

# Proceedings of Regional Conference and Exhibition: “Innovations in Green Buildings- The GRIHA Approach”

25th November 2011, Hotel Royal Orchid, Bangalore

Prepared for

Ministry of New and Renewable Energy (MNRE)



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## Acknowledgements

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We are extremely grateful to Shri S V Ranganath, Chief Secretary, Government of Karnataka for gracing the conference by his presence and giving his insights on Green Buildings and Sustainable Development in Karnataka state.

We are indebted to Dr. A Ramachandran, Chairman TERI, Dr. Michelle Addington, Professor, Yale School of Architecture for their presence in the inaugural session.

We show our gratitude to the honourable speakers -: Dr. C Hariharan, CEO, Biodiversity Conservative (India) Ltd., Mr. Guruprakash Sastry, Senior Manager, Green Initiatives, Infosys, Mr. V Vishvanath, Principal Architect, Vishwanath Associates, Dr. Sujit Kumar, Director, Klimart, Ms. Shamim Banu, Additional Chief Secretary, Department of Energy, Govt. of Karnataka, Mr. Asheesh Sharma, Commissioner, Pimpri Chinchwad Municipal Corporation, Ms. N S Prasanna Kumar, Managing Director, Karnataka Renewable Energy Development Limited, Mr. Jayapaul, Senior Country Director, International Development Division, Building & Construction Authority, Singapore, Mr. P V Srinath, Vice President- Smart Planet Solutions, IBM, India/ South Asia, Ar. Krishna Rao Jaisim, Principal Architect, Jaisim Fountainhead, Mr. Sudharshan Anant, Vice President & Business Head- Wipro Eco Energy, Dr. Avlokita Agarwal, Asahi India Glass Ltd, Mr. Rajmohan, Armstrong for giving their valuable inputs to the participants.

We would also like to thank Dr. R.K.Pachauri, Director General, TERI; for giving the welcome address and being the patron throughout the process of organizing the event. We express our sincere gratitude to Mr. Pranob Dasgupta, Distinguished Fellow and Director, TERI, Southern Regional Centre for his wonderful support and encouragement in organising the event.

We would like to specially thank Ms. Mili Majumdar, Director and Mr. Pradeep Kumar, Associate. Director, Sustainable Habitat Division, TERI, and other colleagues of Centre for Research on Sustainable Building Science CRSBS for their full cooperation in successfully organising the conference.

In the end we would like to thank all the sponsors, viz. Asahi Glass, IBM, United Technologies Corporation, Armstrong Design, Berger Paints, L&T ECC, MNRE, Bangalore Electricity Supply Company (BESCOM), Karnataka Renewable Energy Development Ltd. (KREDL), Housing and Urban Development Corporation Ltd (HUDCO). and all the exhibitors for making the event possible.

All the participants showed great enthusiasm to understand different aspects of sustainability with reference to buildings and their commitment to translate their understanding in their future projects was really motivating.

## Executive Summary

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The Regional Conference and Exhibition -“Innovations in Green Buildings- The GRIHA Approach” was organized at Hotel Royal Orchid, Bangalore on 25<sup>th</sup> November 2011 with the aim of taking forward the national green building rating system “GRIHA” in South India. The conference served as a platform for major stakeholders who are keen to explore green buildings and to create an enabling environment for the adoption of green buildings.

GRIHA National Conference is held every year in New Delhi and is attended by the professionals from different disciplines like architecture, engineering, construction companies, financing institutes etc. This year for the first time a Regional Conference was organized in the city of Bangalore. TERI’s Southern Regional Centre in Bangalore took this vital step to spread awareness and create a movement on green buildings. The event focused on recent issues related to the GRIHA rating system.

The conference was attended by over 250 people. The event was supported enthusiastically by the industry, reflecting in sponsorships and exhibition of green materials and technologies. The conference and exhibition were well attended by the participants across the industry including architects, developers, consultants, and academicians. It was a unique opportunity for these professionals to come together and engage in lively discussions on topics related to green buildings.

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# Conference in Detail

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## Background

ADaRSH (Association for Development and Research of Sustainable Habitats) established in 2009 as an independent society is the secretariat for GRIHA, the National Rating System jointly promoted by the Ministry of New and Renewable Energy, Government of India and TERI. The Regional Conference is an initiative to create awareness and increase understanding about the National Green Building Rating System - GRIHA among the people related to the construction industry. The current scope of criteria in the GRIHA rating system is the building and its immediate environment. The performance benchmarks in the rating system are developed for commercial and residential buildings. With increasing awareness about climate change and the important role of green buildings in mitigating climate change, there is a need for developing benchmarks for other building types like hotels, industrial buildings and all types of existing buildings. India is also witnessing large scale development through SEZs, Townships and gated communities. There is an imminent need to develop guidelines for design of large developments. Technical sessions focused on these issues and capacity building for addressing them at a regional level.

GRIHA is India's National Rating System for Green buildings, which has been developed by The Energy and Resources Institute (TERI) and endorsed by the Ministry of New & Renewable Energy (MNRE). It was developed as an indigenous building rating system particularly designed to address the climatic requirements in the country, and it promotes the use of traditional architectural techniques and is synchronized with government policies and programmes. It provides an evaluation method to design, build, operate and maintain a resource efficient built environment. It can be applied to commercial, institutional, and residential buildings. It attempts to minimize a building's resource consumption, waste generation, and overall ecological/environmental impact by comparing them to certain nationally acceptable limits and benchmarks. The unique characteristic of this rating system is a single window process from design to rating because of its compliance with all major environmental and building codes of India. In 2009, it was mandated that all central government and public sector unit buildings be built with a minimum of GRIHA 3- star rating. As of today, over 140 projects have undertaken GRIHA registration.

The objectives of the conference were to:

- Create a common platform for the major stake holders of the industry.
- Demonstrate the advantages of an integrated design process and its impacts on building construction and operation.
- Illustrate the financial impacts and business strategies by adopting energy efficiency in building design.
- Develop the awareness on impact of government initiatives on achieving resource efficiency across various sectors.

- Showcase advantages of using low-energy materials and low-cost construction strategies for construction of green buildings.

## Inaugural Session

The inauguration session was attended by Shri S.V Ranganath, Chief Secretary-Government of Karnataka; Dr A Ramachandran, Chairman-TERI, Dr. Michelle D Addington, Professor, Yale School of Architecture, Ar Krishna Rao Jaisim, Principal Architect, Jaisim Fountainhead and Chairman, Indian Institute of Architects, Bangalore, Ms. Mili Majumdar, Director, Sustainable Habitat division, TERI, Mr. Pronab Dasgupta, Distinguished Fellow and Director, TERI and Ms. Minni Sastry, Area Convener, Center for Research on Sustainable Building Science , TERI.



Committing TERI's expertise towards the development of the state of Karnataka Dr. R K Pachauri, Director General-TERI & President ADaRSH in his address said, at present India is undergoing a massive development in all spheres due to rapid urbanization and lifestyle changes. With the high rates of economic growth that India is registering and is likely to achieve in the future, a major expansion in infrastructure is bound to take place in the coming years. To ensure efficient use of resources, including energy, lower levels of environmental impacts and meeting the challenge of climate change, it is essential that we carry out greening of India's infrastructure. To bring about a major change, ratings based on solid scientific principles, architectural techniques and methods that stand the test of times are essential. GRIHA rating is tailor-made to all conditions, which makes it suitable and practical to be used in India. I am happy that the government of Karnataka has always reiterated its commitment to achieve sustainable development in the state.



Shri S V Ranganath, Chief Secretary, Government of Karnataka addressing the crowd and lauding TERI for its work in the realm of sustainable development said, "Cities are facing the challenges of urbanization. Energy and water are crucial issues to be tackled and TERI can play a major role in addressing these challenges in cities and help chart a sustainable way forward. He said "Action will be taken to see that all future government buildings should have 3-4 stars as per the GRIHA standards. The new buildings will be evaluated by the officials of GRIHA. This has not been made mandatory in other states. Karnataka Government is keen to implement this and will offer all its support for construction of green buildings. People should adopt environmental friendly approaches as early as possible to overcome scarcity of water and energy. We have to complete these works in 4-5 years" .This headed a hope for GRIHA being implemented in the state of Karnataka.

At this juncture, a video clip containing the message of Mr. Farooq Abdullah Minister for Renewable Energy was played. In his message, he informed that "Central Government will offer all its help for environmental friendly buildings. They have to come forward to get approval of GRIHA. There are about 34 criteria under GRIHA. Out of these the buildings should satisfy atleast 8 standards to get the approval of GRIHA. We can save energy upto 40% by going in for environmental friendly buildings.

Dr. A Ramachandran, chairman of TERI in his speech told -People are neglecting urban areas. They are not giving importance to urban areas as much as they are giving to rural development. This development might be due to the reason that most of our legislators come from rural areas. "United Nations has published a list of 100 cities which are fast developing. Out of this 25 cities are in our country. We have to think about the developments of these cities. In this regard, he mentioned that in the 12th five year plan, environmental provisions should be included in JNNRUM urban development plans.





Ms. Minni Sastry proposed the vote of thanks and invited the participants to visit the inauguration of exhibition and a tea break was followed.



## Inauguration of Exhibition on Green Materials and Technologies

The conference had a parallel exhibition in green materials and technologies. Dr. Michael Addington, formally inaugurated the exhibition. The exhibition had various technologies on display that are relevant to green buildings, insulation material for building envelope, high performance glass, efficient cooling systems, low emitting paints, high albedo coatings, smart utilities, lighting technologies and renewable energies were the categories. The exhibition was open to public from morning till late evening.





Several of the top green product manufacturers like Armstrong, United Technologies, Berger Paints, Asahi Glass, Insuladd, Dow Corning, Akzo Nobel, Dow Chemicals and Owens Corning showcased their products in the exhibition.

After the teak break, updates on GRIHA rating system were conveyed by Ms. Priyanka Kochhar, Programme Manager- Strategic Partnerships & Implementation, ADaRSH. Various mechanisms for implementation and the major steps towards the development of the rating system were also highlighted. SVAGRIHA, an affordable rating system has been designed as an extension for GRIHA, specifically for projects with built- up area less than 2,500 Sq.m. Guidelines and benchmarks for Green Large developments is another new development in this regard.

The conference was structured to include three technical sessions where experts discussed various issues prevalent in the green buildings industry today.



## Technical Session 1:

### Green Buildings- Innovation in Design with Integrated Approach

This session was scheduled to highlight advantages of an integrated design process and its impacts on building construction and operation. Benefits of designing energy efficient

buildings were showcased through case studies. Innovation in design, construction and materials adopted by some pioneer energy efficient buildings were presented. The session also highlighted the economic benefits of incorporating energy efficiency features, which provide impetus and business case for adoption of energy and resource efficiency in buildings.

Dr. Michelle Addington chaired the session, and discussed the importance of integrated approach in designing for human comfort in buildings. A few case studies were shown by Dr. Hariharan, a green economist based in Bangalore on Total Zero Emissions Development (TZED)/ Low carbon buildings. The importance and benefits of using low emission materials was highlighted with relevant examples.

Mr. Guruprakash Sastry, senior manager from Green Initiatives of Infosys explained on the major steps taken by Infosys towards energy efficient buildings. Infosys is very keen in setting their internal targets in achieving energy efficiency in all their buildings.



Bangalore based green architects Mr. V Vishwanath and Dr. Sujit Kumar, were the two other speakers in the session who presented their works for GRIHA compliance projects. India's first green metro station is designed by Ar. Vishwanath in Gurgaon and it shows the commitment of public sector in encouraging green features for public building to increase the awareness among the people. Dr. sujit in his presentation shared his experiences of providing architectural support for one of the public sector campuses coming up in Bangalore.



## Technical Session 2:

### Panel Discussion on policies and initiatives by Local Governments and their initiatives to achieve sustainability and resource efficient built environment

After lunch, there was a panel discussion on policies and initiatives taken by local governments to achieve sustainable and resource efficient building environment. The session was chaired by Smt. Shamim Banu, additional chief secretary, department of energy, govt. of Karnataka. A special mention was given to the Pimpri Chinchwad Municipal Corporation which has already set an example by announcing mandatory compliance of their future government projects with GRIHA.



The session showcased international and national experience of various local governments and their initiatives to achieve energy efficiency in the building sector. The session highlighted the experiences and their journey on the path towards sustainable development through various case studies.

Mr. Jayapaul, Senior Country Director, Building & Construction Authority, Singapore discussed about the various policies and initiatives taken by the Singapore government towards sustainable development. Mr.N S Prasanna Kumar, MD, Karnataka Renewable Energy Development Ltd mentioned the various implementation programmes and incentives given by Government of Karnataka in the renewable energy sector.

Ms. Mili Majumdar, Director of Sustainable Habitat Division at TERI illustrated the current scenario of sustainable buildings in India. Various approaches and enactment programmes for green buildings were highlighted in her presentation. The presentation given by Mr. PV Sreenath, Vice president of Smart planet solutions of IBM showed how the corporate sector in keen in providing solutions for intelligent buildings.



### Technical Session 3:

The conference also delved into innovative technologies and building material/ strategies being adopted in green buildings in the third session. This session that was moderated by the eminent architect Jaisim. Dr. Alokita Agarwal who is the head for green design solutions for Asahi India Glass ltd. explained about various glazing products that could provide green solutions in buildings. Mr. Sudharshan, from Wipro Eco green solutions illustrated on various approaches for making buildings energy efficient. Mr. Pradeep Kumar, Associate Director, Building Energy systems at TERI and Mr. Rajmohan from Armstrong spoke about design challenges and approaches for achieving optimised energy solutions in green projects. The technical sessions were concluded with an extremely engaging presentation by Ar. Jaisim which was appreciated with a standing ovation from the participants.

## Annexure I: Agenda

### Green Building Regional Conference and Exhibition 2011 Innovations in Green Buildings – The GRIHA Approach

Hotel Royal Orchid, Bangalore

25<sup>th</sup> November, 2011

#### Agenda

09:00 – 10:00	<b>Registration</b>
10:00 – 10:45	<b>Inaugural Session</b>
Welcome Address	Mr P R Dasgupta, Distinguished Fellow & Director, TERI
Address	Dr R K Pachauri, Director General, TERI
Inaugural Address	Shri S V Ranganath, Chief Secretary to Government of Karnataka
Observations	Dr A Ramachandran, Chairman, TERI <i>[Former Under Secretary General, United Nations (Habitat) Former Secretary to Government of India – Science &amp; Technology and Director General, CSIR]</i>
Vote of Thanks	Ms Minni Sastry, Fellow, TERI
10:45 – 11:00	<b>Inaugural of the exhibition</b> (Exhibition on green building materials, green companies and green consultants)
11:00 – 11:15	<b>Tea/Coffee</b>
11:15 – 11:45	<b>GRIHA/ADaRSH updates**</b> <b>Ms Priyanka Kochhar</b> , Programme Manager- Strategic Partnerships & Implementation, ADaRSH
11:45 – 13:15	<b>Technical Session 1: Green Buildings – Innovation in Design with Integrated Approach</b>  <i>This session shall highlight advantages of an integrated design process and its impacts on building construction and operation. Benefits of designing energy efficient buildings shall be showcased through building case studies. Innovation in design, construction and materials adopted by some pioneer energy efficient buildings will be presented.</i>  <i>This session shall also highlight innovative financial schemes and economic benefits of incorporating energy efficiency features, which provide impetus and business case for adoption of energy and resource efficiency in building and construction projects.</i>

<b>Chair:</b>	<b>Dr Michael D Addington</b> Professor, Yale School of Architecture
<b>Speakers:</b>	<b>Dr C Hariharan</b> , CEO, Biodiversity Conservation (India) Ltd <b>Mr Guruprakash Sastry</b> , Senior Manager - Green Initiatives, Infosys <b>Mr V Vishwanath</b> , Principal Architect, Vishwannath Associates <b>Dr Sujit Kumar</b> , Director, KlimArt
<b>13:15 – 14:00</b>	<b>Lunch</b>
<b>14:00 – 15:30</b>	<b><u>Technical Session 2: Panel discussion on policies and initiatives by local governments to achieve sustainable and resource efficient built environment</u></b>
	<i>This session shall showcase international and national experience of various local governments and their initiatives to achieve energy efficiency in the building sector. The session shall highlight their journey on the path towards sustainable development through various case studies.</i>
<b>Chair:</b>	<b>Ms Shamim Banu</b> , Additional Chief Secretary, Department of Energy, Government of Karnataka
<b>Speakers:</b>	<b>Mr Asheesh Sharma</b> , Commissioner, Pimpri Chinchwad Municipal Corporation <b>Mr. N S Prasanna Kumar</b> , Managing Director, Karnataka Renewable Energy Development Limited <b>Mr Jayapaul</b> , Senior Country Director, International Development Division, Building & Construction Authority, Singapore <b>Mr P V Sreenath</b> , Vice President – Smart Planet Solutions, IBM, India / South Asia <b>Ms Mili Majumdar</b> , Director, TERI
<b>15:30 – 15:45:</b>	<b>Tea/Coffee</b>
<b>15:45 – 17:15:</b>	<b><u>Technical Session 3: Green Buildings – Innovative Technologies &amp; Building Materials</u></b>
	<i>This session will focus on strategies being adopted in the construction industry which promote the use of low-energy materials and low cost construction techniques in green buildings. The session will also have presentations and discussions around innovative technologies and systems that are available in the market and are adopted in green buildings.</i>
<b>Chair:</b>	<b>Mr Krishna Rao Jaisim</b> , Principal Architect, Jaisim Fountainhead
<b>Speakers:</b>	<b>Mr Sudarshan Anant</b> , Vice President & Business Head- Wipro EcoEnergy <b>Ms. Avlokita Agarwal</b> , Asahi India Glass Ltd. <b>Mr. Rajmohan</b> , Business Manager – Energy & Retrofit, Armstrong <b>Mr Pradeep Kumar</b> , Senior Fellow & Associate Director, TERI
<b>16:45 – 17:00:</b>	<b>Vote of Thanks and Closing Session</b>

## Annexure II: Speakers Profile

### Dr. Sujit Kumar

Dr. Sujit Kumar is the Founder Director of klimArt.Pvt.Ltd . klimArt started as a proprietorship firm in the year 1993. and became a PVT LTD company in the year 2001. He holds a Bachelor of Architecture, Masters in Building Science & Construction Management and a Ph.D in Solar Passive Architecture & Earth Coupling in Buildings from IIT Delhi. He holds expertise in space Conditioning of Non Air Conditioned Buildings. He has been in the pursuit of **Green and Sustainable Buildings** design for about two decades and is also a certified **TERI GRIHA** Trainer and Evaluator. Designing with nature, micro climate, and delivering high quality buildings within tight cost and time frames is his forte.

### Mr. Guruprakash Sastry

Working in the field of energy efficiency and green buildings for more than 6 years and currently responsible for ensuring energy efficiency in new buildings in Infosys. Also involved in evaluation and implementation of new and innovative technologies at Infosys for achieving leadership position in energy efficiency. Been involved in building energy modeling, energy audits, energy consultancy and LEED consultancy projects in the past. Prior to Infosys, has worked in TERI and Johnson Controls.

### Dr. C Hariharan

Chandrashekar Hariharan is an economist turned eco-pioneer who has presided over projects on water, energy and green buildings since 1989. He is Chairman of Biodiversity Conservation India Ltd which has, since 1995, created many community-based, sustainably developed residential enclaves that have won global acclaim for representing the future of construction. He is a Chartered Accountant who worked as a journalist in the early 1980s, before turning to do his doctoral in econometrics. Started a couple of other initiatives – a printing house, and a publishing firm – before turning to work on projects in areas of water and energy. This journey of over eight years in 14 districts across AP, Gujarat, Rajasthan and UP, led eventually to the founding of BCIL.

### Ar. Vishwanath

V. Vishwanath passed out of Architecture from Bangalore University in the year 1990, worked with leading Architects at Bangalore for 8 years before branching out on his own and setting up an Architectural practice along with his wife Vidya Vishwanath in the year 1998 in the name of Vishwannath Associates. VA branched out to Chennai in the year 2007 by setting up its Branch office.



### Dr. Michael Addington

Prior to teaching at Yale, Ms. Addington taught at Harvard University for ten years and before that at Temple University and Philadelphia University. Her background includes work at NASA/Goddard Space Flight Center, where she developed structural data for composite materials and designed components for unmanned spacecraft. Ms. Addington then spent a decade as a process design and power plant engineer as well as a manufacturing supervisor at DuPont, and after studying architecture, she was an architectural associate at a firm based in Philadelphia. She researches discrete systems and technology transfer, and she serves as an adviser on energy and sustainability for many organizations, including the Department of Energy and the AIA. Her chapters and articles on energy, environmental systems, lighting, and materials have appeared in many books and journals and she recently co-authored Smart Materials and Technologies for the Architecture and Design Professions.

### Mr. P V Sreenath

He serves as Vice-President at IBM India / South Asia. He leads the area of Smarter Cities, which is one of the biggest thrust areas for IBM globally. Prior to IBM, he served with the ICICI Group, India's leading financial sector player - initially with ICICI Ltd and then as a Member of the Global Executive Management Team at 3i Infotech.

He has served on various Panels & Committees. He has served a Member of the Evaluation Panel and a Coach for the Dubai Internet City's 'Global e-Biz Challenge' in 2001. He has also served on government-constituted committees in India pertaining to e-Governance- among them being the Ministry of Communications & Information Technology, Govt of India constituted Working Group for the National e-Governance Service Delivery Gateway He was closely involved with NISG and Dept of IT - Govt of India in the formulation of a Post-Graduate Programme in India. He currently serves on the Advisory Council for the e-GPX Post-Graduate Programme in e-Governance at TAPMI, Manipal (TA Pai Management Institute). He is a post-graduate in management from the Indian Institute of Management - Ahmedabad (IIM-A), and B. Tech. in Electronics & Communications Engineering from the Institute of Technology, BHU, Varanasi.

### Ar. Krishnarao Jaisim

Born in 1944 in the City of Madras, elementary and primary schooling all over the state, and higher secondary from the famed Madras Christian College High School. Entered the portals of the School of Architecture, Madras in 1961, did internship in various field of the building industry during the summer vacations and finally a four year intensive learning with L. M. Chitale and Son to finally emerge as an independent practice in 1970, the same year of marriage to Geeta. The formative years in SoA consisted of a Design teacher Prof. Shiela Tribe who recognized my potential and gave me the confidence to seek nobler pastures inspired by Buckminster Fuller and Otto Konigsberger whom I interacted as a student and later spirited away by the writings of Ayn Rand and her FOUNTAINHEAD. This Romanticism led to the starting of JAISIM FOUNTAINHEAD which continues to today

perusing the adventures of the built environment searching and researching beyond boundaries of Time and Space. The beginning in the seventies suddenly took off to such heights that I decided to ground myself by a four year stint in Muscat and Oman which opened up the belief in oneself to return and write many a new chapter in the Architecture of the sub-continent and beyond. Having written over 150 papers and articles and presented about 1500 presentations in all formats of this incredible discipline, I pause and look back only to find fresh growth all around. I wonder and continue to wander this wonderful environment.

### Mr. Rajmohan

Mechanical engineer with Post graduate diploma in management. Has an experience of over 8 Years in the field of HVAC. Started the career with Blue Star Ltd as a Trainee Engineer and has worked in different locations, different profiles & capacities there. Associated with Armstrong since May, 2010. At Armstrong he looks after energy and retrofit business for India. leads the energy solutions team which offers energy solutions to end users, ESCOs and OEMs, focused on the HVAC plant room mainly.

## Annexure III: List of Participants

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### **Sustainable Building Science: Overview**

One of the prime areas of activity within the Energy Environment Technology division is adoption of efficient and environment-friendly technologies in new and existing buildings. The activities of this area focus primarily on energy and resource use optimization in existing buildings and design of energy efficient sustainable habitats.

The Centre for Research on Sustainable Building Science (CRSBS) comprising architects, planners, engineers, environmental specialists, specialised in urban and rural planning, low energy architecture and electro-mechanical systems, water and waste management and renewable energy systems has been offering environmental design solutions for habitat and buildings of various complexities and functions for nearly two decades. The group also undertakes LEED facilitation for buildings.

The Green Rating for Integrated Habitat Assessment (GRIHA) cell, also comprising professionals from the above-mentioned fields is actively involved in facilitation of green rating for buildings under the GRIHA framework. Inputs from CRSBS feed into the processes undertaken at GRIHA cell. The different services offered by the Sustainable Building Science (CRSBS and GRIHA) are as follows:

#### **Environmental design consultancy**

□ Specialised environmental design consultancy and building performance analysis are conducted. A wide range of computations and simulation tools including DOE2, TRNSYS, ECOTECT, RADIANCE, FLOVENT, AGI32, LUMEN DESIGNER, BLAST, Phoenix, RETScreen are used to assess the environmental and cost impact of the design decisions.

#### **LEED and GRIHA facilitation**

□ The team has experience in technically facilitating LEED accreditation [LEED India for New Construction (LEED India NC) and LEED India for Core and Shell (LEED India CS)] for buildings. The group also assists and administers GRIHA, an indigenous green building rating system for buildings, developed at TERI. GRIHA has now been now endorsed by the Ministry of New and Renewable Energy, Government of India, as the national building rating system for India.

#### **Energy audits and energy management programs**

□ Energy conservation studies for a large number of buildings are conducted. There exists a vast experience in conducting energy audits and evaluating a whole range of building upgrade options including envelope retrofit and system retrofit or changes in operational patterns. In addition to establishing operating efficiency of electrical, HVAC, lighting and thermal systems, recommendations to improve upon the same by suitable retrofit measures or by refinement of operational practices are also offered. The group also has expertise in development of energy management programs for service industries like hotels and the corporate sector.

#### **Capacity building**

□ Capacity building for architects, building developers and service engineers on issues such as energy efficiency in building envelopes and systems has been undertaken. Over 1000 architects, developers and engineers in the area of green buildings, energy efficiency and sustainability aspects of built environment have been trained through training programmes, refresher courses, seminars and workshops.

#### **Policy inputs**

□ Several policy initiatives at central and state governments' level towards mainstreaming high performance buildings in India have been successfully completed. Senior members of the group are members of the Committee of experts for development of the Energy Conservation Building Code (ECBC) of India (2007). The manual for environmental clearance of large construction for the Ministry of Environment and Forests, Government of India has also been developed at CRSBS.

#### **Climate Change related projects**

□ Climate change is increasingly being recognized as a major global challenge. The group has provided inputs to the National Mission on Sustainable Habitat (a part of the recently released India's National Action Plan on Climate Change). Project Design Documents (PDD) are prepared in order to facilitate trading in carbon through the Clean Development Mechanism (CDM).



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