAR are the top performers for energy efficiency nationwide and use about 35 percent less energy than average buildings. Developed by EPA who provides. assistance, and recognition opportunities to help buildings and plants improve energy efficiency. More than 3,200 buildings in all 50 states representing almost 575 million square feet have earned the ENERGY STAR label. Source: http://www.energystar.gov/	Energy Efficiency	Homes and commercial and industrial buildings including offices, bank branches and financial centers, courthouses, hospitals, hotels and motels, K12 schools, medical offices, supermarkets, dormitories and warehouses.	A Professional Engineer must verify the Statement of Energy Performance for verification to obtain ENERGY STAR rating above 75. No fee.
Standard 189P (Standard for the Design of HighPerformance Green Buildings Except Low Rise Residential Buildings) is a building standard that is being developed to provide minimum guidelines for green building practices and will provide a baseline for sustainable design, construction, and operations in order to drive green building into mainstream building practices Source: Proposed Standard 189, Standard for the Design of HighPerformance Green Buildings Except LowRise Residential Buildings First Public Review (May 2007)	Sustainable sites, Water use efficiency, Energy efficiency, Building's impact on the atmosphere, Materials and resources Indoor environmental quality	New commercial buildings and major renovation projects. Excludes Low Rise Residential Buildings. Excludes existing buildings. required as outlined in code.	No certification. It is not a rating system, and is meant to be used in conjunction with other ASHRAE (American Society of Heating, Refrigerating and AirConditioning Engineers) standards. Submittals
BREEAM (Building Research Establishment Environmental Assessment Method) BRE is the certification and quality assurance body for BREEAM ratings in the UK. Source: http://www.breeam.org	Management Health and Wellbeing, Energy Transport, Water, Material and Waste, Land Use and Ecology, Pollution	Courts Homes Industrial MultiResidential Prisons, Offices, Retail, Schools Bespoke – system for buildings that fall outside the standard BREEAM categories International can assess a single development or BRE can also assist in creating a BREEAM version for a country or region outside of the UK.	There are several licensed assessment organizations mainly in the UK.
GREEN STAR Developed by Green Building Council Australia (GBCA) Source: http://www.gbcaus.org	Management Indoor Environment Quality, Energy, Transport, Water, Materials, Land, Use & Ecology, Emissions, Innovation	Commercial office design and construction. Rating systems have been recently developed for shopping centers, healthcare facilities education facilities, mixed use/multiunit residential, industrial, and public buildings.	In Australia, GBCA validates the achievement through a formal assessment.

Internationally, voluntary building rating systems have been instrumental in raising awareness and popularizing green design. However, most of the rating systems devised have been tailored to suit the building industry of the country where they were developed.

In India, a US based LEED rating system is under promotion by CII Green Business Centre, Hyderabad, which is more on energy efficiency measures in AC buildings. Keeping in view of the Indian agro-climatic conditions and in particular the preponderance of non-AC buildings, a National Rating System – **GRIHA** has been developed after a thorough study and understanding of the current internationally accepted green building rating systems and the prevailing building practices in India. The system was initially conceived and developed by TERI (The Energy & Resource Institute) and the MNRE (Ministry of Non-Renewable Energy) as **GRIHA** – the National Rating System after incorporating the useful inputs from the upcoming mandatory voluntary building codes/guidelines being developed by the Bureau of Energy Efficiency, the Ministry of Non-Conventional Energy Sources, MoEF (Ministry of Environment and Forests), Government of India, and the Bureau of Indian Standards. The system, by its qualitative and quantitative assessment criteria, would be able to 'rate' a building on the degree of its 'greenness'. The rating would be applied to new and existing building stock of varied functions – commercial, institutional, and residential. GRIHA aims to achieve efficient resource utilization, enhanced resource efficiency, and better quality of life in the buildings. The MNRE has constituted a national and technical advisory committee comprising of eminent professionals and representatives from several government bodies to guide the evolution of GRIHA.

GRIHA is an acronym for Green Rating for Integrated Habitat Assessment. GRIHA is a Sanskrit word meaning – 'Abode'. Human Habitats (Buildings) interact with the environment in various ways. Throughout their life cycles, from construction to operation and then demolition, they consume resources in the form of energy, water, materials, etc. and emit wastes either directly in the form of municipal wastes or indirectly as emissions from electricity generation. GRIHA attempts to minimize a building's resource consumption, waste generation, and overall ecological impact to within certain nationally acceptable limits / benchmarks. Going by the old adage 'what gets measured, gets managed', GRIHA attempts to quantify aspects such as energy consumption, waste generation, renewable energy adoption, etc. so as to manage, control and reduce the same to the best possible extent.

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, thereby providing a definitive standard for what constitutes a 'green building'. The rating system, based on accepted energy and environmental principles, will seek to strike a balance between the established practices and emerging concepts, both national and international. The guidelines/criteria appraisal may be revised every three years to take into account the latest scientific developments during this period.

The Indian building industry is highly de-centralized with people and/ or groups engaged in design, construction, equipment provision, installation, and renovation working together. Each group may be organized to some extent, but there is limited interaction among the groups, thus disabling the integrated green design and application process. Hence, it is very important to define and quantify sustainable building practices and their benefits. It is also important to separate the role of different participants in ensuring that the building consumes minimal resources over its entire life cycle and leaves behind a minimal environmental footprint.

The system has been developed to help 'design and evaluate' new buildings (buildings that are still at the inception stages). A building is assessed based on its predicted performance over its entire life cycle – inception through operation. The stages of the life cycle that have been identified for evaluation are:

- Pre-construction stage (intra- and inter-site issues like proximity to public transport, type of soil, kind of land, where the property is located, the flora and fauna on the land before construction activity starts, the natural landscape and land features)
- Building planning and construction stages (issues of resource conservation and reduction in resource demand, resource utilization efficiency, resource recovery and reuse, and provisions for occupant health and well being). The prime resources that are considered in this section are land, water, energy, air, and green cover.
- Building operation and maintenance stage (issues of operation and maintenance of building systems and processes, monitoring and recording of energy consumption, and occupant health and well being, and also issues that affect the global and local environment).

India has always maintained a balance for centuries between the architectural heritage and traditional wisdom. Green Ratings can help sustain it by combining time-tested wisdom with scientifically rigorous validation procedures available today. GRIHA, Green Rating for Integrated Habitat Assessment emerged out of a protracted exercise involving researchers at TERI, policy makers at the highest level, practicing professionals and concerned citizens. Most development decisions are taken at the building project level and the first version of GRIHA is decision making tool for any developer to gauge and achieve sustainability in his project. Currently there are around 40 projects of various types registered with GRIHA across India. GRIHA helped make a big difference in the triple-bottom-line of these projects. IIT Kanpur, Environmental Science and Engineering Block was able to reduce its energy consumption significantly in its bid to earn a 5 star rating. The common wealth games village won accolades from the Ministry of Labour in its bid to comply with GRIHA.

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Forthcoming Conferences on the theme "Green Building"

GRIHA National Conference & Exhibition on Green Building Materials and Technologies
04 Jan 2010
Convention Centre, India Habitat Centre, New Delhi
http://www.grihaindia.org/index.php?option=com_events&task=details&sid=5

International Conference on Environmental Sustainability with Green Building Technology - 2010 - ICESGBT-10
15-17, March 2010
Meenakshi Sundararajan Engineering College, Chennai
http://www.icesgbt10.org/

Sixth International Conference on Urban Regeneration and Sustainability
14 - 16 April 2010
La Coruña, Spain
http://www.wessex.ac.uk/10-conferences/the-sustainable-city-2010.html

Third International Conference on Harmonisation between Architecture and Nature
12 - 14 April 2010
La Coruña, Spain
http://www.wessex.ac.uk/10-conferences/eco-architecture-2010.html

Sustainable Building Conference 2010
26 - 27 May, 2010
Wellington, Newzland
http://www.sb10.co.nz

16th International Conference "Open and Sustainable Building"
17-19, May, 2010
Bilbao (Spain)
http://info.labein.es/openbuilding-2010/

Central Europe Towards Sustainable Building
30th June- 2nd July, 2010
Czech Technical University in Prague, Czech Republic
http://www.cesb.cz/en/venue