



Bureau of Energy Efficiency



सत्यमेव जयते
Government of India
Ministry of Power



giz International Services for
Development Cooperation

ANGAN 19

COMPENDIUM

An International Conference on Building Energy Efficiency

9th – 11th September 2019 | New Delhi, India



Augmenting Nature by Green Affordable New-habitat







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giz Engineering, Technology
for International
Cooperation (GIZ) GmbH

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Knowledge Partner



Event Partner



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Bureau of Energy Efficiency (BEE)

The Bureau of Energy Efficiency (BEE) of the Government of India and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under the Indo German Technical Cooperation, have jointly agreed to promote the “Indo-German Energy Programme” (IGEN) with the aim to promote Buildings Energy Efficiency, which is aligned with the commitments made by the Government of India to meet its objectives submitted under NDCs.

In this respect, BEE and GIZ organized ANGAN (Augmenting Nature by Green Affordable New - habitat), an international buildings Energy Efficiency Conference that took place at The LaLiT, New Delhi from 9th to 11th September, 2019.



VISION

Augmenting sustainable development through energy efficient habitat.

MISSION

To foster strategic national and international partnerships, networks and information exchange to promote adoption of energy efficient habitat through collaborative actions



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List of Abbreviations

- AAC - Autoclaved Aerated Concrete
- AAHR - Axis-Aligned Hyper-Rectangles
- AC – Air Conditioning
- AEEE - Alliance for an Energy Efficient Economy
- AMRUT - Atal Mission for Rejuvenation and Urban Transformation
- BEE - Bureau of Energy Efficiency
- BEEP - Building Energy Efficiency Project
- BEET - Buildings Energy Efficiency Task
- BIPV - Building Integrated Photovoltaics
- BU – Billion Units
- C&D - Construction & Demolition
- CFD - Computational Fluid Dynamics
- CII - Confederation of Indian Industry
- CoA – Council of Architects
- CPWD – Central Public Works Department
- CVC – Construction Value Chain
- DBSCAN - Density-Based Spatial Clustering of Applications with Noise
- DC – District Cooling
- DISCOM – Distribution Companies
- EC Act - Energy Conservation Act
- ECBC - Energy Conservation Building Code
- ECBCR – Energy Conservation Building Code for Residential or Eco-Niwas Samhita
- EDGE - Excellence in Design for Greener Efficiencies
- EE- Energy Efficiency
- EEFP - Energy Efficiency Financing Platform
- EER – Energy Efficiency Ratio
- EESL - Energy Efficiency Services Limited
- EM - Expectation Maximization
- EPD - Environmental Product Declaration
- ERV - Energy Recovery Ventilation
- ESCO – Energy Service Company
- ESG - Environment, Social and Governance
- EU – European Union
- FAR - Floor Area Ratio
- FEEED - Framework for Energy Efficient Economic Development
- FICCI – Federation of Indian Chamber of Commerce
- GDP – Gross Domestic Product
- GHAR - Green Homes at Affordable Rate
- GHG – Greenhouse Gas
- GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit
- GRIHA - Green Rating for Integrated Habitat Assessment
- HVAC – Heating, Ventilation and Air Conditioning
- IAQ - Indoor Air Quality
- ICAP – India Cooling Action Plan
- IEA - International Energy Agency
- IFC - International Finance Corporation
- IGBC - Indian Green building Council
- IGEN – Indo German Energy Network
- IPCC - Intergovernmental Panel on Climate Change
- IRENA - International Renewable Energy Agency
- ISHRAE – The Indian Society of Heating, Refrigerating and Air Conditioning Engineers
- kVA - kilo Volt-Ampere
- kWh – Kilo Watt Hour
- LC3 - Limestone Calcined Clay Cement

- LCE - Life Cycle Energy
- LCEA - Life Cycle Energy Analysis
- LECaVIR - Low Energy Cooling and Ventilation for Indian Residences
- LEED - Leadership in Energy and Environmental Design-India
- MEA - Ministry of External Affairs
- MEP - Mechanical, Electrical, and Plumbing
- MEPS- Minimum Energy Performance Standards
- MNRE – Ministry of New and Renewable Energy
- MOHUA – Ministry of Housing and Urban Affairs
- MoP - Ministry of Power
- MTEE - Market Transformation for Energy Efficiency
- NAAQS - National Ambient Air Quality Standards
- NAMP - National Air Monitoring Programme
- NCR – National Capital Region
- NDCs - Nationally Determined Contributions
- NEERI - National Environmental Engineering Research Institute
- NIUA - National Institute of Urban Affairs
- NRDC - Natural Resources Defence Council
- NZEB - Net Zero Energy Buildings
- OE - Operational Energy
- PAT - Perform, Achieve and Trade
- PCR - Product Category Rules
- PHPP - Passive House Planning Tools
- PMAY - Pradhan Mantri Awas Yojana
- PPP – Public Private Partnerships
- PRGFEE - Partial Risk Guarantee Fund for Energy Efficiency
- PRSF - Partial Risk Sharing Facility
- PV – Photovoltaic System
- RE – Renewable Energy
- RERA - Real Estate (Regulation and Development) Act
- RETV - Residential Envelope Transmission Value
- SDA - State Designated Agency
- SDC - Swiss Agency for Development & Cooperation
- SDG - Sustainable Development Goal
- SRI - Smart Readiness Indicators
- TERI - The Energy & Resources Institute
- TPA - Third Party Assessor
- TR - Tonnes of Refrigeration
- TWh – Terrawatt Hour
- UHI – Urban Heat Island
- ULB - Urban Local Bodies
- ULBs – Urban Local Bodies
- UN - United Nations
- USD – United States Dollar
- WHO – World Health Organization
- WWR - Window to Wall Ratio
- ZNC – Zero Net Carbon

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Message

Recent studies have projected that India will face an unprecedented scale of urbanization - 350 million Indians will move to cities by 2030; a number likely to double to 700 million by 2050. To provide livable and healthy cities to all citizens, it is necessary to ensure both environmental and energy security. In this respect, the Government of India has laid out an ambitious vision to provide for secure, affordable and sustainable energy. It is important that access to clean energy needs to be accompanied through an integrated approach by reducing our energy consumption.

2. The Bureau of Energy Efficiency is making great strides in this area by ensuring the adoption of the Energy Conservation Building Code, which aims to make India's commercial and residential building stock energy efficient. I am also pleased to see the collaborative effort made as part of the Indo German Technical Cooperation, under the "Indo-German Energy Programme" have supported and facilitated critical development of energy efficiency in India. I would also like to appreciate the work done by institutions like The Energy and Resources Institute (TERI) in ensuring the availability of technical and domain knowledge.

3. I am pleased to see representation from state authorities, implementation agencies, multi-lateral & civil society organizations, private developers, industry professionals and academic institutions amongst the delegates as well as the audience. ANGAN has succeeded in by providing a platform to share knowledge and experience from across 11 developed and developing economies. I would like to congratulate the organizers of ANGAN 2019 in supporting international discourse and deliberation on various aspects of energy efficiency in buildings.

4. I hope to see the discussions held during these three days to materialize into effective action. I also look forward to the BEE's future initiatives in enhancing the energy efficiency of buildings across India. I would like to thank BEE and GIZ for addressing the need of the hour in organizing ANGAN 2019 and inviting me to be part of the same.

(Raj Pal)





Preface

The consumption of the energy is directly proportional to the progress of manpower, a growing population, improvement in living standards and the level of industrialization of a nation. With India's population expected to grow rapidly in the future, energy demand will see a significant rise and with that associated greenhouse gas (GHG) emissions as well. India has the 4th largest electricity generating capacity and is the 3rd largest energy consumer globally, accounting for 5.5 % of global energy consumption. India's energy demand has grown at 3.7 % per annum over the past 30 years, and is set to grow 4.2% a year by 2035. If the growing demand for energy is not curbed through adoption of energy efficiency measures, the environmental impact of meeting this demand will be of an unimaginable scale.

The Energy Efficiency Building Programme, which is joint activity between Bureau of Energy Efficiency (BEE) and Indo-German Energy Programme (IGEN), serves as an effective instrument to harness the potential of Indo-German Technical Cooperation. And in this endeavor, it provides a visionary framework in the form of ECO-NIWAS platform, which aims to foster knowledge exchange and strengthening of research in the field of building energy efficiency. In order to strengthen the sharing of knowledge, ideas and solutions, Bureau of Energy Efficiency (BEE) and GIZ jointly organized a three day International Conference and Exhibition on Building Energy Efficiency, ANGAN 2019, The theme of the Conference "Augmenting Nature by Green Affordable New-habitat" (ANGAN) reflects the paradigm shift that is underway to meet India's NDCs under the Paris Climate Agreement and to facilitate the successful implementation of the National Action Plan on Climate Change. It is also a response to India's international commitments under the Kigali Amendment to the Montreal Protocol, Sustainable Development Agenda 2030, and the Kyoto Declaration on 'Sustainable Cities and Human Settlements for All'. The organizers, BEE and GIZ, would like to extend their gratitude to all national and international delegates for their participation and contributions in ANGAN 2019. The valuable support provided by the Ministry of External Affairs (MEA) was also critical to the success of the event. The organizers are also grateful to the knowledge partner The Energy and Resources Institute (TERI) and the event partner TEC India Entertainment Private Limited for their devoted assistance in providing technical support and in facilitation & organization of ANGAN 2019. The ANGAN platform will continue to further collaboration, network and knowledge exchange to bring about a revolutionary change in Building Energy Efficiency.

Abhay Bakre
(Abhay Bakre)

रसहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation

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Message



Dr Winfried Damm
Cluster Coordinator,
Indo-German Energy
Programme

With a fast pace developing nation like India, the opportunities are as unique as the challenges it presents. By 2030, India is expected to be home to seven mega-cities with populations above 10 million. 41% of the country's total population live in urban areas. The Government of India's Smart Cities Mission, the Jawaharlal Nehru National Urban Renewal Mission, and the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are working to address the challenge of improving urban spaces. The prime minister's Pradhan Mantri Awas Yojana aims to achieve housing for all by 2022.

With two-third of the built infrastructure yet to come up till 2050, the nation calls for advancement and innovation in the construction sector. It is worth noting that construction sector is particularly resource intensive: it represents 30% of Indian electricity consumption, and has a high material footprint. We need more efficient alternatives in the construction and energy sector alike.

GLZ is implementing the Indo-German Energy Programme (IGEN) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The Energy Programme promotes measures to improve energy efficiency and integrate renewable energy into the grid. Through numerous activities in the areas of energy efficiency, renewable energy expansion and its integration into the grid, and sustainable energy supply in rural areas, we are seeking to bolster the energy transition, and help support and sustain the nation's rapidly developing infrastructure growth.

This conference served as a platform to foster national and international strategic collaborations, partnerships, networks and information exchange to promote energy efficient habitat. Eminent speakers and dignitaries around the world gathered to deliberate and collaborate on the aspects of sustainability in the context of skill development, livelihood and inclusivity. The actionable points derived from the discourse of this conference need to be incorporated for implementation in the future goals of the micro to macro levels of implementation of the construction sector, to achieve ecological, economic and social sustainability. This compendium presented to you combines all the national and international experiences from the conference.

The exhibition on Energy Efficient Building Material and Products that was a part of the conference proved to be a coveted platform for Technology suppliers, Research and educational Institutions to showcase the latest advancements in the field of Building Energy Efficiency.

A handwritten signature in blue ink, consisting of a series of fluid, connected strokes.

Dr Winfried Damm
Cluster Coordinator,
Indo-German Energy Programme

■ Executive summary

With a rapidly growing urban population, India is in the midst of becoming the first political entity to be home to more than 1.5 billion people by 2030 (IDB, 2012). To provide infrastructural support and adequate housing for this growing population, India needs to build 700 to 900 million square meters of commercial and residential space every year (The Indian Economic Survey 2017-18). To ensure that this development is achieved sustainably, alternative low-carbon pathways need to be envisaged such that it does not stress our existing stock of resources and meets the requirements of healthy, liveable habitat. As per our international commitments, India plans to reduce the emissions intensity of its GDP by 33-35% by 2030 from 2005 levels. Since the energy consumption of residential and commercial buildings represented about 33% of total delivered energy consumption in India in 2015 it will be integral to achieve this reduction by integrating energy efficiency in the buildings sector. Recently, the concept of global partnerships has gained prominence in international sustainable development forums, most notably as a central element of the Sustainable Development Goal (SDG) 17, which is at the heart of the global United Nations (UN) development agenda for the period 2016 – 2030. As we move closer to 2030, the stress is on collaborating and working together towards knowledge exchange, sharing of ideas and solutions, strengthening research at a global level. The Bureau of Energy Efficiency (BEE) of the Government of India and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under the Indo German Technical Cooperation, agreed to jointly promote the “Indo-German Energy

Programme” (IGEN) to promote energy-efficient buildings and in turn improve the liveability of our cities. BEE and GIZ are pleased to have organized ANGAN, an International Buildings Energy Efficiency Conference and Exhibition in New Delhi from 9th to 11th September 2019 to augment sustainable development through energy-efficient habitat by fostering strategic national and international partnerships, networks and information exchange to promote adoption of energy-efficient habitat through collaborative actions. The three-day conference consisting of 99 sessions, including thematic tracks, keynotes, panel discussions and media sessions, gathered participation from more than 11 countries, 110 speakers and 951 participants. With more than 140 representatives from the Government of India, ANGAN 2019 helped to build capacity among Indian policy makers at all levels of the government and to equip them with greater knowledge and skills to develop and implement energy efficiency initiatives in the buildings sector. The International Exhibition was envisaged to connect building energy efficiency solution providers to key stakeholders from the construction industry. The Compendium aims at documenting the pertinent discussions, dialogue and perspectives shared by international experts during the event. The Compendium is a repository of technical, political and social solutions that can help professionals respond better to rising energy demands in the buildings sector, impact of climate change on our cities and ameliorating the stress on critical resources. The compendium also aims at furthering the discussions held during ANGAN 2019 and creating effective action to enhance the energy efficiency of buildings internationally.



CONFERENCE AGENDA



Augmenting Nature by Green Affordable New-habitat (ANGAN)

– A courtyard for revolutionary change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9th – 11th September 2019 | The LaLiT, New Delhi

CONFERENCE AGENDA

9 th September, 2019 (Monday)			
08:30 – 10:30	Registration & Tea		
10:30 – 10:40	Inauguration of Exhibition on Energy Efficient Building and Walk through Building Exhibition (Venue: Plaza Terrace)		
10:40 – 11:00	Exhibition Walk Through		
11:00 – 12:30	Curtain Raiser & Inaugural Session (Venue: Crystal Ball Room)		
11:00 – 11:10	Welcome Address by Mr Abhay Bakre, Director General, Bureau of Energy Efficiency		
11:10 – 11:20	Theme Address by Dr David Goldstein, Energy Co-Director, NRDC, USA		
11:20 – 11:50	Keynote Address by Dr Ajay Mathur, Director General The Energy and Resources Institute		
11:50 – 12:05	Inaugural Address by Mr Raj Pal, Economic Advisor, Ministry of Power		
12:05 – 12:25	Special Address by Mr Saurabh Kumar, Managing Director at Energy Efficiency Services Limited		
12:25 – 12:30	Vote of Thanks by Mr Saurabh Diddi, Director, Bureau of Energy Efficiency		
12:30 – 13:00	Exhibition Walk	Role of Media in Promoting Building Energy Efficiency (Venue: Plaza Terrace Room)	
13:00 – 14:00	Lunch		
Parallel Sessions	Thematic Track 1 (Venue: Plaza Terrace Room)	Thematic Track 2 (Venue: Crystal Ball Room)	Thematic Track 3 (Venue: Regal)
	Meeting Two Ends: Heritage and Indigenous Construction Practices	Policy Framework for Energy Efficiency in Buildings (Codes and Standards)	Circular Economy (Waste or Resource)
14:00 – 15:30	Tea/ Coffee Break		
Parallel Sessions	Thematic Track 4 (Venue: Crystal Ball Room)	Thematic Track 5 (Venue: Plaza Terrace Room)	Thematic Track 6 (Venue: Regal)
	Smart Cities and Smart Readiness Indicators (SRI) for Buildings	Climate Resilience in Buildings	Affordable and Sustainable Development: Priorities for India

10th September, 2019 (Tuesday)

10:00 – 11:00	Keynote Address by Mr Sonam Wangchuk, Founder-Director, SECMOL (Venue: Crystal Ball Room)		
11:00 – 11:30	Tea/ Coffee Break		
Parallel Sessions	Thematic Track 7 (Venue: Plaza Terrace Room)	Thematic Track 8 (Venue: Crystal Ball Room)	Thematic Track 9 (Venue: Regal)
11:30 – 13:00	Emerging Construction Practices & Technologies	Policy Framework for Energy Efficiency in Buildings (Rating and Labelling System)	Integration of Renewable Energy in Buildings in India
13:00 – 14:00	Lunch		
14:00 – 15:00	Panel Discussion on Roadmap of Sustainable and Holist Approach for Energy Efficient Built Environment by 2030 (Venue: Crystal Ball Room)		
Parallel Sessions	Thematic Track 10 (Venue: Plaza Terrace Room)	Thematic Track 11 (Venue: Regal)	Thematic Track 12 (Venue: Crystal Ball Room)
15:00 – 16:30	State-of-the-art Cooling Systems, including District Cooling System	Analytical Tools to Estimate Building Performance	Market Development & Financing Mechanisms for Energy Efficiency
16:30 – 17:00	Tea/ Coffee Break		

11th September, 2019 (Wednesday)

Parallel Sessions	Thematic Track 13 (Venue: Regal)	Thematic Track 14 (Venue: Crystal Ball Room)	Thematic Track 15 (Venue: Plaza Terrace Room)
10:00 – 11:15	Contemporary System Solutions (Lighting, Air Quality, Heat and Cold Recovery)	Embodied Energy and the Life Cycle Approach	Entrepreneurship & Innovative Business Models
11:15 – 11:30	Tea/ Coffee Break		
Parallel Sessions	Thematic Track 16 (Venue: Plaza Terrace Room)	Thematic Track 17 (Venue: Regal)	Thematic Track 18 (Venue: Crystal Ball Room)
11:30 – 13:00	Steps towards Net Zero Energy Buildings	Occupant Comfort: Thermal, Visual, Acoustic, Indoor Air Quality	Policy Implementation and Enforcement
13:00 – 14:00	Lunch		
14:00 – 15:00	Keynote Address by Ar Prem Nath, Architect and Interior Designer (Venue: Crystal Ball Room)		
15:00 – 16:00	Valedictory Session (Venue: Crystal Ball Room)		
16:00 – 16:30	High Tea		





PROCEEDINGS



Inaugural Session & Keynote Address by Dr Ajay Mathur

09th September 2019 | 1030 hrs – 1230 hrs



Panelist

Mr Abhay Bakre
Director General, Bureau of Energy
Efficiency (BEE)

Dr Winfried Damm
Cluster Coordinator, IGEN, GIZ

Mr Saurabh Kumar
Managing Director, Energy Efficiency Ser-
vices Limited (EESL)

Dr David Goldstein
Energy Co-Director, Climate & Clean Energy
Program, Natural Resources Defence
Council (NRDC)

Dr Ajay Mathur
Director General, The Energy and
Resources Institute (TERI)

Mr Raj Pal
Economic Advisor, Ministry of Power (MoP)

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency (BEE)

Welcome Address

Mr Abhay Bakre began by introducing the mandate of Bureau and mentioned that BEE is responsible to take out policy and programs on energy conservation and implement them through various initiatives. He further emphasized that these initiatives are mainly demand-side initiatives that are largely supported and managed by state authorities, think tanks, expert bodies, academia, consumer groups, and associations. He acknowledged their support and knowledge that had helped BEE to manage and implement these initiatives.

Mr Bakre mentioned that BEE always looks forward to what is affordable and accepted by the consumer. He spoke about the ECBC mandate for the commercial sector and stated that they are now moving forward towards creating and implementing energy efficiency solutions for the residential sector. He also highlighted the importance of consumer feedback for maintaining and enhancing building energy efficiency.

He concluded by deliberating the need for more detailed discussions in the coming three days for initiating policy processes.

Dr Winfried Damm emphasized that Germany is very much concerned about the impact of Climate Change. Stating climate change to be a real problem, he mentioned that changes in weather are causing harmful impact and leading to loss of life.

He emphasized that everybody has joined together here to move hard and fast to achieve carbon neutrality all over. He mentioned that the EU has pledged to reduce CO₂ emissions by 40% by 2030; serious discussions are taking place to become carbon neutral by 2030.

He explained by 2030, the developing world will be more urban and by 2050, 2/3rd of inhabitants are likely to live in urban areas. Over 17 million new urban housing units will be needed in the next 20 years. Hence, there is a possibility of more emission reductions happening during construction and over the lifetime of the building. He further emphasized that regulations will play a key role. He thanked the Ministry of Power for taking key initiatives and mentioned the joint programs of labelling scheme and building materials and ECBC. Implementing these programs could lead to 380 billion units CO₂ reduction by 2030.

He concluded by suggesting the need for continuous discussions to create the best solutions. This conference can lead to discussions towards what can be achieved and taking ahead new learning and implementing them.

Mr Saurabh Kumar mentioned that this

conference has been organized at the very right time given that the weather and climatic conditions are rapidly changing around the world.

He spoke about the role of government, especially the Ministry of Power which gave directions to all government offices to upgrade to energy efficiency. This nudge led to 10,000 buildings being upgraded across the country, about 30 MW of demand reduction and massive reductions in electricity bills of the government. This success of India in policy and implementation front has been recognized at the international level.

Theme Address

Dr David Goldstein measures the importance of this event by quoting definitions of International Energy Agency (IEA) and Intergovernmental Panel on Climate Change (IPCC) regarding energy efficiency in buildings as about the largest greenest and fastest resource that will prevent climate pollution. He emphasizes the correction of systematic biases which understate the importance of improving energy efficiency in buildings. He adds that zero net energy buildings have taken up all around the world with almost no policy incentives to do so.

He states that the Paris agreement target of 1.5 degrees could be achieved solely by zeroing out all emissions from the building's sector by 2030. He pointed out that it is easier for India than for Japan or the United States to achieve this as most of the building stock is going to be new.

He highlighted the importance of energy

efficiency in buildings towards achieving Sustainable Development Goals (SDGs), especially India's goals to eliminate poverty. He concluded by pointing out approaches by having a holistic approach towards zero net energy buildings and using market incentives by valuing building efficiency.

Keynote Address

Dr Ajay Mathur started by pointing the huge opportunity in improving energy efficiency in the large stock of building to be added in India. He stated that every year many buildings are added and most of them are not energy efficient. These add on to the stock of existing buildings where energy efficiency must be improved with retrofitting.

The problem he touched upon was the very nature of the buildings that are being built. He listed two main trends of the problem; one being the use of air conditioners and two being the design of buildings with more space per person. Air conditioners have enhanced our lives at the office and home. He said those equivalent buildings in India now are larger, which makes them require more land and hence they cost more. He asks the listeners to consider the two trends and their effect on the commercial and residential markets. In the case of a commercial building, the rentals have enhanced due to larger space. Energy efficiency is seen in only those structures where the owner and the builder of the building are the same.

He suggests to the architects in the audience that the energy-efficient buildings must not compromise on comfort. He quotes an

instance of an individual in the Paryavaran building to make his point. He insists that the problem could have solved easily with better circulation. What we need are better air circulation and air ventilation. He argues that energy-efficient buildings are those where we can marry natural air circulation with air conditioning. Even though this is known, the vernacular of the architectural detail is not yet developed. He adds another problem regarding commercial buildings as to how do design the financial incentives to nudge the developers to ensure the users reap the benefits of energy-efficient buildings.

He states that one of the good things that happened with many utilities in India including the utilities in Delhi is that your monthly electricity bill also shows your energy consumption for 11 months before that. He congratulated the BEE for bringing out the guidelines for energy-efficient buildings. He draws attention to the fact that even though only 12% of households in Delhi have air conditioners; the peak electricity load on the grid is between 9 and 11 pm. This is a major challenge in the long term as we are transitioning into renewables. This calls for solutions in energy storage. Clearly, because of constraints of climate change, we must shift from new plants to meet the peak demand and switch to storage systems. For architects, the ability to merge the advanced cooling systems with limited space is a challenge. We need to start integrating batteries in our building design as well. He also emphasized the importance of materials used in the buildings. He points out the potentially useful materials from the construction and demolition waste

builders to increase the utilization of such waste. The final problem he spoke about was the convergence of interests. There is no clear linkage between energy-efficient buildings and the municipality. Dr Mathur urges BEE to help states and municipalities to facilitate the creation of environments for energy-efficient buildings.

He concluded by stating that this is big enough, important enough and beneficial enough for all the stakeholders to move towards energy-efficient buildings.

Inaugural Address

Mr Raj Pal starts by appreciating the name ANGAN for the conference. He adds that the government of India has committed itself under COP to reduce the energy intent of the GDP by 33-35% by 2030. The building sector holds the key to meet these targets. Buildings consume about a third of the energy in India. He reiterated that 70% of the building stock required for 2030 is yet to be built. Shri Raj Pal pointed that this is a challenge and opportunity. Challenge in terms of how to procure those materials sustainably, the opportunity that these buildings could be constructed most efficiently.

He states that the Government of India has taken a two-pronged approach to meet their energy demands; on the demand side as well as on the supply side. On the supply side, it is to have more renewables and on the demand side, it is to have higher energy efficiency. ECBC code was first launched in 2007 and was revised and made more contextually relevant in 2017.

Vote of thanks

Mr Saurabh Diddi thanked the esteemed panel for their valuable time and presence during the inauguration. He acknowledged the importance of the work done by the panellist across the building energy efficiency sector.

Media Session

Launch of the Media Engagement Program on Energy Efficient Buildings

9th September 2019 | 1140 hrs – 1315 hrs



Moderator

Ms P N Vasanti
Director General Centre for Media Studies (CMS)

Speakers

Panel Discussion I: Building Energy Challenge and Solution

Mr Raj Pal
Economic Advisor, Ministry of Power

Dr Sameer Maithel
Project Head, Indo- Swiss Building Energy Efficiency Project (BEEP)

Dr Anand Shukla
Senior Thematic Advisor- Swiss Agency for Development & Cooperation (SDC) Government of India's Building Energy Efficiency Program

Mr Abhay Bakre
Director General – Bureau of Energy Efficiency (BEE)

Panel Discussion II: Bridging the Gap

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency

Members from the Media

Panel Discussion I: Building Energy Challenge and Solution

Ms P N Vasanti addressed the panel by indicating the importance of building energy efficiency issues which the media often bypasses. Hence identifying the need for a focussed discussion and interaction between the stakeholders on this issue. She further elaborated on the role of Centre for Media Studies (CMS), a research-based think tank that extensively works, undertakes discussions and reports issues related to climate change by engaging with media. The need to brief media on technical issues and bridging the gap between consumers and policymakers are the key areas that CMS is associated with the building energy efficiency sector.

Mr Raj Pal officially inaugurated and launched the program on Media Engagement in Building Energy Efficiency.

Taking forward the discussions from the inaugural session, Dr Sameer Maithele shed light on the issue of linkage between the buildings and increase in electric energy consumption, he presented the findings on-trend an increase in electricity consumption in Delhi, most of which (around 80%) is consumed by buildings. He said that it is important from the media perspective to connect buildings with the life of common people, he emphasized that a large part of our population still does not have basic thermal comfort. He mentioned that buildings are connected with the outside environment, and cities are now largely facing the issue of the 'Urban Heat Island Effect'.

Hence, the building's energy efficiency is also linked with urban design. Starting from the site planning, architectural planning, choice of materials, systems for cooling and lightening the building, to generating electricity from renewable sources, all these factors play a crucial role in determining building energy efficiency. He concluded by saying that behavior change, consumer awareness, and market engagement are the areas where the role of media engagement becomes crucial in this sector.

Dr Anand Shukla applauded the vision of BEE and GIZ for having the session. He mentioned the work of SDC in India along with different thematic areas that align with the National priorities. Extensively working on climate change issues, the organization covers the dimensions of adaptation and mitigation. Mentioning about BEEP (Indo-Swiss energy project), he said that the project majorly

focuses on building design, technology, and policy along with outreach across the three components. At the national level, BEEP is closely working with builders and contractors to sensitize them with the issues of energy efficiency.

Mr Abhay Bakre indicated that building energy efficiency is more of a demand-side management issue and the solutions that policymakers offer have to be adopted by the consumers. The consumers then try to evaluate and give feedback to the policymakers whether it is affordable and useful for them. The role of media primarily lies in communicating the policy decisions from the policymakers to the consumers and taking back the feedback of consumers. Hence, the role of media is very important for promoting energy efficiency.

Mr Raj Pal delivered the special address and said that he is eager to have interaction with the media. He said that regulations can't be implemented properly if they are not correctly articulated by media and appreciated by people at large. He further welcomed all the comments and criticism, if any from the media to address the communication gap.

Panel Discussion II: Bridging the Gap

Mr Dinesh C Sharma emphasized the importance to see that many of the subjects are interconnected and interlinked and cannot be looked in isolation. The issue of climate change covers everything from diplomacy to regulation. This media engagement session can aid in discussions related to media

engagement and sensitization in the field of energy efficiency. The building sector is a major sector where energy consumption is going to be there. Within energy efficiency, issues related to technology and policy need to be addressed together.

Mr Rishi Kumar spoke about how The Hindu has a separate publication space for energy efficiency and green buildings. He mentioned that the Indian Green Building Council has been a landmark development that triggered the major debate on energy efficiency. This initiative in Hyderabad has 'energy efficiency' as the central focus of development. He also appreciated the labeling system of BEE. He highlighted that people still lack awareness of the availability of green products and their procurement.

Mr Bhavnesh Gupta mentioned that his publishing house has been extensively engaged in publishing work related to energy efficiency. He highlighted that the main problem lies in implementing energy efficiency initiatives and discussed a few existing gaps. Talking about his home state Rajasthan, he said that there are only 5-6% energy-efficient buildings and only 2-3% builders are there who are thinking towards this direction. He said that the main reason for such a situation is that it is not a proper interconnection between the states and the central government. It is also important to change the building codes by better collaboration between the governments to achieve energy efficiency.

Ms T V Padma informed that a whole range of products are available to enhance energy efficiency but there is a lack of awareness and usage. She also said that there is some gap at the policy level in terms of interconnections. It is important to come back to the basics, to be clear about what is the kind of building that we are talking about and what could be the possible energy efficiency solutions required for that particular category of building. A journalist can look through this issue of EE from different lenses, such as Climate Change, Sustainable Development Goals, Health, Business, Policy perspective. She further said that this issue has not yet gained the importance in mainstream media but there is a scope to incorporate this topic into several subjects.



Thematic Track 1

Meeting Two Ends: Heritage and Indigenous Construction Practices

9th September, 2019 | 1400 hrs – 1530 hrs



Moderator

Ar Sanjay Prakash
Principal Architect, SHiFt (Studio for Habitat Futures) Design Studio

Speakers

Prof Dr Deepika Shetty
Director- Faculty of Architecture, MAHE,
Manipal Academy of Science

Ms Revathi Kamath
Principal Architect, Kamath Design Studio

Mr Ripu Daman Singh
Associate Professor, GZS School of
Architecture and Planning.

Prof Uta Pottgiesser
Chair of Heritage and Technology, TU
Delft and Chair Building Construction and
Materials, TH OWL, Detmold

Abstract

The intent of the session was to highlight the various construction practices, materials and details in indigenous construction and the resulting compositional richness in the built form that reflects the uniqueness of the regional architecture of India.

A vestige of distinctive traditional building practice still survives and thrives in regions of India. Knowledge of local climate, availability of local materials and tools, and the resultant building practice is deeply rooted in the environment and the cultural practices and traditions of the region. These practices have proven to be more resilient to the harsh spells of natural anomalies. The session focussed on how these solutions from our past can help us achieve sustainable development in the present.

Presentations

Prof Dr Deepika Shetty spoke about the key findings on learning from heritage from her case study on Barkur town in the Udupi district

of Karnataka. She spoke on the importance of role identification before starting the process of designing cities. She listed 4 pillars of sustainability that moulds the urban design: Ksetra (physical zone of influence i.e. regional context with respect to place, demography, background, landscape, and environment), Loka (socio-cultural and economic aspects), Desa (manmade conditions i.e. density land use, history, social and public infrastructure) and Kala (development of guidelines according to the times).

She emphasized that each situation needs rethinking of urban development strategy as per the nature of the development in the region. Increasing the size and density of a town may not always be the solution. There is a need to discover alternative growth patterns for sustainable development which may be the demand of the times.

Ms Revathi Kamath reminded the attendees that one creates architecture by imbibing it from the environment and history. She spoke on the importance of inclusion of traditional architecture practices in the building design. She listed three main aspects to be kept in mind while designing a building: To do more with less, Eco literate architecture and Diverting the mainstream. Any responsible building design should be in accordance with the type of area and economy of the place. She spoke at length about her projects emphasizing on various sustainable building practices and traditions that should be mainstreamed in the building construction industry. For building design, she highlighted the use of eco-friendly

and locally available materials, benefits of mud architecture, celebrating the use of craft and labour by incorporating the traditional items for decoration, abandoning the use of red burnt bricks as they are energy-intensive and practicing minimalism in forms. She emphasized that such practices not only cut the construction cost but also go in harmony with the natural environment.

Mr Ripu Daman Singh introduced the topic of key architectural aspects of an energy-efficient building design. He highlighted that the major concern in any building design is the use of the HVAC system which is the most energy-intensive. Around 55% of the annual energy demand of a building is utilized by HVAC. One of the crucial reasons for such rapid increase in energy consumption in today's times is the shift from vernacular building architecture to buildings with huge glazed non shaded facades.

He broadly elaborated about his research work on the impact potential of architectural design parameters that an architect should adopt in the early stages of design which helps in creating an energy-efficient building. The early design stage involves 3 design principles which are reduction in solar exposure, reduction in incoming solar radiation and reduction in heat transfer. He highlighted that the key architectural aspects which affects the building envelope performance are the building envelope form, orientation, WWR, glazing proportions, window, wall and roof shading, and window, wall and roof insulation. Various combinations of these parameters can widen

the scope of design decision-making and lead to the enhanced energy efficiency of up to 22.36%.

Mr Singh concluded by emphasizing on the use of passive elements of architecture in the building design which can enhance the energy efficiency of buildings.

Prof Uta Pottgiesser spoke about an integrated relationship between heritage, sustainability, and circularity. She emphasized that heritage is not just the listed monuments but heritage is what we inherit from our past. In the context of the built environment, it is both tangible and intangible. The inclusion of heritage is important to find solutions to the growing global, societal and local environmental issues.

She described that present era is witnessing advancements in technology and building materials which are having an adverse impact on the environment and can't be neglected. A responsible solution to this lies in the use of new technology and knowledge in a wise and intelligent manner combined with the traditional principles.

Prof Pottgiesser introduced the term circular massivity which highlighted the use of lightweight monolithic construction in building design which has benefits of enhanced thermal comfort, increased structural strength and reduction in dead loads. She also mentioned about the need of transition of cities from ecopolis to the circular city where high-performance buildings will play a key role.

Questions & Comments

A number of perspectives emerged in the general discussion. Several participants noted that there is still a lot of potential as far as the adoption of vernacular architecture elements in buildings is concerned. There is a need for mainstreaming traditional building design practices and build confidence among the stakeholders to adopt them.

Some participants highlighted the impact of the projects mentioned in the presentations on the psychology of people. One argued that such passive architectural designs in buildings might not necessarily be accepted by people, and thus requires sensitization of occupants about the positive impact of traditional architectural practices on the energy efficiency of the building.

“Engineering is not hard science; it is something which has to do with heritage as well.”

Conclusions

In concluding remarks, **Ar Sanjay Prakash**, the moderator, talked about his personal experience on the aspect of heritage inclusion in the building sector. He gave the example of the development of building code for cyclone-prone areas of Orissa and Andhra Pradesh. People have lived with cyclones in this region for millennia. They have worked out certain systems of managing high-velocity winds, minimizing the damage and recovering from it. But the way modern code is written he said

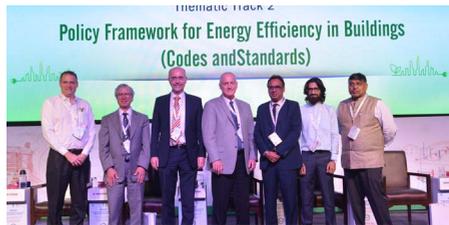


it invalidated all those efforts of heritage and assumed that the only way to build would be modern engineering materials like concrete and steel. Development of building codes should be more inclusive of heritage practices.

Thematic Track 2

Policy Framework for Energy Efficiency in Buildings (Codes and Standards)

09th September 2019 | 1400 hrs – 1530 hrs



Moderator

Dr Winfried Damm
Cluster Coordinator, Deutsche Gesellschaft für Internationale Zusammenarbeit, IGEN-GIZ

Speakers

Mr Abdullah Nisar Siddiqui
Technical Expert, Deutsche Gesellschaft für Internationale Zusammenarbeit, IGEN-EE-RB, GIZ

Dr David Goldstein
Natural Resources Defense Council (NRDC)

Mr Mario Schmidt
President, uPVC Window and Door Manufacturers Association (UWDMA), New Delhi

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency (BEE), New Delhi

Mr William Prindle
Director, ICF USA

Abstract

The thematic track focused on the deliberate discussion on various policies put together for enhancing the energy efficiency of buildings in India. India and other nations in South Asia and Southeast Asia are on track to record the world's biggest increases in demand for electricity consumption. Global energy demand is expected to increase around a third by 2040, driven by improvements in living standards, particularly in India, China and across Asia. This will be met mostly by natural gas, which is expected to overtake coal as the second largest source of energy by the mid-2020s and converging on oil by 2040 (IEA, 2018) with the residential sector expected to be the largest consumer within the country in coming years. India has a surplus power generation capacity but lacks adequate distribution infrastructure. This calls for an initiative to put together various policies to meet the capacity of the nation as we look to progress aggressively towards being the largest economy of the world.

Presentations

Dr Winfried Damm being the moderator hosted the session by briefing the audience about the session and how the discussion would be focused on various policies being developed and implemented by the government along with the aid of many international organizations and private societies. He emphasized the fact the ANGAN to date was the biggest conference ever to be conducted on topics of energy efficiency and sustainable development of the energy sector to meet the ever-growing demands of the world. He talked about the importance of the regulations in place and what should be done on an international and national level to meet the sustainability factor in terms of energy generation and consumption. Keeping the discussion in progress he passed on the question to the panellist asking them about their views about the challenges, problems, suggestions, and solutions for better implementation.

Mr Abdullah Nisar Siddiqui started by pointing out the exceptional work done by BEE and its current supporting organization GIZ. He took the conversation back in time by reminding us all that the journey of building energy efficiency in India began with the Energy Conservation Act 2001. The act came into function in 2002 and led to the birth of BEE which functions under the ministry of power. Mr Siddiqui said that once the bureau was made and enforced at the central level, they made a few guidelines and recommendations which were mentioned in the EC Act specifically for the building sector. One of the guidelines

was to specifically address the buildings under the EC act. He defined what type of structures are considered as a building under the scope of EC Act and elaborated that any building or building complex having a connected load of 100 KW or contract demand of 120 Kilovolt Ampere (kVA) and above and is used or intended to be used for commercial purposes is considered as a building. This definition became the laying stone of the first edition of the Energy Conservation Building Code and was launched in the year 2007. He then shared decade long experiences and lessons learned through the course of the implementation of the first edition of ECBC. The further progress of the ECBC code was carried out by the voluntary adoption of ECBC code by various state-level agencies. The establishment of state-level ECBC cells was marked as the next milestone achieved by the BEE in the continuous quest for driving energy efficiency throughout the nation.

Mr Siddiqui concluded his views by suggesting that the EC Act should be implemented at each municipal level along with the central or state level to enhance its implementation and effectiveness. He suggested that the 100 smart cities that have already been identified in the nation should be the testing ground as a starting platform for the next step of the EC act.

Mr Mario Schmidt started by stressing the importance of building envelope specifically windows which contribute to about 25% of the load on electricity consumption either through heat ingress in summers or heat loss during

winters. He also talked about smart planning of buildings so that high-performance glass need not be applied in places where it is not needed so that it ensures cost-effectiveness.

Mr Schmidt also thanked the contribution of GIZ in organizing training & development programs across India. He said that such programs would not only bring the required skill needed for the job but also will help in better integration of authoritative bodies such as BEE with implementation bodies and projects from across the nation.

Mr Saurabh Diddi started by acknowledging the suggestion put forward by the panellists; and was thrilled that such solutions was already articulated as a response to the challenges being faced in the nation's approach towards energy efficiency and sustainability.

Mr Diddi said rather than looking at new and emerging solution and implementing them, we should first work towards implementing the market ready solutions that already exists. He acknowledged the fact that implementation plans need to be developed at the ULB level. However, the challenge of having an ECBC cell in each city is huge and thus innovative solutions must be devised to address it. Mr Diddi informed us about the tool “Energy method information system” which has been developed by BEE that will support all the ULB's across the country and will integrate the various governing bodies through the tool. He told us about the salient features of the tool which can perform a wide range of application from registration, assessment and

even simulations for the applied buildings. He stressed that such type of mechanism and systems are needed to be installed in every ULB and carried forward from there on for more advanced and swift integration at a local level.

Mr Diddi then introduced us to the other strategies that the ECBC and BEE are working towards to meet the energy efficiency targets in residential buildings. The Energy Conservation Building Code for Residential Buildings, which is known as Eco – Niwas Samhita, has been introduced in 2018. He stated the biggest challenge for the residential building code is that it does not fall under the EC Act and hence cannot be mandated across the country. The solution to the integration of residential buildings under ECBC comes through the inclusion of code in already existing municipal bylaws.

Mr Diddi further stated that energy efficiency can be best achieved when end-consumers are made more aware and requisite training is imparted. The best example of such mass awareness is the BEE star labelling program for appliances. As consumer become more aware of the benefits of a star labelled home the market revolution would emerge organically. Mr Diddi concluded by informing us all about the 24-degree campaign which promotes the users to use their cooling appliances at 24°C so that the habit of living energy efficiently is also inculcated.

Dr David Goldstein started his presentation by highlighting that India is on the right path towards ensuring energy efficient buildings. Before elaborating on the solutions, Dr Goldstein shifted back the focus on what our problems are. He highlighted that combatting climate change and greenhouse gas emissions are of paramount concern and needs to be addressed keeping in mind economic development and standards of user comfort and health.

Dr Goldstein pointed out that energy efficiency is about continuous improvement and not just an instantaneous leap that can completely transform the industry. He presented the example of California where the energy efficiency was achieved using a slow but steady process. The results of that continuous effort were seen in 2019 when the energy efficiency pattern in California became 10% of what it was before the existence of any energy codes in 1977.

Dr Goldstein added his suggestion of what more India could be doing. He highlighted that there is a need to look into other ways of energy efficiency that would be complementary with the code. This could include mainstreaming low-technology and high market penetration regulations implemented on a large scale. For example, the enhanced implementation of ECBC and making start labelled appliances mandatory. Similarly, promotion of high-technology and low market penetration regulations can be promoted using the existing framework of Super ECBC and making a 3-star product the minimum requirement.

He said that one way of promoting new technology would be to introduce incentives for things that would not be done voluntarily. Alternatively, incentives to the manufacturers for rolling out new technologies may be introduced to ensure that the capital cost is in a competitive range with respect to the existing technologies. He added that just like incentives another way of pushing the technology in the market is by introducing tax credits. For example, if a manufacturer or consumer meets certain efficiency levels, he would be granted a certain tax credits against his efforts. The latter strategy has an advantage over the former one as essentially there is no capital investment required. He shared an example of such a strategy being implemented with energy-efficient homes in the United States.

Dr Goldstein concluded by stating that the implementation of ECBC and ECBC residential in India will help develop energy-efficient buildings which can be enhanced with the introduction of some complementary policies.

Mr William Prindle introduced himself and his organization highlighting their contribution of work in ECBC-R (Eco-Niwas Samhita) along with GIZ. Like Dr Goldstein, Mr Prindle highlighted the step that had been adopted in the United States for its effort towards the development of energy-efficient homes which are commonly known as energy star rated homes. He shared his experience of the US market trends and transformation that took place due to the introduction of high-performance glass. The glass manufacturers

took the initiative and equipped the market with standardized products to enhance energy efficiency in buildings.

He concluded his presentation by stating that the implementation of energy efficiency codes and policy require infrastructure like a power line, metering systems, rating frameworks, labelling schemes, performance standardization and accredited test centres in order for the whole system to thrive. Thus, the presence of such infrastructure and facilities help enhance adoption of energy efficiency measures.

Questions & Comments

The first question posed by the audience was if India can build an energy-efficient building with the current lack of skilled and organized labor. Mr Schmidt responded to the question by informing the audience about the upskilling, training and development programs being organized by GIZ for enhancing the knowledge of workers and professionals in the construction industry for better awareness in building energy efficiency. Mr Diddi added to the answer by highlighting the efforts made by BEE in organizing 16 training programs conducted in various states throughout the country. He also stated the efforts made by BEE in conducting training programs of labors and masons involved in the construction industry.

The next question was if the ECBC can be integrated with other building codes like the National Building Code. Mr Diddi answered the question by reminding that NBC already has a chapter for building energy efficiency. However, due to the launch of NBC in 2016 the code is not in sync with the latest ECBC. He also stated that ECBC is planning the revision of the code every 5 years.

Conclusions

Dr Winfried Damm, the moderator, summarized the session by highlighting once again the need to enhance the adoption of the ECBC both in the commercial and residential buildings. He highlighted that all of the solutions discussed during the session are important to be considered and explored. He concluded the session by thanking the speakers and audience for their participation.



Thematic Track 3

Circular Economy (Waste or Resource)

9th September, 2019 | 1400 hrs - 1530 hrs



Moderator

Dr Shailesh Agarwal
Executive Director, Building Materials &
Technology Promotion Council (BMTPC)

Speakers

Dr K. Vijaya Lakshmi
Vice-President, Development Alternatives

Mr Pekka Huovila
10YFP SBC Coordinator, Finland - Ministry
of Environment

Dr Satish Kumar
President and Executive Director, Alliance
for an Energy Efficient Economy (AEEE)

Mr Siddharth Singh
Lead India Analyst, International Energy
Agency (IEA)

Abstract

The session aimed at exploring the business case for adopting circular economy by presenting economic arguments, beyond the environmental considerations and good corporate citizenship. Over the years, mankind has emerged as the most dominant force shaping the world's physical, economic and social environment. This anthropocentric approach has led to depletion and, in some cases, exhaustion of natural resources. With the world population moving towards the 9 billion mark, an increase in demand for natural resources is inevitable. Further, the New Year came in with the alarming news of Cape Town going dry, clearly a sign of climate change and resource scarcity that the world would face in the coming times. In a world of finite resources, it is crucial to identify and innovates a new and restorative economic model for judicious consumption and replenishment of resources.

Presentations

Dr Shailesh Agarwal welcomed the panellists and introduced the session to the participants by giving illustrations of agricultural utility of fly ash, and bricks made up of marine sand. He mentioned that though there are many proven models, which establish waste as resource, but not many of them have been converted to viable business models. He underscored the significance of disruptive products, technologies and models that can satiate the needs of a growing economy of \$5 trillion by 2022, and government's vision of "Housing for All" under Pradhan Mantri Awas Yojana.

Dr K Vijaya Lakshmi presented viable business models for affordable and eco-friendly materials by adopting circular economy method. With increase in population, use of natural resources increases. This needs to be checked for inter-generational equity by promoting the use of alternate materials. There are various sectors like agriculture, infrastructure, mining, etc. where waste materials can be recycled into construction materials. In a few years to come, India is expected to fall short of raw materials like sand, limestone, aggregates, soil, etc. It is not only the production of raw materials; it is the consumption of resources that needs to be changed. This can be achieved by increased usage of industrial wastes and mining wastes, judicious use of natural resources, reduction in energy consumption, reduction in environmental and fugitive emissions, and reduced cost of construction. For example, increased adoption of fly ash bricks can fruitfully deploy 180 million tonnes of fly

ash generated every year in the brick sector, and leverage the latent potential of 30,000 enterprises, 0.2 million skilled jobs and CO2 savings upto 46 million tonnes/ year. Similarly, utilization of C&D (Construction & Demolition) waste from the construction sector holds the key to tap latent potential of 3600 enterprises, 0.1 million jobs and CO2 savings upto 1.5 million tonnes/ year. Dr Lakshmi elaborated on a successful case study of a PPP model wherein Ahmedabad Municipal Corporation, Amdavad Enviro Projects Pvt Ltd and Development Alternatives collaborated to deploy C&D waste purposefully. Other innovative products like limestone calcined clay cement, waterless handmade paper, building blocks made with plastics and rags, pine wood shingles in roofs, and bamboo-resin wood were also discussed during the presentation. All these materials reduce overall energy consumption and carbon emissions into the environment, thus promoting green growth.

Mr Pekka Huovila emphasised on the approach towards circular built environment in Europe. It involves reducing waste and increasing waste recovery by managing the whole life cycle of the built environment. He elaborated how 90% of construction can be disassembled and reused without losing value in the Circle House, a scalable demonstration project in Denmark. In the case of Alliander Head Quarters in the Netherlands, 92% of the materials are labelled as 'circular'. Various instrumentalities have been in vogue in Europe to increase the market adoption of circular economy, for e.g. material and building passports, material banks and

digital marketplaces. Mr Huovila also drew a parallel between the two thematic focus areas of the “SBC Programme 2015-2022”, and the initiatives taken up by Ahmedabad City in India. The SBC Programme focuses on affordable and resilient built environment, and responsibly sourced materials in a circular built environment. Ahmedabad City has incentivized the use of waste, in general, and C&D waste, in particular, by introducing policy measures like 75% procurement of non-structural products from waste. According to Mr Huovila, circular economy gives opportunities for rapid urban growth of sustainable cities, increasing employment and enterprise development, reducing municipal and construction waste, organic waste recycling, urban recycling in informal settlements and waste micro grids. He explained how the idea of circular economy has flourished greatly in the field of vernacular construction, where locally available materials are used for construction, such that they can be reused in the future.

Dr Satish Kumar rued the fact that though the construction industry is the world’s largest consumer of raw materials, but still, the traditional linear economy with “make-use-dispose” approach is quite persistent. He suggested a paradigm shift in business models and public policies to move towards a climate resilient future. He explained, in detail, about different frameworks that may enable such a shift. These included the Environment, Social and Governance (ESG) framework for rating of companies and the ReSOLVE framework for circular economy. Dr Kumar positioned circular economy as an alternative to a

traditional linear economy that is supposed to look at the entire life-cycle of any process. It would, according to him, reduce the demand for non-renewable virgin materials, reduce waste and provide highest possible utility and value to the concerned stakeholders. He discussed the role of various stakeholders like manufacturers, suppliers, designers, contractors and clients in enabling circular economy. He prophesied that in a decade or two, the earth would fall short of natural materials and it is high time to find alternatives of natural materials with similar stability, durability, longevity and quality. He suggested that to boost demand and further research on circular economy, the government ought to provide subsidies for the use of alternative materials, to make them viable for every household. It would bring about rapid growth in circular economy and hence, a healthy urbanization scenario.

Mr Siddharth Singh presented the case for the role of buildings in clean energy transitions. He emphasized that building energy use plays a large role in the global energy system. Globally, buildings account for 30% of final energy demand, 55% of electricity use and more than a quarter of energy related CO₂ emissions. However, 70% of the economic potential to improve energy efficiency in buildings remains untapped. He said that global buildings sector energy demand rose by more than 20% between 2000 and 2017. This growth is linked to increasing floor space and appliance ownership. Specifically, space heating and cooling energy use increase significantly due to increased ownership. It

results in other externalities. For example, despite improving carbon intensity of power generation, rapidly increasing electricity demand contributes to growth in CO₂ emissions related to buildings energy use. Mr Singh explained that improving energy efficiency of buildings can contribute to a range of policy objectives, including energy security, health and well-being, poverty alleviation, resource efficiency, and climate resilience. According to him, circular economy is a core pillar of energy efficiency in buildings. Material recycling, reuse and life time extensions reduce demand, externalities and waste. For instance, material efficiency measures could reduce upstream emissions from cement and steel use in buildings by 23% from 2017 to 2050. Envelope improvements, technology selection and equipment performance are other important levers to reduce energy demand in buildings. For India, the path towards a better life is to develop comprehensive efficiency policies, integrate energy efficiency in urban, building and housing policies & programmes, and strengthen state-level implementation capacity.

Questions & Comments

The audience raised their concern over sustainability of C&D waste management plants, like Burari Plant that is reportedly running at 25% capacity due to slack demand. They enquired about policies and frameworks that ensure viability of these initiatives. The panellists agreed with the seriousness of the concern, noting that even Ahmedabad Plant is reportedly running at around 30% capacity only.

They underscored the view that preferential public procurement is the biggest driver for ensuring sustenance of these plants. However, prospects seem positive with Swachh Bharat Abhiyan also mainstreaming C&D waste management. Similarly, the Construction & Demolition (C&D) Waste Management Rules (2016), CPWD specifications on C&D waste products, and the government circular mandating 10% building products to be derived from C&D waste are some other examples of policy interventions.

One of the participants asked if there were some reliable references for technologies and best practices in the sector. The panellists cited the Ready Reckoner entitled “Utilisation of Recycled Produce of Construction & Demolition Waste”, published by the BMTPC. They also emphasized upon NITI Aayog’s documents on circular economy and resource efficiency for the purpose.

Taking a cue from the e-waste management, a participant wanted to know if the concept of “extended producer responsibility” could be applied to the C&D waste management sector. The panellists replied in affirmative explaining that demolition permit could, in future, insist on ensuring that the C&D waste reaches recycling plants.



Conclusion

The session witnessed lively deliberations with active engagement from both the panellists as well as the participants. Various business models, policy measures, market instruments and frameworks were discussed that can provide traction to circular economy. Many national and international case studies were analysed to enable cross-learning. The need for circular economy, material efficiency and its linkage with energy efficiency in the buildings sector was conclusively established. Dr Agarwal concluded the session by extending a vote of thanks to all the speakers and the audience.



Thematic Track 4

Smart Cities and Smart Readiness Indicators (SRI) for Buildings

09th September 2019 | 1600 hrs – 1730 hrs



Moderator

Mr Kunal Kumar
Joint Secretary & Mission Director (SCM),
MOHUA, New Delhi

Speakers

Mr K K Joadder
Former Chief Planner, Town and Country
Planning Organization

Mr Swayan Chaudhary
Managing Director & CEO, Imagine Panaji
Smart City Mission Director

Mr Samit Ray
Director - Government Affairs, United Tech-
nology Corporation (UTC)

Ms Vaishali Nandan
Project Head, Climate-Smart Cities, GIZ

Mr Anand Iyer
Chief Programme Manager, NIUA

Mr Edwin Koekkoek
Counsellor, Energy and Climate Action,
Delegation of the European Union to India

Abstract

The number of people in India's cities will overtake the rural population in the next three decades. Furthermore, the rapid growth of cities in the developing world, coupled with increasing rural to urban migration, has led to a boom in mega-cities. In 1990, there were ten mega-cities with 10 million inhabitants or more which has grown to 28 mega-cities, home to a total of 377.1 million people.

To ensure that our cities cater to every citizen and are efficient and green in doing so, Smart Cities and Buildings have taken the spotlight in recent years. However, discourse regarding what SMART cities mean is still growing. Do SMART cities mean ensuring efficiency through technological advancement or is a city that provides safety, sustainability, and security to all? How do we measure the SMART-ness of a city? Can India make all its cities SMART? How do we do so?

This session focused on these questions and delved into what SMART cities in India should look like and how to achieve the same.

Presentations

Mr Kunal Kumar started the deliberation with a simple thought - how does one explain in simple terms to a layman or a child, about energy consciousness and the way we currently use it. He stated that one of the reasons why common people do not connect themselves with climate change is the disconnect they face with the technicality behind it and the way it is discussed with people who need to understand this in small or big measures. There are important reasons for discussing energy and bringing energy consciousness to the masses. Awareness of our growth in terms of population is one of the primary ones. Our needs are growing and we ponder if we have enough fossil fuels to keep providing us the energy that we need. It is one of the fundamental questions that we always ask ourselves. The second question he deliberated upon was regarding energy security, which is very critically linked to geopolitical security. He iterated that energy security and climate change should become household concerns, gaining traction by enough deliberation between concerned stakeholders leading to find sustainable solutions.

Mr K K Joadder started his presentation by putting forward a common man's perspective on the smart cities, asking whether "smartness" of a city should attribute to the technological advancement or resource security by sustainable means. He iterated that a smart system should perform on high efficiency and resiliency, leading to disruption-proof performance.

If guidelines for the smart city had to be set, no single approach could define achieving this. It was suggested that certain "Area-based" strategy must be uptaken that looks at the smart development of the particular case contextually.

He discussed a few ways for achieving a functioning smart city, focusing his points on greenfield development. Considering the green roof on the urban fabric, he presented the potential of harnessing solar energy on Delhi rooftops along with green terraces supporting resilient local vegetation that would help bring down the conventional energy demand of the setup.

Mr Swayan Chaudhary began by discussing the aims of the Imagine Panaji Smart City mission, all of which collectively lead to a smart city that has embedded "smartness" into its operations, and is guided by the overarching goal of becoming more sustainable and resilient. Discussing various features of the program he iterated that objective of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local development and harnessing technology as a means to create smart outcomes for citizens.

Leading by the given example discussed, he urged that the government should promote the formulation of more programs like the Smart Cities Mission, creating replicable models, which would act as lighthouses, showing the way for others to follow. At the micro-level, he stated that incentivization is essential for

consumers to uptake sustainable measure that comes with a higher upfront cost. This could be supported by directives from the government, making the goal achievable.

Mr Samit Ray began the discussion by putting forward a question – how do we keep our cities clean in India, attributing the smart systems of sanitation in the developed countries. Focusing on the fact that we are one of the fastest-growing economies in the world, our infrastructure demands are still grappling with resource crunch. It is only an indication that we have been reckless in our resource usage. We need to realize that we don't have unlimited resources and that we need to come up with smart ways of resource management to maintain a sustainable inventory of resources. Utilization of waste as resources by recycling and upcycling, saving energy alongside, becomes imperative in the Indian context to support the delicate balance. He stated that the incentivization of energy-efficient products needs to be done to encourage their uptake.

Ms Vaishali Nandan shared the work done on the Climate Smart Cities Assessment Framework developed by them at GIZ. She shared that the objective is to come up with climate-friendly solutions for urban infrastructure projects with a strong footing and area-based development in the planning and implementation of Smart Cities.

Through this framework, 100 Smart Cities are enabled to assess their status of climate adaptation and mitigation and target future projects and investments to the indicators.

A help desk and an online portal have been established to guide and monitor the cities. An extensive actor-network of national and international funding and research organizations is providing technical support to the MoHUA and GIZ.

Mr Anand Iyer started the discussion by re-evaluating the definition of “Smart Cities” and reassigning the importance of technological advancement in it. Apart from smart technology, smart people are great contributors to making a city smart. It is imperative to realize that having smart citizens is as crucial, if not more, as having advanced technology, in the formulation of policies leading to smart cities.

It is the responsibility of the policymakers and implementers to invest enough money to make sure all citizens can meaningfully access and profit from that technology. Cities are made up of citizens. They are the main components of any city. Infrastructure is the requirement of citizens and technology is an enabler. It is very important to ensure that citizens themselves are ready to be smart and build a smart city by involving themselves to the municipal council and are able to think through what kind of future they want for themselves. As if citizens and government envision together, implementation will be more impactful.

Mr Edwin Koekkoek started his talk by focusing on the similarities between India and the EU in terms of their approach towards sustainability. He shared his viewpoints on the Smart Readiness Indicators – Focused

parameters assessing a building or building unit's capabilities to adapt to occupant and grid's needs and to improve energy efficiency and overall performance. The SRIs are envisaged to contribute to enhancing energy efficiency, comfort, and well-being in buildings, improve policy linkages with connected initiatives while contributing to the integration of buildings into future energy systems and markets. This system would eventually cover the optimization of energy performance and operation, adaptation to occupants' needs, maintaining healthy indoor climate conditions while bringing flexibility to a building's overall electricity demand

challenge is to use the power of data to create smart solutions that address the real needs of city users and are perceived as meaningful by them. Finally, the third cornerstone of smart cities is smart people. Success depends on the quality of the decisions that are made and the way these decisions are executed.

Questions and Conclusion

A question was asked by one of the audience members if one should look at Smart Cities from being technologically advance or sustainable? It was answered by the panelists that having to select one of the above does not necessarily mean being devoid of the other. One is merely a way of achieving the other. Cities have to use technology to become sustainable. We have been reckless in the use of our resources.

The need for energy efficiency is becoming urgent, increasing population puts higher pressure on the urban infrastructure and public authorities need to do more with less permanently. Technology has been getting incorporated by cities for many years but the pace at which this is happening has been increasing rapidly. As a consequence, urban areas transform into 'smart cities'. The

Thematic Track 5

Climate Resilience in Buildings

09th September, 2019 | 1600 hrs – 1730 hrs



Moderator

Dr R R Rashmi
Distinguished Fellow and Programme Director, Earth Science and Climate Change, The Energy and Resources Institute (TERI)

Speakers

Ms Alokandanda Nath
Technical Expert, Climate-Smart Cities, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Dr Anir Upadhyay
Architect and Urban Planner, Faculty of the Built Environment, UNSW, Sydney

Prof Hina Zia
Dean, Faculty of Architecture and Ekistics, Jamia Millia Islamia, New Delhi

Mr Ashish K Jain
Partner, AEON Integrated Building Design Consultants

Abstract

Decades of irresponsible consumption and production patterns have led to adverse effects on the climate of the planet leading to unpredictable weather patterns, natural disasters, loss of livelihood and damage to life and property. In 2017 alone, 2,726 deaths in India were directly related to extreme weather-related events. India suffered an economic loss of about USD 13.8 billion in the year. Given the gravity of the situation, immediate action and farsightedness are essential.

At the same time, India is expected to increase the current building stock by nearly four times by 2030. This provides a great opportunity to provide for resilient habitat which can cater to the changing conditions and provide for safe structures for all citizens.

The session focused on identifying existing challenges and putting forth solutions to ensure climate resilience, battle climate change, enhance adaptability, and reduce the vulnerability of habitats in the face of changing environmental conditions.

Presentations

Ms Alokananda Nath presented the learnings from the projects on the climate sector in GIZ. She started with an overview that buildings and construction sectors together account for 36% of global final energy use and 39% of energy-related carbon dioxide emissions. In 2015, 82% of final energy consumption in buildings was supplied by fossil fuels. To accommodate the global urban population growth, around 2.48 trillion sq ft (230 billion sq m) of new floor area have to be added to the global building stock by 2060. All these accounts to the problem that by 2030 globally, we might not be able to meet the target of 30% energy intensity improvement in buildings and our international commitments as per the Paris Climate Change Agreement.

She further added that in India, GHG emissions account for about 7% of the global figure, making it a crucial player in combating climate change. The Urban population is set to touch 900 million by 2050 which would result in total energy requirement to grow at 6.5% per year to support the projected growth rate. The building sector is expected to grow between four to five-fold by 2050 to accommodate the urban population. Two-thirds of the commercial and high-rise residential structures that will exist in 2030 are yet to be built. These will contribute significantly to the upcoming challenges and their impacts will be grave in the form of climate change. Some of the major changes visible at a larger scale annually include climate hazards and extreme weather events - heavy downpours, hurricanes, or wildfires;

Increase in flooding and rise in sea-levels; Adverse impact on human health, ecosystems, flora-fauna.

According to the UNFCCC, Climate resilience refers to changes in processes, practices, capacities, and structures to curb potential damages or to benefit from opportunities associated with climate change. The concept of resilience requires both mitigation and adaptation measures by assessing the hazard, exposure, and vulnerability of various systems. The objective of the Climate Smart Cities Project by GIZ is to anchor climate-friendly solutions for urban infrastructure projects and area-based development in the planning and implementation of Smart Cities. Under the Climate SMART Cities Assessment Framework launched by MoHUA in February 2019- a part of the Smart City Mission, GIZ is working for three cities Kochi (Kerala), Bhubaneswar (Odisha), Coimbatore (Tamil Nadu). She further explained that the framework is having five thematic areas with 30 indicators. The five themes are Energy and Green Buildings; Urban Planning, Green Cover and Biodiversity; Mobility & Air Quality; Water Resource Management and Waste Management. She elaborated on the Energy and green buildings theme that is having six indicators out of which level of compliance for green buildings and the percentage of Green building ratings are the two indicators focusing on green buildings. It is essential to look at the building sector because it offers a highly cost-effective opportunity to curb energy demand. Resilience building should be done in a holistic way and thus the following hierarchy should

be followed, site planning of the building, then neighborhood, ward and at last city level. She concluded by adding that changing user behaviors and attitudes are very important to strengthen institutions and governance frameworks for the implementation of policies.

Dr Anir Upadhyay began with asking the audience if we really understand climate change and its impacts. He emphasized that being an Architect; he is interested in this research because he believes that the majority of architects doesn't understand the climatic context and are not able to respond when the situation is atypical. He cited the definition of Resilience from the Resilience design institute.

“Resiliency is a multifaceted lens which balances proactivity (this will happen and we will resolve it) and reactivity (something happens and we learn out from that) to inform solutions to disruptions.” He added that we need to work towards it by defining a structured approach to do so.

Dr Upadhyay defined a net-zero energy buildings as a facility where the net energy balance is zero based on the yearly cycle. Some of the interventions that an architect or designer may deploy involves the protection of building envelope from penetration of heat through design. However, Dr Upadhyay added that building design should depend on the climate data which may change over time. For example, Delhi falls under the composite climate at present but by 2050 it will be predominantly be hot and humid with a brief cool period. He further mentioned about his work in Ahmedabad where he has used a

psychometric chart and ISHRAE 2014 code to analyze climatic concerns. He concluded his presentation by adding that in order to design for resilience, there needs to be a coherent understanding of the context and we should respond to it and take into account projected climatic data through building design.

Prof Hina Zia started with putting this question that climate-resilient buildings are the new normal and through pictorial representation, she added that future houses will have to be ready with boats hung on their terraces given the looming threat of extreme weather events like urban flooding. Globally there have been many disasters aggravated by climate change in recent years, for instance the adverse conditions caused by the Kerala floods every year and Rajasthan being exposed to increasingly intense Heatwaves and thunderstorms. These extreme challenges make the need for readiness in buildings imperative but do not provide a well-defined objective. India has been ranked as the sixth most climate change-vulnerable country in the world in terms of facing extreme weather events by the Climate Risk Index 2018. The report noted that in 2016, India had lost the maximum number of human lives (2,119) and over US \$21 billion worth of property to such events. It states that countries like India are repeatedly hit by extreme weather and have no time to fully recover.

She added that resilience as a concept is borrowed from the field of ecology and the approach is typically implemented in a top-down manner. The focus should be on the

mainstreaming of sustainable development models which are based on a holistic approach of ecology, society, economics and politics instead of considering only GDP. She defined Climate Resilient Buildings, as a structure (permanent or temporary) that is enclosed with exterior walls and a roof, constructed on a plot of land that has the capacity to absorb disturbances, in particular climate change-related impacts, and still retain its basic function and structural integrity. The intention of the designing climate-resilient buildings should be to provide better comfort conditions with less use of electricity/fossil fuels, designing and retrofitting structures which can withstand the damages caused by flooding (increased precipitation), not building in vulnerable locations and where access to safe quality of water is limited and integrating decentralized waste (liquid/solid) management for all habitats. In addition to that, to avoid health risks better indoor air quality needs to be maintained unlike most Indian cities of today.

At a building scale, the focus should be on passive design strategies like creating roof gardens to reduce the UHI effect. She further noted some design initiatives for heat control in buildings such as solar control strategies like shading, building orientation and morphology to reduce external heat gains and maintain comfortable indoor conditions, increase in green cover around the house and increase in ventilation through optimization of window design and size. Further, to manage water resources and quality risks, strategies like rainwater harvesting should be incorporated.

She added that the best possible results for the same have been obtained at the neighborhood level. Resilience strategies at neighborhood and building scale need to be implemented with public participation and a lot of capacity building and hand-holding. There has to be an ecosystem for innovation at all scales and there is a lot of scope for contextual innovation. Her conclusion statement emphasized that sustainability needs to be mainstreamed and it should become a way of designing and building rather than an option.

As a market expert in green buildings, **Mr Ashish K Jain** defined resilience in two words; “Future-ready”, but added that how we achieve resilience is the bigger question. He added that climate responsiveness should be focused on when we talk about resilience. He added that the motto for future buildings should be “Shunya-the future” meaning Zero energy, waste and water. He highlighted the need for an integrated approach in designing climate-responsive buildings. The process needs to start with a pre-design stage with a detailed analysis of climatic and site conditions. Green ratings should become a by-product of good design practice. Further, he shared some details of his projects where on-site solar shading analysis had been carried out to design interior spaces as well as plan the site. Urban heat island is a known problem at a city level but needs to be addressed at a project level for effective change to be initiated. In addition to that, he mentioned that the prevailing wind directions vary in different months and needs to be plotted on the site to inform the orientation of buildings and take advantage of the natural

ventilation available on site.

Questions & Comments

One of the participants from Bureau of Energy Efficiency (BEE) commented that cities have shown to deviate from the weather patterns of their assigned climatic zones raising the concern that they have been erroneously categorized. They highlighted the need to re-assess the climatic configuration and assumptions for major Indian cities. Other participants mentioned that the right message to be sent is that policies should focus on the process rather than on the product. While the discussants acknowledged that the Energy Conservation Building Code is trying to implement this strategy, they highlighted that a more in-depth analysis is required for further development.

Conclusions

Dr R R Rashmi, the moderator, summarized the session by highlighting the need to look at climate zoning afresh to design for the future. He added that the focus should be on a top-down approach to achieve resiliency at the national level and innovation in architectural design should be integrated into planning processes. He highlighted that all of these solutions are equally important to achieve our national goal of climate-resilient future. He concluded the session by thanking the speakers and audience for their participation.

Thematic Track 6

Affordable and Sustainable Development: Priorities for India

09th September 2019 | 1600 hrs – 1730 hrs



Moderator

Ms Jessica Grove-Smith
Physicist & Senior Scientist, Passive House Institute

Speakers

Prof Ashok B Lall
Principal Architect, Ashok B Lall Architects

Ms Janhavi Parab
Deputy General Manager - Sustainability,
Mahindra Lifespace Developers Ltd

Mr Chinmaya Kumar Acharya
Chief of Programmes, Shakti Sustainable Energy Foundation

Abstract

While India undergoes rapid urbanisation, the imperative of providing housing to all becomes more conspicuous. Recent government initiatives, including the Pradhan Mantri Awas Yojana (PMAY), have targeted bridging the projected gap of 19 million affordable housing units in urban areas in India by 2022. Fallouts in terms of high prices of land and building materials render houses unaffordable for the segment at the bottom of the pyramid. It also needs consideration that urban population is growing exponentially which may further aggravate the situation. One of the key reasons for urban migration has been climate change and other impacts of environmentally hazardous practices. Sustainable development is not a negotiable front and needs to be addressed immediately. Unfortunately, more often than not, affordability and sustainability are perceived as at odds with each other. The session in-tended to focus on how affordability and sustainability can be addressed coherently to achieve sustainable and inclusive development through efficient, healthy, green and resilient habitat.

Presentations

Prof Ashok B Lall kicked off his presentation by discussing the predicted urbanisation scenario in India by the year 2031. By 2031, it is projected that there would be 6 cities with a population greater than 10 million. The sustainable development goals, specifically the achievement of goals 10, 11, 12 & 13, he argued, were crucial to manage this situation. He expounded that the purpose of urban development is to produce greater equity along with economic growth that must benefit all citizens. It can be achieved by adopting the DNA of urban morphology in seeding a city's regeneration and expansion plans to make cities affordable, easily accessible, environmentally secure as well as sustainable. He detailed how the development of low carbon, affordable cities can be facilitated by espousal of low rise, high density buildings with the use of rationalised simple construction techniques based on embodied energy of building materials. The trend towards usage of higher embodied energy systems was geared more towards high rise developments than low rise developments.

The presentation was concluded by presenting several strategies to integrate public transit access, pedestrian friendly urban grids, town planning & development controls, and decentralised affordable utility systems.

Ms Janhavi Parab began her presentation by simplifying sustainable urbanisation and the triple bottom line framework. She explained that if we develop our businesses re-sponsibly,

it would then automatically ensure profits. Sustainable urbanisation would be a success if, and only if, it is supported by community development and outreach pro-programmes.

She emphasized that property is an asset in the life of an affordable housing occupant, and added that prosperity, economic parity, quality of life and environmental stewardship are the main pillars of sustainable urbanisation at Mahindra Lifespace Developers Limited. Site selection and planning are the most important aspects when it comes to adopting the integrated design approach for affordable housing projects. Managing the cost of construction is a crucial element while adopting sustainable practices in such projects. Ms Parab said that construction industry is very dependent on innovation in sustainable construction techniques and materials for affordable housing. She noted that it is a key element in controlling the cost of construction for the entire project. Although this is a challenging task from the developer's perspective, it assures affordability for the end-user.

The presentation was concluded by deliberating on the usage of alternate construction materials such as bamboo and the cost of ownership in affordable housing projects.

Mr Chinmaya Kumar Acharya initiated his commentary by explaining how Shakti Sustainable Energy Foundation works with their partners and stakeholders in the clean energy domain and power sector. He agreed with and built on the presentations made by the

previous speakers and deliberated on why we don't see scale in green projects even though "sustainable is affordable" is an established fact.

Simplicity in adoption of a process of resource consumption and attaching a price tag to it makes it more marketable. He pondered on the question "Are we making energy efficiency too complex for public consumption?" This complexity imbued with ambiguities in how energy efficiency is measured and verified make it difficult for public acceptance. However, the saving grace, when it comes to authenticity of the measurement and verification process, is the increase in deployment of smart devices. It enables us to reduce the ambiguities and put a price tag on energy efficiency. It would allow for increasing the scale of adoption of affordable and sustainable solutions in the free market.

Mr Acharya moved on to his next point on affordable solutions for air quality. He likened the current line of solutions to improve air quality to buying health insurance as a precautionary measure. He concluded the presentation by urging the crowd and the organisations they represent to partner with Shakti Sustainable Energy Foundation in developing innovative, affordable and sustainable policies and solutions for improving air quality.

Questions & Comments

A fruitful and interactive discussion was held between the panellists and the audience. Various factors that aid us to limit embodied energy and operational energy of buildings and the necessity to integrate passive design strategies in the planning phase of projects were highlighted. It was deliberated whether developers of green projects should charge an additional premium in the current market scenario wherein there's an excess supply compared to demand. The incremental cost of going green can be brought down to 1%-2% from the market average of 7%. The audience agreed that it can be achieved only through adoption of the integrated design approach early on, in the planning phase of new projects.

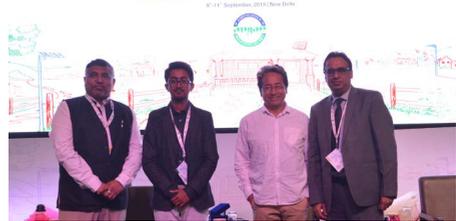
Ms Jessica Grove-Smith asked the panellists what their priorities were in terms of enabling affordable and sustainable development. Prof Ashok B Lall answered the question by saying that his priority was to enable integration of a progressive development theory in designing future smart cities. Mr Acharya said that his priority was in ensuring re-removal of barriers impeding progress in development of affordable and sustainable solutions. The audience clapped their hands loudly upon hearing the answers.

Conclusions

All the panellists agreed that the running theme through the session was one on “how to think differently what sustainability and affordability is about”. There is a larger scope to expand our thinking beyond the horizon when it comes to affordability of sustainable development and, in particular, sustainable urban development. The session concluded with the panellists noting the critical role played by mayors of municipal corporations, and demand-side dynamics that would further the research and development of affordable and sustainable solutions.

Keynote Address by Mr Sonam Wangchuk

10th September 2019 | 1000hrs – 1100hrs



Moderator

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency

Speakers

Mr Sonam Wangchuk
Founder-Director, Students' Educational
and Cultural Movement of Ladakh (SEC-
MOL)

Mr Rohit Ranjan
Research Engineer, Himalayan Institute of
Alternatives, Ladakh (HIAL)

Mr Sonam Wangchuk began by underlining the necessity for behavioural changes and climate adaptability for reducing energy consumption. He emphasized the need to up our standards to be in tune with nature.

Mr Wangchuk stated that despite diversity, all Indians share the spirit of seeking solutions and innovation. He added that if Ladakh can find harmonious solutions to environmental issues, given its harsh ecological conditions, the rest of India, with more favourable conditions can certainly find solutions. Illustrating the stark landscape of Ladakh, often compared to a moonscape, Mr Wangchuk remarked that Ladakhi villages have thrived in this landscape and created several green patches on the barren land. The ancestors with their wisdom and ingenuity have made Ladakh habitable and created a civilization in harmony with nature. They were able to channelize melting glaciers into summer springs which were then used for cultivating crops etc. he added.

Elaborating on the several challenges faced by the communities in Ladakh, Mr. Wangchuk

mentioned how it is not only an ethnic minority but also has a climate drastically different from the rest of the country and hence often disadvantaged. In Ladakh, water in taps freezes in winters and due to lack of provisions, people have come up with their own indigenous solutions to address this issue. Reiterating the importance of contextual solutions, he added that replicating solutions from one part of the country in another can often lead to problems. Mr Wangchuk then went on to explain the inception of SECMOL, which started out as an initiative to teach underprivileged children who were failing in their board exams, due to the inadequacy of the education system. He explained how children are taught alien concepts in school, often due to the uniformity of educational discourse in the country and this leads to difficulties in learning. This prompted like-minded young people to start a movement to make education more contextual and meaningful for children in the mountains. Driven by the motto- “If they don’t learn the way we teach, then let’s teach the way they learn”, they went on to establish a school which emphasizes a more hands-on, practical approach to teaching and children are taught to seek sustainable solutions to live more comfortably in the harsh environment.

He spoke in detail about the school, which has been built with natural and local materials and is powered by the sun. To imbibe core values of sustainability, the school stresses on implementing environment-friendly solutions rather than repetitive text-book learning. Mr. Wangchuk illustrated how the school building has incorporated various passive design

solutions to create comfortable spaces and reduce consumption. The children are taught to channelize their energy into constructive thought. To teach accountability and concepts of governance, the children have their own parliament which is re-elected every two months. By way of such alternative teaching methods, the students learn by experiencing subjects pertaining to their coursework in real life.

Dismissing the idea of mud construction being “kuccha” (temporary), he gave examples of ancient mud buildings which have stood for over 1500 years and added that concrete construction in-fact has a much shorter life span of about 60 years, but due to the commercial viability it has been made popular over the years. Such concepts are a part of the course at SECMOL and equipped with this practical knowledge, the students have gone on to have successful businesses and ventures across the world.

He further added that mud has been marketed as the poor man’s material has hence garnered negative connotations over the years. Entrepreneurs from the school are trying to break this myth and popularizing mud construction, making it aspirational for all socio-economic groups.

Mr Wangchuk then went on to discuss that a majority of the energy consumption in Ladakh is in residences due to the heating requirements and this can easily be met by capturing the sun’s energy for various applications such as space/ water heating, cooking, cultivation,



animal husbandry daylighting and electricity generation for meeting other demands.

Mr Wangchuk spoke about mud building prototypes which were designed for the flood rehabilitation program in 2010 with enhanced thermal comfort; rapid construction technology using modular straw-clay; gravity-fed drainage system etc.

Mr Wangchuk elaborated upon the plans for an alternative university in Ladakh with specially designed courses to understand issues in the local context and deploying various sustainable strategies on the campus. He concluded by showing a short presentation about the several initiatives and array of innovations developed at SECMOL as well as introduced plans for the alternative, self-sufficient university campus for which the government of Ladakh has earmarked 200 acres of land.

Mr Rohit Ranjan spoke about the nuances of the design process behind the alternative university which focussed on spaces having dual functionalities. He explained how using innovative sustainable strategies, the campus will be fully self-sufficient with solar energy, e-vehicles, and enhanced thermal comfort. He enunciated some of the strategies such as solar-heated battery backup rooms, greenhouses, wind barriers, etc.



Thematic Track 7

Emerging Construction Practices & Technologies

10th September, 2019 | 1130 hrs - 1300 hrs



Moderator

Prof Ashok B Lall
Principal Architect, AB Lall Architects

Speakers

Ar Poorva Keskar
Director, VK:e environmental, Pune

Dr Soumen Maity
Team Leader – Technology, Technology, and Action for Rural Advancement

Ar Neeraj Kapoor
Managing Director, Kalpakrit Sustainable Environments Pvt Ltd
Prof Hina Zia

Ar Sanjay Prakash
Principal Architect, SHiFt (Studio for Habitat Futures) Design Studio

Er C K Varma
Chief Engineer, Central Public Works Department (CPWD)

Mr Pramod Adlakha
Managing Director, Adlakha Associates Pvt Ltd & Adlakha Affordable Homes

Abstract

Recent government pushes have highlighted the need to identify, scale-up and define feasible business models for replicable solutions for fast construction at a large scale to meet the rapidly growing demand for infrastructure. Initiatives like Global Housing Technology Challenge and an array of pilots undertaken by Government of India is the first step towards achieving the need of the hour. The need to tackle the environmental impacts of construction is as urgent as catering to the needs of a growing urban population. The construction industry serves almost all other industries, as all economic value creation occurs within buildings or other “constructed assets”. As an industry, it accounts for 6% of global GDP. It is also the largest global consumer of raw materials, and constructed objects account for 25- 40% of the world’s total carbon emissions. The session focussed on the emerging construction practices & technologies and how they can provide a solution to mitigate the environmental impacts of the construction industry and provide feasible, reproducible and fast construction.

Presentations

Prof Ashok B Lall introduced the context of the discussion by elaborating the need for supporting emerging construction technologies to keep the environmental impacts of construction under control. He discussed the traditional methods of construction and indigenous building materials that India used in the past. He further highlighted that the construction practices that we are using today have a huge impact on the environment through GHG emissions, waste generation, consumption of critical resources and rising energy demand. He also highlighted that a 20 storey high rise concrete reinforced building is not the solution for reducing CO₂ footprint. He further highlighted the necessity of innovation in construction technologies.

Ar Poorva Keskar spoke at length about his work in education and architectural practice and elaborated on how synergies in education and practice can do wonders. She highlighted that the design process should include four steps i.e. Reduce, Rethink, Recycle and Regenerate. She acknowledged that an architectural design approach for energy demand reduction is the first step and it is the most affordable one. She further added that an architect does not require to invest financially but needs to approach the project with good intentions when (s)he designs a building.

Ar Keskar also spoke about the integrated approach for building design and planning, which is the key to constructing sustainable buildings. She outlined that an architect should

think about orientation, spatial planning, daylighting, energy-efficient building envelope and the use of appropriate building materials. She believed the use of appropriate energy-efficient materials would pave the way for energy-efficient operation while an embodied energy-oriented approach would focus on reducing our carbon footprint. She emphasised on rethinking the active systems that are in place and whether renewable can be integrated with them. She presented two case studies; the Enpro Headquarter office building at Pimpri, Pune and Parksyde Homes at Nasik.

Dr Soumen Maity introduced the topic by discussing that innovation and research are all about profitable utilisation of creative ideas. He presented his research work on the development of Limestone Calcined Clay Cement. The project was in collaboration with the SWISS Development Corporation in partnership with IIT Delhi, IIT Madras, the University of Santa Clara in Cuba and lead by EPFL in Switzerland.

He discussed that the objective of the project was to address the impact on the environment due to the current scenario of cement production in India and across the globe. He further added that India has produced almost 450 million tonnes of cement every year and considering the growth of building sector cement production will only increase in the coming years. By the year 2050, cement production will double which means an increase in cement production from 8% to 22%. He further elaborated on the emission of CO₂ for producing one tonne of cement and

talked about the two major areas where CO₂ is emitted; the consumption of fuel for energy and from chemical dissociation of calcium carbonate. He explained the opportunities for reduction of CO₂ in both areas. Firstly, he talked about how fuel consumption has been a major area for interventions. However, only 2% of further reduction is possible which will require a lot of effort. He introduced the work done by him and his organization in LC3 cement which aims to reduce the use of calcium carbonate in cement production.

Dr Maity elaborated that in the last decade not only India but across the globe the approach to making He further added that Limestone and clay are found in abundance in India and can be used to produce a new kind of cement; Limestone Calcined Clay Cement (LC3). Dr Maity explained the chemical composition of the cement and highlighted that the use of clinker can be reduced from 70% to 50% in the cement. He also mentioned that most of the material used in the manufacturing of LC3 is waste material and it saves a lot of energy and reduces CO₂ emission. He also discussed the advantages of Limestone Calcined Clay Cement and explained its production scale diversity. He presented a residential project where this technology had been demonstrated and presented CO₂ and resource savings of 48 kg/m² and 164 kg/m² respectively.

Dr Maity concluded by summarizing sustainability indicators and highlighted how it can help the government to fulfil the SDG (Sustainable Development Goals).

Ar Neeraj Kapoor explained how emerging technologies can be implemented in building envelope systems, building lighting system and comfort system. He then briefed about the time when red clay brick was used predominantly by the construction industry and gave the example of Chandigarh city. He further added that with time these red clay bricks were replaced by alternative building blocks such as autoclaved aerated concrete (AAC), which provide environmental impact mitigation opportunities. He then defined the parameters for assessing the technologies that should be considered as emerging; affordability, fast construction, replicability, scalability, etc. He again gave the example of incandescent lamp, which was not initially affordable but was able to reduce its cost due to the uptake of the technology because of its other advantages.

With regards to the building envelope, he introduced a technology in which concrete is filled between two insulated panels. He illustrated its use through site photos and final constructed building. He talked about the coating materials which can be used to coat window glazing to prevent direct sunlight entering the building. He also talked about the venturi effect in jalis that had shown considerable thermal benefits when used in the IIT campus at Gandhinagar. With respect to lighting systems, he talked about the level of automation we have reached today in lighting, where one could control lighting operation remotely through a smartphone.

Ar Kapoor spoke about Energy Recovery Ventilation (ERV) which provides a balanced

air solution for fresh air ventilation. He further discussed the inverter control refrigeration system and its advantages in terms of energy savings and better performance.

Ar Sanjay Prakash presented his work which focussed on avoiding three most energy-intensive materials in construction; cement, steel and clay fired brick. He showcased a few projects where alternative binding materials other than cement was used. Firstly, he discussed the Resort for Taj Safaris, situated in Pashan Garh, Panna National Park. He explained that the wall and roof were constructed in stone and earth. Interlocking masonry with mud mortar was used in walls and broken sandstone bedded with the earth was used for constructing the roof,

The second project that he illustrated was the Shraddha Suman Ashram at Kangra. The ashram had been constructed with locally available materials as per the client's request. The client wanted to revive the traditional craft of area as well as traditional eating habits. The project team found that nailed slate is a viable alternative in Kangra but masons with the required knowledge were few in numbers. The knowledge from this small group of masons needed to be disseminated back into the community of Kangra. Ar Prakash also showed pictures of the building with nailed slated roof.

The Resort for Taj Safaris at Kanah National Park used a material like cloth, wood, and bamboo for constructing the structure. Using a double layer of cloth with insulation in

between, they were able to reduce the cooling load requirement from 15 TR to 3.5 TR. Ar Prakash further elaborated on T-Zed Homes in Bangalore which used interlocking mud blocks for a five-storey building, ICNA Maatighar in Delhi which was built in 1989 with alternative materials, Gnostic Centre in Bijawosan and Indian Pavillion – Expo 2010 Shanghai in China which used bamboo to construct a dome. Ar Prakash concluded by highlighting that there is a lot of scope for using such materials in construction even in mainstream construction.

Er C K Varma gave a brief description of the Central Public Works Department (CPWD) established in 1854. He then described the two primary roles of CPWD. Firstly, as a Principal Technical Adviser to Government of India to support them in framing policies related to the construction sector, develops specification, schedule of rates, manual and guidelines etc. Secondly, as a premier construction agency to Government of India. Mr. Varma then elaborated on few buildings constructed by CPWD in the recent past such as the National Institute of Securities Markets in Navi Mumbai, the Incubation and Data Centre for STPI in Mohali, the National Salt Satyagraha Memorial in Dandi, Dr. Ambedkar National Memorial, Supreme Court Additional Office Complex, the PNB Head Quarter Building, Parliament Annexe Building Extension, Dynamic Facade Lighting - North Block / South Block and Indira Paryavaran Bhavan in Delhi. Mr Varma highlighted how various technologies were deployed by CPWD to enhance the energy efficiency, integration of

renewable energy and water conservation in the above buildings.

Mr Verma highlighted the use of fly ash bricks, AAC block, use of C&D waste material and solid waste management in buildings. He further added that towards the greening of Delhi, as a special drive, CPWD has planted over 60000 trees at various residential colonies and office complexes. In conclusion, he mentioned CPWD's commitment towards constructing sustainable buildings by adopting new greener materials and technologies.

Mr Pramod Adlakha enlightened the audience about his experience with over 50 construction technologies that he had deployed in his projects. He added that he has held a world record for using 10,72,000 precast elements used in a single project. He elaborated on the selection parameters for different technologies and then discussed the issues associated with them. He highlighted how there is a need for transition from manual to mechanisation to increase quality and productivity. He elaborated on the comparative benefits of Indigenous construction technologies as opposed to western ones.

He briefed about some of the technologies he had used in an array of mass housing project such as Rajiv Gandhi Housing, Bawana (3164 Houses), Bawana, Delhi (1184 Houses), Narela, Delhi – (1892 Houses), Bhorgarh, Delhi (1272 Houses), Baprola, Delhi (5568 Houses), Bakarwala, Delhi (240 Houses), Poothkhurd, Delhi (10140 Houses), Kalkaji, Delhi (3024 Houses), Faridabad & Palwal

(ERA Group) (578 Houses), Sushant Golf City, Lucknow (2750 Houses), Ashray, Sulabh Awas yojana, Lucknow (4500 Houses).

He concluded by underscoring the importance of energy efficiency and water conservation measures in buildings of today. He added that the vernacular technologies he had used to build his own house provided a thermally comfortable habitat.

Questions & Comments

A representative from PWC asked Dr Maity about the cost of LC3 compared to OPC and PPC and payback period. In response, Dr Maity told that LC3 cost is 20% cheaper than the conventional cement. He further mentioned that it is cheaper because it uses a lesser amount of fuel and uses waste material provided that clay should be brought within a distance of 200 km.

An audience member asked Ar Sanjay Prakash about the extent to which emerging building materials are feasible in high rise building construction. In response to the question, Ar Prakash said it depends on the load-bearing capacity of these materials. The ones which are incapable of taking the load for a multi-storey can be used as a wall in-fill instead.



Conclusions

Prof Ashok B Lall concluded the session by thanking the speakers for the valuable knowledge they had shared and the audience for their presence. He added that to ensure sustainable development in the construction industry, efforts need to be focussed on the uptake and development of low-carbon building material and technologies.

Thematic Track 8

Policy Framework for Energy Efficiency in Buildings (Rating and Labelling System)

10th September, 2019 | 1130 hrs-1300 hrs



Moderator

Mr Sanjay Seth
CEO, Green Rating for Integrated Habitat Assessment (GRIHA) Council

Speakers

Ms Mili Majumdar
Managing Director, Green Business Certification Inc. (GBCI) India

Ms Tanya Spisbah
Director, Australia India Institute

Ms Camille Sifferlen
Project Manager, Passive House Institute

Mr M Anand
Principal Counsellor, Indian Green Building Council (IGBC)

Dr Ian Hamilton
Consultant, Energy Efficiency Division, International Energy Agency (IEA)

Mr Spondon Bhagwati
Green Building Consultant, International Finance Corporation (IFC)

Mr S Vikash Ranjan
Project Manager, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Abstract

Improving energy efficiency is one of the best ways to simultaneously meet multiple sustainable development goals linked to the energy sector. Consumers are often inclined to buy the cheapest product available in the market. This burdens them with a much higher running cost for years to come, and countries with the need to invest much more in energy supply networks. Neither one customer nor one manufacturer alone can alter this situation. Ratings and labels work best as part of a holistic market transformation strategy. One such strategy is the Minimum Energy Performance Standards (MEPS). MEPS establish standards for energy performance that products must meet or exceed before they can be sold to consumers. It improves the average efficiency of products available in the market and raises the performance of the least efficient products. The session intended to bring together experts to exchange knowledge on the policy framework and discuss necessary interventions for accelerating adoption of energy efficiency in buildings.

Presentations

Ms Mili Majumdar presented the synthesis between the performance of buildings and impact on people in terms of better living standards. She informed that LEED (Leadership in Energy and Environmental Design) measures performance outcomes of five prerequisites—transportation, water, energy, waste and indoor environmental quality. While projects need to achieve a certain performance threshold to meet the prerequisite requisites, they can earn points for going beyond that threshold. Detailed analytics of the project are available on the ARC platform, which helps in setting performance targets. When data related to emissions or natural resource consumption is entered into the platform, it is analysed and a visual score is obtained. The score enables setting up of annual goals and benchmarking against other comparable buildings.

She asserted that according to the research conducted by the WHO (Global) and Center for Disease Control (US), genetics are only responsible for about 10% of the state of our health. The physical and socio-economic environments influence our health to a much larger extent. The built environment, with its characteristics like air quality, water abundance & quality, avoidance of toxicity, health ecosystem services and physical comfort has to bear on our well-being. She explained that nearly 75% of LEED credits have either a direct or indirect, yet proven health impacts. Hence, she concluded that LEED as a rating system not only results in a space that is better from energy and environmental perspective

but also makes a positive impact on human health.

She informed the audience that LEED is now being evolved from buildings to communities and cities. LEED for Cities & Communities is an evidence based and data driven performance rating mechanism that ultimately results in more sustainable, equitable and resilient communities. She announced that the city of Surat has received the distinction of being the first city in Asia to achieve LEED Platinum Certification, with a score of 87 points in total.

Ms Tanya Spisbah contextualized the Australian experience by stating that around 70% of the Australian landmass is arid and unfit for agriculture. Fortunately, the effect of pollution is not very strong and it enjoys a high degree of air quality. More than one million people are employed in the infrastructure sector making it the 2nd largest sector of employment in Australia. This explains the influential lobby group of stakeholders dealing with energy efficiency. The National Construction Code 2019 specifies minimum standards for safety, health and sustainability. It stipulates energy efficiency performance requirements for both residential and commercial buildings.

Ms Spisbah celebrated the work of Prof Veena Sahajwalla, popularly known as the “Queen of Waste”. She mentioned that Prof Sahajwalla was concerned about the waste produced and getting dumped into landfills. She thought of upcycling the fabrics, glass and metals and is also responsible for establishing micro-factories that convert e-waste to usable

material, which is used as inputs for many products. These micro-factories create a small eco system within cities and also create employment away from the cities.

Ms Camille Sifferlen elaborated on the five Passive House principles—continuous insulation, Passive House windows & shading, continuous airtightness, ventilation unit and absence of thermal bridges. She informed that there are more than 65000 Passive House units worldwide, and their further mainstreaming can be accelerated through financial and non-financial incentives. While financial incentives may include better loan rates and subsidies, non-financial incentives could comprise of extra floor area, height or density allowance and fast-tracking of permits for high performance buildings. She stated that the government needs to lead through example by adopting Passive House standard in municipal buildings, educational buildings and social housing projects. Frankfurt in Germany presents a successful case study where schools have been built to Passive House standard since 2003.

She highlighted the knowledge gap between the current building practices and the high-performance standards that need to be bridged. As an example, the British Columbia Energy Step Code (Canada) has set higher goals to instil in people the confidence of achieving targets like implementing net-zero construction by the year 2032. According to Ms Sifferlen, while achieving these targets, some lock-in effect may be observed that needs to be mitigated by following a step by

step retrofit approach. Also, subsidies given for components and innovative training could help accelerate the adoption of Passive House.

Mr M Anand presented the case for Indian Green Building Council (IGBC) Rating System. He explained that IGBC was formed by the Confederation of Indian Industry (CII) in 2001 with the vision to enable “sustainable built environment for all”, and to establish India as one of the global leaders in the sustainable built environment by 2025. IGBC comprises of 25 GREEN Rating Systems that are classified into 7 categories—commercial, residential, built environment, industrial, transit, education, health & well-being. These systems comply with the Energy Conservation Building Code (ECBC) and the Star Rating Programme of the Bureau of Energy Efficiency (BEE).

Then, he discussed the Green Product Certification Framework of IGBC, known as “GreenPro”. This framework assesses how green a product is based on its life cycle. GreenPro complies with international standards and protocols followed for product testing and evaluation. Hence, it is at par with global eco-labelling standards. Mr Anand expressed that since India’s ancient temples and monuments are also energy efficient, it’s nothing new for the general populace to adhere to the same principles. So, with the collective efforts of all relevant organizations and stakeholders, the Green Movement would be a success in India.

Dr Ian Hamilton discussed the findings of the “World Energy Outlook 2017”. The report claims that the buildings sector accounts for 39% of the global energy-related emissions, and 36% of the global energy use. He cautioned that the share of cooling in the energy demand is increasing rapidly. The intensity of the peak demand is led by cooling and that’s very important for the electricity system. In 2016, India was one of the countries with a low share of cooling in peak electricity load. But by 2050, without significant energy efficiency improvements, India could top the list of countries under comparison. However, he was optimistic that with energy efficiency measures and better building design & construction, cooling energy demand in India could be considerably reduced while also allowing millions of people better access to cooling.

Dr Hamilton introduced the “Global Alliance for Buildings and Construction” to the audience, which supports countries in achieving the Paris Agreement goals through interventions in the buildings and construction sector. The alliance has identified 8 strategic priority areas that cover a range of factors that influence energy and emissions in the buildings & construction sector—urban planning, new buildings, building retrofits, building operations, systems, materials, resilience and clean energy. Each of these strategic priorities has a range of targets and timelines across key topics including policy, technology, finance, capacity building and evaluation of multiple benefits. The alliance is working in three major regions including Asia.

Mr Spondon Bhagowati presented the key policies and strategies for developing green buildings standards and certifications systems which have been developed by the International Finance Corporation (IFC). India is home to the second largest population in the world with 1.3 billion people which is equivalent to 18% of the world’s population. Around 450 million people live in urban areas, i.e. more than the entire population of the USA. So, an increase in the growth of population and urbanization inevitably leads to the growth of India’s building sector footprint. In 2017, the total floor area of India was estimated to be about 17-18 billion square meters. By 2040, a total of about 16-17 billion square meters may be added. This means that the total floor area in India is expected to double in roughly about 20-23 years.

With an increase in floor-space, overall energy consumption is also expected to increase. Air conditioning and lighting are the two main energy demands which constitute up to 75% to 90 % of the total energy demand of residential and commercial buildings. Increase in floor-space would also lead to an increase in the demand for building materials. Among building materials, steel in RCC has the highest embodied energy, followed by cement. Among popular walling materials, bricks and monolithic concrete have comparatively higher embodied energy than AAC blocks or fly ash bricks. As buildings grow taller due to constraints of space in urban areas, the quantity of high embodied energy materials used and hence the overall carbon footprint of the buildings is set to increase.

The above scenario implies more greenhouse gas emissions in the future. As a response, to stimulate the growth of green buildings, the government may adopt a wide variety of incentives, including expedited permitting, reduced stamp duty, property tax incentive, height bonus, extra FAR, soft financing, etc.

Mr Bhagowati elaborated on the IFC's Green Building Market Transformation Programme which is divided into 4 categories—investment & advisory for banks, investment & advisory for the building sector, the EDGE certification, and green building codes & incentives. The EDGE standard focuses purely on resource efficiency. The requirement is to achieve a minimum savings of 20% in energy consumption, water consumption and embodied energy. Six building typologies may be evaluated using EDGE—home, hospitality, retail, offices, hospitals and education. Key energy efficiency strategies for the compliance are—optimized Window to Wall Ratio (WWR), external shading devices for glazing, high thermal performance glazing, reflective paints/ tiles for roofs, energy-efficient lighting, lighting controls, and renewable energy.

Mr Bhagowati stated that Architecture 2030 and the IFC have partnered to support the international architecture and building community in designing Zero Net Carbon (ZNC) buildings worldwide. As part of the partnership, the EDGE software has been enhanced to include carbon reporting, as well as take recognition for the procurement of off-site renewable energy and carbon offsets. This improvement will support building projects in

dense urban areas, to target on-site efficiency strategies and eventually integration of renewable energy to reach ZNC, as defined by Architecture 2030.

Mr S Vikash Ranjan discussed the Energy Efficiency Label for Residential Buildings. He stated that out of the total electricity consumption, about 33% is used by residential and commercial buildings in India. According to him, three billion square meters of new residential building space would be added in India by 2030 compared to 2018. Hence, there is a need for a labelling programme to tackle soaring energy consumption in the residential sector. It would also help consumers make an informed decision while buying/ leasing through the provision of direct, reliable and costless information. The objective of the labelling programme is to assist public and building industry in identifying the extent to which a new or existing house has the potential, through design and construction, to be of high efficiency in its use of cooling and heating energy. It would also facilitate the rating of thermally efficient dwelling unit design and construction in a manner that is nationally coordinated and consistent and is regionally sensitive to variations in climate. The energy saving potential through the labelling programme is estimated to be 388 BU by the year 2030, which is greater than the energy consumption in 2016 (250 BU).

He explained that the programme covers all types of residential buildings. Thereafter, he enlightened the audience about two types of labels and the provision of a passport system

under the programme. While the ‘Applied For’ label is applicable for new buildings with a construction permit issued by the authorities having jurisdiction, the ‘Final’ label is applicable for both existing and new buildings. For a new building, the ‘Final’ label can only be awarded after the occupancy certificate is issued by the authorities having jurisdiction. The passport system contains all the parameters of energy consumption and a plaque is provided to the applicant (developer or owner) of the respective residential dwelling upon approval of the ‘Final’ label. The developer or owner is required to submit a request to the Bureau of Energy Efficiency for issuing the plaque. The energy efficiency of a unit is rated on a scale of one to five stars with five stars indicating the best performance.

Conclusions

Mr Sanjay Seth, the moderator for the session, concluded by thanking the speakers and the audience for their presence and participation. He highlighted the need to focus on policy frameworks for assessing energy efficiency in buildings as what gets measured gets managed.

Thematic Track 9

Integration of Renewable Energy in Buildings in India

10th September, 2019 | 1130 hrs – 1300 hrs



Moderator

Mr Joerg Gaebler
Principal Advisor, Deutsche Gesellschaft
für Internationale Zusammenarbeit (GIZ)

Speakers

Mr Anand Shukla
Senior Thematic Advisor, Swiss Agency for
Development and Cooperation (SDC)

Mr Sanjay Dube
President & CEO, International Institute for
Energy Conservation (IIEC)

Mr Daniel Magallon
CEO, Basel Agency for Sustainable Energy
(BASE)

Mr Nabeel Ahmad
Associate Director, Environmental Design
Solutions (EDS)

Mr Sameer Kwatra
Policy Analyst, Climate & Clean Energy
International Program, Natural Resources
Defense Council (NRDC)

Abstract

The objective of the session was to deliberate on identification of potential measures to increase both the share of renewable energy (RE) and the level of energy efficiency (EE) improvement in the buildings sector. According to a joint study conducted by the International Renewable Energy Agency (IRENA) and International Energy Agency (IEA) in 2017, the global energy related carbon dioxide (CO₂) emissions can be reduced by 70% by 2050 with a net positive economic outlook. When approached together, EE and RE can result in higher shares of renewable energy, a faster reduction in energy intensity, and a lower cost for the energy system. The aim was to explore in detail case studies, business models, technological advancements, policy frameworks and financing mechanisms that enable integration of renewable energy systems in buildings to complement the efficient design of high-performance new/ existing buildings.

Presentations

Mr Anand Shukla elaborated on inception of the Project ‘Renewable Energy Integration in Buildings in India’ as a climate change initiative with a focus on the built environment. Building Design, Building Technology, Building Policy and Outreach are the four key focus areas for the SDC in the project. He also briefed on various other projects initiated by the SDC in the urban sector, building materials development and the construction sector as well.

Mr Shukla stated that from the building design perspective, the SDC has been working very closely with developers, architects and other stakeholders to develop good case studies not only at the national level but internationally as well. The SDC has demonstrated that practically it is possible to save 25 to 50 percent energy through energy efficiency measures. And with the combination of renewable energy and energy efficiency, it is possible to save up to 80 percent of the energy that is consumed in the buildings sector. He opined that in India, there’s a dire need for good business models both from the EE point of view and also from the RE point of view.

Mr Sanjay Dube presented on the Project ‘Renewable Energy Integration in Buildings in India’ jointly being undertaken by IIEC, BASE, EDS and Meghraj Capital Advisors Pvt Ltd. He elaborated on the project’s broad objective to design, showcase, implement and monitor building integrated new and innovative renewable energy technologies

in alignment with India’s 2022 target for renewable energy. The project emphasises on involving public and private sector stakeholders to demonstrate technological interventions, and to develop methods, tools and manuals for research, monitoring and performance evaluation of systems. Mr Dube touched upon technological aspect, policy environment and business models necessary for implementation of such a project to drive the market towards implementing RE. He opined that by using relevant innovations, buildings attain the potential to become micro grids, which can, beyond self-sufficiency, generate power for the surrounding areas as well. The role of stakeholders such as technology providers, public and private sector players, developers and end users, along with their distinct motivational factors like competitive differentiation, improved CSR image, lower electricity bills and energy security, was discussed at length. He concluded with a brief on conducive policy environment for such initiatives, technological advancements, and supporting codes and rating systems.

Mr Daniel Magallon discoursed on the three business models developed by the BASE for the project discussed above to scale up actions in different countries. He initiated his discussion with a brief on the evolution of RE technologies, various advancements, their applicability and financial viability in the Indian context, following which he expanded on market drivers, stakeholders and their varied motivations to implement different technologies. He established the need for developing business models to achieve

this intent through incentives for different stakeholders. Mr Magallon presented the 'Energy Savings Insurance Model', which emphasises on long term savings associated with buying an expensive but more energy-efficient appliance or equipment. By stating the example of an air-conditioner, he suggested that over the lifetime, cost of equipment accounts for a meagre 6% of the total cost, with operation and maintenance accounting for the rest. Therefore, a more energy efficient equipment with 10%-15% higher cost generates significant savings by lowering operation and maintenance cost. Under this model, the technology provider of the appliance guarantees a certain amount of savings to the end user, failing which s/he shall be held financially accountable. Following this, he presented the 'Servitisation Model', which focuses on sharing benefits equitably among the technology providers and the end users. The cost of equipment under this model is covered by the technology provider whereas only the cost of service provided is collected from the end user. He concluded his presentation with a model highlighting benefits of a short-term PPA contract for Solar PV.

Mr Nabeel Ahmad presented an overview of the energy consumption pattern within India and also, at the building level by various components such as HVAC, lighting, elevators and equipment. He highlighted the role of building envelope in determining levels of comfort, natural lighting and ventilation, and how it can reduce dependence on mechanical systems and equipment.

Mr Ahmad then elaborated on renewable energy technologies in the context of buildings, segregated by different parameters including their associated end uses. He asserted that integrating photovoltaic elements into the building envelope using building-integrated photovoltaics (BIPV) helps in establishing a symbiotic relationship between architectural design, structure and multi-functional properties of building materials, and also in generation of renewable energy. He concluded with examples of different technologies in the fields of solar PV, solar water heater, small wind turbines, bioenergy and geothermal energy, which can be integrated within the building envelope.

Mr Sameer Kwatra briefed about the initiatives by the NRDC across sectors in India with focus on finance, employment generation, access to modern energy, and RE. He accentuated the role of a systematic approach to achieve optimum performance through design, efficient operation and integration of RE. He opined that communities should aim for zero net emissions at the inception stage of buildings itself by managing resource demand, adding RE storage and integrating eco-mobility. Further, he reiterated that technologies like rooftop PV, BIPV and at/near site systems already exist and should be promoted by increasing accessibility through supporting policy frameworks. He suggested that state and city governments should promote implementation of building energy codes in consultation with concerned stakeholders through collaboration, knowledge exchange and business models. In addition

to this, he recommended that policy makers should work with distribution companies to advance evolution of next generation business models. It could be realised by establishing institutional financing mechanisms such as “Green Windows” within financial institutions to bring requisite focus and capital.

Mr Joerg Gaebler apprised the audience about advancements in the solar sector with a brief on the Plug ‘n’ Play distributed solar with storage for residential applications developed by the solar team at the GIZ. The concept designed as per the Delhi Model Building Bye-Laws amendment for rooftop solar installations focuses on easing installation, and operation and maintenance of solar systems. The concept’s design and structure ensure easy assembly, adaptation to various weather conditions, and additional functionalities to drive residents towards RE systems. He asserted that the resultant scenario, post installation of such a system, is advantageous to both the consumer and the DISCOM with multiple benefits related to reduction in peak demand, alternative backup during power outages and portable installations.

Questions & Comments

Concerns were raised regarding efficiency of the BIPV system being lower than the conventional PV systems, to which it was agreed upon that the BIPV technology is a step towards integration of RE systems within the building design, which includes vertical components with limited exposure to sunlight and therefore, the reduced

efficiency. Participants also enquired about the availability of various technologies presented during the session, and potential vendors and financing mechanisms for adoption of those systems. The participants expressed their views regarding limited progress of many MNRE schemes and emphasised on the need for suitable intervention in potential areas as well.

Conclusions

In their concluding remarks, the panel emphasised on the fact that the policy environment and schemes are conducive. Schemes like net metering and Telangana State ECBC 6 star are good examples of such initiatives. But the major intervention required is in the form of potential business models to drive the market towards RE. It, coupled with awareness, trust building and contribution from the private sector, will help to mobilize the demand side of the renewables economy.

Road map of Sustainable and Holistic Approach for Energy Efficient Built Environment by 2030

10th September, 2019 | 1400 hrs – 1500 hrs



Moderator

Dr Winfreid Damm
Cluster Coordinator, Indo-German Energy Programme (IGEN), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Panel Members

Mr Bhanu Pratap Singh
Member, Uttar Pradesh Real Estate Regulatory Authority (UP RERA)

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency (BEE)

Mr Mahadev Rudrappa Kamble
Chairman, Real Estate Regulatory Authority (RERA) Karnataka

Ms Shyama Agarwal
Founder, JOP Group

Col Prithvi Nath
Patron and Director General, National Real Estate Development Council (NAREDCO) Haryana

Abstract

To meet India's international environmental commitments, it is imperative to reduce the energy demand from the construction and operation of our buildings. This will require an integrated and collaborative effort across the construction industry and different tiers of the government.

The panel discussion intended to be focused on determining the challenges, barriers and opportunities in ensuring energy efficiency compliance in all buildings of India by 2030. The panel looked at the present and the near future needs and suggested way forward to meeting these energy efficiency targets.

Discussions

Mr Bhanu Pratap Singh opined that India expects a floor space addition of 600 to 900 million square metres until 2030 which will result in significant increase in our energy usage. There are legal and political aspects, but creating effective change will depend on community involvement and public acceptability. Each city in India is socially,

politically and economically distinctive. The diversity in topography, climate and geography further makes each city's requirements unique. He commented on how the government and the industry should establish sustainable metropolitan city goals like "Sustainable Delhi" or "Sustainable Mumbai" and work in conjunction with the public to achieve them. The approach to planning our cities needs to cater to macro and micro stages, governmental and non-governmental level and the needs of its citizens.

Mr Singh made an acute observation that in addition to sustainability's 3R strategy of reduce, reuse and recycle, we need a 3E approach of educate, engineer and enforce. This shall enable us to address the lack of consumer awareness, capable manpower and compliance to codes and regulations. The energy efficient building concept has been an integral part of India's history and can be seen to reflect the climatological needs of the inhabitants across the diverse regions of India. He stressed on the issues of awareness and the needs of a carrot and stick approach with proper incentives or policy imperatives to achieve the sustainable 2030 goal.

Mr Saurabh Diddi suggested that ECBC should also be a part of the RERA act which could be a key to mainstreaming ECBC compliant buildings. He also noted that two third of the buildings are yet to be built in India. In the coming 15 years, the people's standard of living is going to increase which will result in an increase in the cooling demand as well. Mr Diddi also highlighted

that the cooling demand in buildings can be halved using efficient system design. Mr Diddi pointed out that if informed decision making regarding energy efficiency of buildings is integrated into projects from their design and conceptualization stage, energy efficient buildings would not require any additional costs as compared to conventional construction. Agreeing with Mr Bhanu's point of view, he emphasized on the availability of indigenous architectural knowledge and materials in India specific to each state. He added that the conference name, "ANGAN" highlights this fact and encourages the industry to learn from India's past. ANGAN represents the central courtyard of a residence which is integral to occupant thermal comfort, energy efficiency and is an important part of resident's everyday.

Mr Mahadev Rudrappa Kamble noted that the green building concept is a recent phenomenon in India which took off in the 1990s. Given its nascent stage, availability of affordable and appropriate technology is limited and government support and regulations will be required in order to increase the adoption of energy efficient buildings. The construction fraternity has to come forward to inculcate the core values of sustainable development in construction and operation of buildings. The concept can only succeed when the design is inexpensive and aesthetically pleasing.

Ms Shyama Agarwal highlighted that the first step of creating a sustainable habitat is the responsible and informed selection of

sustainable building materials and construction technology. The environmental implications of these choices are manifold. The building must be designed such that thermal comfort standards are achieved by using the right materials. The lack of affordable, viable and energy efficient building materials contributes greatly towards the increase in upfront cost which is a major deterrent to enabling energy efficient construction. Mrs Agrawal highlighted how through incentives and awareness programs these challenges can be resolved. Upon being asked by the moderator on the cost difference of an energy efficient building over a conventional one, she pointed out that it would generally be 10 percent or more. Although the upfront costs of upcoming technologies are expensive, scaling these technologies up across India can reduce this increment.

Col Prithvi Nath noted that NAREDCO chapters have been established all over country which includes a spectrum of architects, developers, agents and associates. He also acknowledged by saying that the industry has been tainted by unreliability which has motivated them to pick up the mantle and formulate several essential guidelines. These guidelines overcome the unreliability and counter the short-comings of each state as well. Col Nath also highlighted how a revolution in housing can be brought about by public-private-people partnership.

Real estate touches various aspect of life, ranging from education in schools to health in hospitals. If the public is not able to retain

these facilities the development of the country will be stalled. The whole thing rests on ethical real estate development which is the goal of NAREDCO.

Questions & Comments

An audience question sought to know the influence that artificial intelligence can have sustainable and smart city design. Mr Saurabh Diddi justified that sustainability is an integral part of smart city and AI can enhance data monitoring, control and analysis to estimate and mitigate energy inefficiencies. Dr Winfried Damm added that informed design and consumer awareness are the more important aspects of a smart city. While AI should be considered given their potential to increase energy savings, their integration is not a pre-requisite to a smart city.

The panel also had an in-depth conversation on the approach towards achievement of energy efficiency. While Mr Diddi and Mr Singh agreed that both top-down and bottom-up design are required, Mr Rudrappa pointed that top-down approach was more successful in India. A large section of the society is unaware of the green building concept. Only if the concept is applied as a campaign in the form of best practices, people emulate the model.

The next question posed to the panel focussed on the integration of the life-cycle cost approach to make green buildings a win-win situation for all. Col Nath highlighted that while lack of awareness is a lingering issue, new cities coming up have inhabitants who

demands an energy efficient home. Mr Diddi responded to the comment by noting the star rating for homes which was introduced by the BEE recently and would take into account the life-cycle cost estimation amongst the public. Mr Diddi also responded the questions regarding the need of revamping of architecture and planning curriculum in colleges across India to include the principles of energy efficiency. Mr Diddi took the opportunity to announce that the BEE is coming up with examinations for Energy Auditors for buildings who will be conducting compliance checks. The examination will consist of two papers, one of which will be on the technical aspects and the other on compliance to existing codes and regulations. The BEE is also doing training programmes with CoA and is currently envisaging the addition of energy efficient modules to architecture curriculum. The session ended with an inquiry into the probability of achieving 100 percent energy efficiency in buildings. Mr Saurabh Diddi responded that energy efficiency is relative and there will always be room for improvement.

Conclusions

In conclusion, **Dr Winfreid Damm** added that the way forward to make building in India more energy efficient is through consumer awareness and making energy efficient technologies affordable and accessible to all. The most effective way of addressing these objectives is through policy imperatives, incentives, training and capacity building. Dr Damm thanked the esteemed speakers for their valuable inputs and the audience for their participation.

Thematic Track 10

State-of-the-art Cooling Systems, including District Cooling System

10th September, 2019 | 1500 hrs – 1600 hrs



Moderator

Mr Markus Wypior
Deputy Cluster Coordinator, IGEN/GIZ

Speakers

Prof R S Agarwal
Professor, Indian Institute of Technology (IIT) Delhi

Mr Bali Singh
Associate Director, Namdhari Eco Energies Private Limited

Mr Daniel Magallon
Managing Director, BASE –Basel Agency for Sustainable Energy, Basel, Switzerland

Mr Sanjay Dube
Chief Executive Officer, International Institute for Energy Conservation (IIEC)

Mr Bakulesh Kanakia
Business Development Manager, National Central Cooling Company PJSC

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency

Ms Shikha Bhasin
Program Lead, Council on Energy, Environment and Water (CEEW)

Mr Rajeev Ralhan

Executive Director, Clean Energy, PwC India

Abstract

The session focused on the rising demand for air conditioning and subsequent increase in energy demand. India and other nations in South Asia and Southeast Asia are on track to record the world's biggest increases in demand for air conditioning. Sales of air conditioners in India rose an estimated 17% over the past three years, with sales rising fastest among residential users.

The session also focussed on the District Cooling systems, which typically require about 15% less capacity than conventional distributed cooling systems for the same cooling loads due to load diversity and flexibility in capacity design and installation.

The session highlighted some of the key challenges including high initial investment, lack of technical expertise for design, limited policy level support and absence of favourable

financial and business mechanisms. The session also reviewed current energy code adoptions and their requirements for cooling systems, and discussed design challenges pertaining to different cooling system types.

Presentations

Mr Markus Wypior started his presentation with the key findings of AEEE-IGEF study. He highlighted how despite the rising cooling energy demand of India which is projected to double by 2027, 25 GW of new coal capacity can be avoided by introducing energy efficiency interventions in cooling. He illustrated how 57% of all Indian energy demand for cooling comes from buildings and the energy demand from fans and air coolers is higher than from ACs. The study also brought to light that significant energy and emission savings can be achieved through improvement in servicing practices of cooling devices and refrigerants.

Mr Wypior discussed India Cooling Action Plan (ICAP) highlighting per capita space cooling energy consumption, sector-wise growth in cooling demand, India's total primary energy supply for cooling, space cooling energy consumption by equipment, and broad targets. Later in his presentation, he gave indicative inter-linkages of cooling with various government programmes and initiatives.

Prof R S Agarwal started his presentation by highlighting the current low penetration of per capita energy consumption for cooling in India.

He also highlighted that the cooling demand is expected to grow at fast rate going forward. He pointed out that the aggregate nationwide cooling demand, in tonnes of refrigeration (TR), is projected to grow around 8 times by 2037-38 as compared to the 2017-18 baselines. Furthermore, the building sector cooling demand shows the most significant growth at nearly 11 times as compared to the baseline. Prof Agarwal then talked about the benefits of different cooling technologies available in the Indian market such as the Vapour Compression System.

In the last section of his presentation, Prof Agarwal talked about the District Cooling (DC) systems and the advantages and challenges associated with the technology. On the advantages, he said that DC systems are good for densely populated urban areas, mixed uses of buildings; high-density building clusters with high cooling requirement; tall building complexes; and industrial complexes. Prof Agarwal highlighted the requirement of high capital investment and the need to properly assess utilization factor.

Mr Bali Singh, in his presentation, talked about different types of cooling systems in India and the energy consumption in different types of cooling system. He discussed in detail about the advantages of deploying centralized Chiller system.

Mr Singh highlighted some of the key methods to optimize Chiller plants by monitoring the Chiller efficiencies online and setting alerts on the Chiller performance deviation. Sequencing

ensures that the most efficient combination of chillers, pumps and cooling towers with optimum frequencies are operating and the system is operating near maximum efficiency. During part load conditions, it ensures that plant is operating on best System Part Load Value. Along with Chiller sequencing, an EMS generates alarm for critical conditions. EMS takes accurate decisions on when the air conditioning system shall be on and off by using its algorithms to avoid unnecessary energy consumption. The control algorithm has a self-learning mode to learn the facility's air conditioning load pattern and modify the operations of the equipment.

Later, Mr Singh discussed the advantages of the DC system. In his concluding remark, he mentioned that DC systems are efficient but our country does not seem prepared for DC system. He stressed on the need to transition from unitary system to centralized system and then from centralized system to DC system. He highlighted that the government policies like ECBC should mandate the installation of performance monitoring equipment's in centralized Chiller plants so there actual performance can be maintained.

Mr Daniel Magallon started his presentation with the challenges and opportunities to the cooling industry. He highlighted the fact that there are 1.6 billion air-conditions today and the cooling demand is expected to become three times by 2050 when the market will be valued at 6.9 trillion USD. Mr Magallon indicated that the average efficiency of air conditioners sold today is one third of best

available technology.

Mr Magallon discussed some of the key barriers faced by the stakeholders in the cooling sector which include the requirement of high up front investments for energy efficient cooling systems, competition with other investment opportunities and high-risk perception. He also highlighted how sometimes the developer is not the electricity customer and hence they do not reap any benefits from integrating energy efficiency in the building.

Mr Sanjay Dube began his presentation by introducing the benefits of DC system. He mentioned that the design of systems like district cooling will help in greatly reducing the peak demands and provide new generation capacity to meet cooling demand. Further, measures to replace individual ACs will lead to huge reduction in cooling-related CO₂ emissions. He highlighted that the DC technology offers about 30-40 per cent savings of the air conditioning load.

Mr Dube then discussed about the goals and broad objectives of the India Cooling Action Plan (ICAP). He mentioned that one of key objectives of ICAP is to map the technologies available which can cater to cooling requirement including passive interventions, refrigerant-based technologies and alternative technologies such as not-in-kind technologies. He then emphasised that in order to kick-start the District Cooling Initiative in India, UN Environment has signed an agreement with Energy Efficiency Services Limited to lead and coordinate the DES-related activities as

the National Coordinating Agency till 2020. At present, assessments have been carried out across five cities: Bhopal, Rajkot, Thane, Pune, and Coimbatore, which confirm that cooling large buildings through district cooling networks is more cost-effective and significantly better environmentally. Electricity and CO₂ reductions of at least 35 per cent are forecasted as there are significant water and refrigerant reductions. Concluding his presentation, Mr Dube gave key updates of district cooling in India.

Mr Bakulesh Kanakia began his presentation by explaining how DC system works. He mentioned that the fixed costs are only 20 per cent of the total lifecycle cost of DC system and majority of the costs are incurred during the operations phase. Mr Kanakia illustrated the barriers of developing DC system. He emphasised the fact that for India, water is a scare resource, and it will be difficult to build DC systems in several parts of the country. Going forward, he indicated that it will be important to offer customised cooling solutions for each of the customers coming from different parts of the country.

Mr Saurabh Diddi began his presentation by highlighting the rapid rise in the sale of room air-conditioners (ACs) in India. The sale of ACs in India increased from 2 million in 2010 to 7 million in 2017. The average efficiency also increased from 2.6 energy efficiency ratio (EER) in 2010 to 3.71 EER in 2017, showing an improvement of 40% in energy efficiency. All the credit goes to the manufacturers who achieved the target. With regard to inverter

ACs, it accounted for only 5 per cent market share because of the cost disparity. With the single rating system for fixed speed and inverter ACs adopted by BEE, the sale of inverter ACs picked up rapidly contributing to 55% of all ACs in 2017.

Mr Diddi talked about the alternative technologies for air conditioning. The big question, he indicated, was how to compare different technologies with regard to comfort level. With regard to Chiller plants, he mentioned that overall efficiency of such plants should be less than 0.6 or 0.7 EER. However, he highlighted that this is not happening in India. On DC systems, Mr Diddi mentioned that a lot of emphasis should not be the only area of focus as cooling solutions.

Ms Shikha Bhasin talked about government's role towards the sustainable cooling sector. It is important to take a step back and analyse the development narrative of introducing newer technologies in the cooling sector. She highlighted how it is important to look from the job security and transparency in data perspectives. It is also key to garner support from the consumers keeping in mind affordability and providing choices.

She highlighted that there is an increasing momentum towards efficient cooling in India, which is reflected in the ICAP document. Ms Bhasin also illustrated the global best practices and analysed what are the policies which would achieve maximum benefit.

Mr Rajeev Ralhan talked about India's growing demand for residential and commercial space. He said, India will add 0.7 billion square metre of new commercial buildings and 4.9 billion square metre of new residential buildings by 2030. He then talked about cooling eco-system in India. According to the ICAP for residential sector, it is estimated that approximately 8 per cent of the current households have room air conditioners. This is anticipated to rise to 21 per cent and 40 per cent in 2027-28 and 2037-38, respectively. For the commercial sector, the current (2017-18) commercial cooling demand is around 30 million TR, which is expected to grow around 4.3 times by 2037-38.

He talked about DC system elaborating on the functioning of the same. DC System distributes the thermal energy in the form of chilled water/ hot water or other media from a centralized location to multiple buildings through a network of underground pipes for cooling/heating applications.

Mr Ralhan talked about the growth drivers for DC system in India and recent developments in the field. These included rapid urbanization, rapid growth in cooling demands, rising electricity demand and policy mandates on climate change. He also talked about the benefits, barriers and international experience related to the DC system.

Mr Ralhan spoke about city-level identification of potential spots for DC system implementation in Bhubaneswar. Under this, he talked about the potential areas for the area

based development in Bhubaneswar, based on potential areas where strategic investments will be made to enhance city's image, address major challenges and provide thrust to economic opportunities.

Later, Mr Ralhan presented the way forward which would drive DC system in India, including support from policy ecosystem, formulation of institutional framework, deep dive assessment and training and capacity building. Lastly, he talked about various business models such as Public Private Partnership, Wholly Public Business Model and Fully Private Business Model.

Questions & Comments

A representative from FICCI raised a question to BEE on any decision regarding fixing a set point temperature to 24 degree Celsius. Mr Diddi mentioned that there are several initiatives to achieve reduced electricity consumption through set-point definition. BEE has come up with a call of 'raise it by 1 degree' in this direction. Major airports have also been asked to operate ACs at or above 24 degree celcius. A representative from KPMG raised a question regarding circular economy for space cooling market in India. The answer was provided by Prof Agarwal talked about DC system and the water constraint, especially in areas where water is scarce. There are diversities of technologies and cooling technology should be deployed based on the requirement and constraints of particular geographical area. Discussion related to how to measure comfort level, also took place.



Conclusions

Once all questions had been addressed, Mr Wypior thanked the speakers and audience for their participation and announced the conclusion of the session. He highlighted the importance of moving toward DC Systems and conducting further research in energy efficient cooling technologies. He mentioned how the ICAP can show the way forward.

purpose that a simulation is intended to serve. She emphasised that energy modelling tools need to effectively guide the design process for better buildings by giving example of the first Passive House building, completed in 1991 in Germany, which had been performing extremely well for over a quarter of a century.

She explained that ‘stationary energy balance’ is a proven approach for simplified energy modelling, and is based on the Law of Conservation of Energy. Thereafter, she elaborated on the Passive House Planning Package (PHPP)—an energy balance and design tool, developed by the Passive House Institute, based on the above approach. The tool is specifically designed for highly energy efficient buildings, both residential and non-residential. Its interface is MS-Excel based and caters to both new as well as retrofit projects. She presented data from various case studies, including projects in Greece, Japan, Sri Lanka and the UAE, where this tool had been applied, to showcase the high level of accuracy of the predicted results. These results led her to quip that the PHPP is an ideal design tool for efficient buildings such as Passive Houses and Net Zero Energy Buildings (NZEBS). However, she conceded that since it is not possible to predict all the boundary conditions, 100% precision and accuracy is a false dream. She concluded by stating that it is better to keep the model simple and robust.

Mr SMH Adil started his presentation by showing various tools and techniques used by humans 3000 years ago and told that they were the needs of that time. Further, he said

that today robots are deployed by humanity to perform different tasks. He wondered what had changed from the primitive era to the modern era. Then he explained a block-chain diagram, showing diverse instruments of socio-economic interaction, such as barter, debt, land records, banking, engineering tools, etc., developed during the evolution of human society. Mr Adil stressed that the most fundamental thing for all the analytical tools is the algebraic, ordinary, partial differential equations. He explained how dynamism is related to time. Then, he related these mathematical concepts to occupant-comfort and energy performance of the buildings. He discussed about the parameters required by a simulation tool/ software to create a building energy model. Mr Adil endorsed the utility of energy modelling by presenting three case studies to the audience on low energy housing, net zero energy mix design and tunnel heat sink analysis.

Ms Swati Puchalapalli opined that India has a 1000 plus years of vernacular tradition in high performance sustainable design that integrates daylight, natural ventilation and climatic responsiveness in the buildings. This tradition focuses on achieving comfort with minimal active intervention. Thereafter, she shared a practitioner’s perspective on the role of simulation tools in designing buildings. According to Ms Puchalapalli, design of built environment is a collaborative activity requiring team efforts on various fronts, including architecture, master planning, sustainability, landscape, interiors, and structural, MEP, fire and lighting engineering. Simulation

tools help in synergizing efforts, identifying problems, finding solutions and optimizing the design. For instance, they may be deployed for conducting shading analysis, daylight studies, glare assessment, CFD analysis, and thermal and energy modelling. Through such analyses, they help to combine design with technology effectively, by enabling appropriate selection of insulation, glazing, efficient HVAC systems, etc. She asserted that comfort assessment must accompany simulation studies while aiming high performance in the buildings. Many case studies were illustrated during presentation to corroborate this viewpoint, including simulation studies performed for Aga Khan Academy, Amaravati High Court, MAHE Architecture School and Organo Antaram. She concluded by highlighting that design is an iterative process. The design process uses simulation and optimization as techniques to formulate a problem and generate an optimum solution. Iterative performance optimization requires a responsive approach to design, which anticipates design modification.

Prof Vishal Garg elaborated the fundamental principles that are to be followed while developing any tool for optimizing design of a building. He stated that it was preferable to perform optimization strategies in the early stages of a project, as the ability to impact cost and functional capabilities is the maximum at that time, while the cost of incorporating design changes is the minimum. He elaborated on the technique of ‘clustering’, which is a popular machine learning technique for identifying groups of data points with common features in a set of data points. In several applications, there

is a need to explain the clusters so that the user can understand the underlying commonalities. ‘Explainable clustering’ is a type of clustering wherein the characteristics of each cluster can be easily understood by humans. Prof Garg provided an in-depth comparative analysis of various clustering algorithms, including K-Means, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), EM (Expectation Maximization) and AAHR (Axis-Aligned Hyper-Rectangles). As an example, he discoursed about the ‘eDOT Tool’ developed by his team for early building design optimization. He also presented a case study where the tool was deployed successfully, and explained the results. The tool takes in ‘aspect ratio’, ‘overhang depth’, ‘window to wall ratio’, ‘orientation’ and ‘glass type’ as some of the input parameters, and displays relative impact of these parameters on energy performance of the building under consideration. Prof Garg concluded by affirming that aesthetics need not be compromised to achieve good energy performance.

Questions & Comments

Some of the participants were curious to know how daylighting is factored into the simulation studies as they believed that most of these studies tend to focus more on thermal performance of the buildings under consideration. The panel explained that both thermal comfort and visual comfort were simultaneously important, and there are software tools available for daylight analysis, shading analysis and glare assessment.

Subsequently, one of the participant expressed interest in knowing if the ‘eDOT Tool’ takes into account daylighting as well. Prof Garg told that simulations, at the back end, are performed in Energy Plus. He assured that the effect of daylighting, dimming of artificial lighting for daytime illumination, and glare is factored into the analyses.

Conclusions

Mr Tanmay Tathagat concluded the session by thanking the speakers and the audience. The panel underscored the significance of evolution in the education system, which could develop and train a new generation of ‘architect engineers’ for aesthetics and mathematics of building design to complement each other.

Thematic Track 12

Market Development and Financing Mechanisms for Energy Efficiency

10th September, 2019 | 1500 hrs - 1630 hrs



Moderator

Mr Saurabh Kumar
Managing Director, Energy Efficiency
Services Limited (EESL)

Speakers

Mr Monu Ratra
CEO, India Infoline (IIFL) Home Finance Ltd.

Smt Vineeta Kanwal
Joint Director, Bureau of Energy Efficiency
(BEE), New Delhi

Mr Sivaram Krishnamurthy
Operations, International Finance
Corporation (IFC)

Abstract

The thematic track focused on the existing gaps in the Indian financial infrastructure to promote energy efficiency and the solutions required to tackle the same. Various initiatives to make the current sustainable construction and green buildings market more robust were discussed and learning from their implementation was shared. The session also delved into the roles and responsibilities of the public and private players to synergize this sector to move forward. Various initiatives taken by other partners to augment the ecosystem of green building financing were discussed as well.

Presentations

Mr Monu Ratra, as a representative of a housing finance company gave an overview of the current housing finance situation in India and the future prospects in housing. He highlighted that the Housing for All scheme, a promise made in 2015, would require 1.1 crore homes to be built and at least 85 % of which are to be green and affordable. If these buildings are made energy efficient it

would have a huge impact in building sector pertaining to the sheer scale. The Indian real estate market is estimated to grow to USD 853 billion within 2030 which makes the creation of an infrastructure for financing significantly important.

The green and affordable housing is mired with challenges of a fragmented developer community, rate sensitive market, higher up-front cost, limited access of finance and lack of confidence. These are some of the larger gaps in the market development for housing. A proper viable business venture is needed for going into the green affordable home market because of its cost sensitivity.

There is an information gap between the central, state governments and individual developers. Furthermore the lack of professional capacity is a major challenge as well. The majority of global players prefer to work on re-finance rather than fresh projects under a green bond. Mr Ratra elaborated on the need to calibrate our practical requirements of a green home. There needs to be an effective policy framework and the same must be notified by the government to the public banks who are forward lending. IIFL has started building the market through its own initiatives like “Kutumb” which is a common platform for all sections involved and “green value partner” to provide support at all stages. The end goal of these initiatives is the creation of a credible value chain to engage customer confidence.

Smt Vineeta Kanwal noted that BEE is running several financing schemes like PAT (Perform, Achieve and Trade), EEFP (Energy Efficiency Financing Platform), FEEED (Framework for Energy Efficient Economic Development) and MTEE (Market Transformation for Energy Efficiency). There is a significant potential of INR 1, 60, 000 crore in energy efficiency across various sectors; residential, commercial, municipal-street light, industry and agriculture. She also highlighted the BEE’s risk sharing mechanism scheme PRGFEE (Partial Risk Guarantee Fund for Energy Efficiency) and its features in extending loans for energy efficiency projects. Smt Kanwal also listed the key features under the PRSF (Partial Risk Sharing Facility) underscoring the eligible sectors, eligibility criteria and extent & tenure of coverage. The achievements of PRSF include empanelling 9 financial institutions and guarantee of 18 projects. EEFF has been established to directly finance large EE projects. Similarly, EEFP has conducted workshops, published case studies, guidelines, assessments and success stories. 22 individual training workshops were conducted, more than 680 participants were trained and 72 financial institutions were covered within 2015-19. The BEE has also started a new initiative called “Investment Bazaar”. In addition to this, BEE will also be introducing new financing schemes such as interest subsidies, credit linked capital subsidies and others. BEE is trying to bring all stakeholders across the sector together through its initiatives.

Mr Sivaram Krishnamurthy introduced IFC as the largest development bank focused solely on private sector. With an objective to have inclusive, strong and sustainable growth, it focuses on investment for mitigating and adapting to the impacts of climate change to deliver electricity & infrastructure access, expand renewables, and reduce GHG emissions and more. IFC has worked on the development of the rooftop solar market. It has also developed an approach to carbon pricing along the CVC (Construction Value Chain) examining the design of effective carbon pricing mechanisms. It was determined that carbon pricing of midpoint levels of \$25/ton CO₂e could potentially change behaviour in the CVC to reduce life cycle cost and ensure GHG savings.

There is no standard industrial definition of the CVC with multiple actors existing and a fragmented approach to carbon emission reduction. IFC has also been working on the low carbon pathway for the construction value chain through the PAT scheme, financing for real estate developers and green financing options. Mr Krishnamurthy also gave a snapshot of the progress of the Indian cement industry with achievements in all set targets within 2017. IFC has setup the first eco-label scheme for ready mix concrete in partnership with the industry. Mr Sivaram also summed up some of the challenges in the sector like adaptation vs mitigation, lack of clarity for carbon pricing, influence of the construction value chain, lack of aggregators in private and deterrents to actual and effective price discovery.

Questions & Comments

The audience posed a question regarding the effectiveness of incentivization on spreading awareness. Smt Vineeta agreed that incentivization does help in spreading awareness. States can more actively work on initiatives while the centre has a focus on devising regulations, schemes to support the states. The other prominent question was regarding the success of ESCO in India. Mr Milind emphasized that it had been successful but was limited because of capacity of ESCO to operate as lender. Several successful projects have been conducted across India. The question remains around the recovery of the money which is easier with incentives issued by the government. Enforcement of contracts is an important parameter.

Conclusion

Mr Saurabh Kumar noted that one of the gaps remains to be equity financing which should be further looked into. The session discussed many of the initiatives taken by BEE to integrate all the stakeholders. It further looked at gaps in Indian financial ecosystem, mainly market development and suggested the way ahead. The moderator concluded the session with a vote of thanks to the speakers as well as the audience.



Thematic Track 13

Contemporary System Solutions (Lighting, Air Quality, Heat and Cold Recovery)

11th September, 2019 | 1000 hrs – 1115 hrs



Moderator

Mr S Vikash Ranjan
Project Manager, Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ)

Speakers

Mr Richie Mittal
President, Indian Society of Heating, Re-
frigerating and Air Conditioning Engineers
(ISHRAE)

Dr Yash Shukla
Technical Director, Building Systems and
BEPL, Centre for Advanced Research in
Building Science & Energy, CEPT University

Dr Kaviraj Singh
Managing Director, Earthood Services Pvt
Ltd (ESPL)

Abstract

As a result of increased carbon emissions due to a growing population and the dearth of affordable mainstream technologies to enhance energy efficiency, major cities in India face challenges of poor indoor & outdoor air quality, inefficient lighting and inability to meet thermal comfort standards.

Buildings consume up to 40% of the world's energy and the major share of consumption can be attributed to lighting and HVAC. With rising consumption due to air cooling and heating, it has become essential to provide technological solutions to efficiently achieve thermal comfort standards. Furthermore, the emissions due to generation, supply and use of energy from conventional sources reduces air quality for both indoor and outdoor environment. It is a major concern that has led to a public health crisis in large and dense settlements like the Delhi-NCR. This track aimed at exploring feasible and viable solutions to overcome poor air quality and reduce energy consumption due to HVAC and lighting equipment.

Presentations

Mr Richie Mittal presented the current challenges and barriers in enhancing outdoor air quality of urban cities and indoor air quality in buildings. He highlighted how New Delhi, which was ranked no.1 in the most polluted cities in the world, was able to come down to the 11th position by introducing several monitors and interventions. Recently, Gurgaon was ranked as the most polluted city in the world followed by Ghaziabad, Faridabad, Bhiwadi and Noida.

Mr Mittal elaborated on the major causes for outdoor air pollution, which includes vehicular emissions, industrial emissions, construction and demolition activities, fossil-fuels based power generation, outdoor cooking using woods, bonfires, and road side waste dumping. The disappearance of green areas due to rapid urbanization exacerbates the poor quality of air. The causes for inferior indoor air quality are usually improper or lack of treatment of outdoor air for ventilation, combustion of biomass, fuels & coal, volatile organic compounds & chemical fumes from paints/solvents, biological pollutants like dust mites and pollen, and infectious agents produced in mattresses, carpets and humidifiers. The impact of poor indoor air quality is a leading cause of death in India and the most affected are children and women. 2 million premature deaths occur annually due to pneumonia (44%), COPD (54%) and lung cancer (2%). Other health impacts include acute respiratory tract infection resulting in wheezing or asthma, low birth rate, naso-pharynx & larynx cancer,

leukaemia, cardio vascular disease, TB and blindness.

Given the threat posed to public health, government initiatives in the capital city of Delhi have aimed at alleviating poor air quality through public mandates regarding the use of vehicles such as the odd and even policy, the use of low-emission fuel in public transportation and the introduction of penalties against activities causing pollution such as the unauthorized dumping of waste.

Mr Mittal went on to describe practical, environmentally friendly, simple and low cost technology solutions that can create effective impact on the ground. He highlighted how scientific methods of demolition and construction, increase in the green cover of cities and enhanced public awareness can minimise dust pollution. Consumers should be encouraged to use solar cookers or affordable clean-burning stoves, properly designed chimneys and improved ventilation design. Furthermore, inter-sectoral co-ordination needs to be facilitated to ensure effective action. Mr Mittal also regretted the lack of Pollution Monitoring Stations in some of the most polluted cities such as Durgapur, Gorakhpur, Asansol, Siliguri, Bareilly and Ludhiana.

The speaker discussed various initiatives of the Government of India such as the air pollution study carried out by the National Environmental Engineering Research Institute (NEERI) from 1967 to 1989 and the constitution of the Central Pollution Control

Board (CPCB) in 1974. The CPCB adopted the first Ambient Air Quality Standard (AAQS) in 1982 under the Air (Prevention and Control of Pollution) Act of 1981. The CPCB initiated the National Ambient Air Quality Standards (NAAQS) programme in 1984 with seven stations. It was renamed as the National Air Monitoring Programme (NAMP) with the number of stations increasing to 295 by the year 2001. The revised NAAQ standard was released in 2009.

Mr Mittal further illustrated that 90% of our lives are spent indoors or within a closed environment. Indoor air can be 1000 times more dangerous than outdoor air (WHO, 1999). Improved air quality reduces sick leaves by 39% and costs related to the same by 44%. While discussing the technique of molecular filtration, he explained that molecules are 1,000-10,000 times smaller than particles, and particle filters are not able to remove these molecules. However, adsorption using activated carbon and activated alumina can help address this challenge. That's why it is important to focus on indoor air quality.

Dr Yash Shukla presented the key learnings from the research project “Low Energy Cooling and Ventilation for Indian Residences (LECaVIR)”. The project began in 2017 and would continue till 2020. The project consists of three phases and aims to develop, and make freely available, new designs and control algorithms for low energy cooling and ventilation strategies for use in the natural and mixed-mode residential buildings of India. The first phase focuses on developing

a matrix of designs, and control algorithms. These designs are to be validated in the second phase, using computer modelling and testing. The final phase targets demonstration and dissemination of the devised design tools and control strategies.

The project finds the feasible size of openings (single or multiple openings) required for delivering the desired natural ventilation to buildings in India. Once the openings are fixed, designers can estimate whether the recommended size is suitable for occupancy or not. A state-of-the-art facility consisting of an internal and an external chamber is used to validate the mixed mode strategies in a controlled environment. Dr Shukla hoped that the project would help designers in utilizing natural ventilation in the building design to enhance operational energy efficiency.

Dr Kaviraj Singh introduced “Contemporary System Solutions” as an array of technologies that started to gain public traction with the oil crisis in the early 1970s. With the price of oil shooting up, energy efficiency and renewal were considered to be the key in making sure that future energy demands were met. Dr Singh illustrated how for any space to be habitable, thermal and visual comfort standards of the occupants need to be met through HVAC and lighting, leading to significant energy consumption in buildings.

Dr Singh posited that the amount of lighting required for different types of spaces, for example offices, hospitals, classrooms, residences, is different and that the same goes

for the ideal temperature for each of these spaces. To maintain visual and thermal comfort inside a building, there are several solutions available in the market such as double glazed windows, bricks with better insulation and green cover within the site. He highlighted that improving indoor air quality (IAQ) is the utmost need of the hour as unhealthy air leads to several unimaginable health hazards.

Using energy efficiently helps reduce the amount of carbon emission into the atmosphere. The biggest barrier in implementing energy efficient interventions are challenging the status quo, limitation of available funds and payback period. Stakeholders refuse to acknowledge the need for energy efficient measures in their projects as these measures require a decent capital investment, which is unfortunately not affordable by all. Dr Kaviraj Singh concluded on a hopeful note citing funding agencies and banks, who have recently come forward to fund energy efficient projects.

Questions and Comments

The audience and the panel discussed how there can be lack of understanding among stakeholders across various countries about what it means to save energy. Different ministries and different agencies report data using different units. It was deliberated how quantification and comparison of data across reporting entities could be ensured.

One of the participants raised concern about the quality of materials produced from the C&D waste. The panel replied that quality is

very important and whenever the government produces a product, it is ensured that it passes through the requirements of applicable standards—for example, whether a product comprising C&D waste meets the threshold requirements of compressive strength, water absorption and stability.

An audience member was interested in understanding more about the parameters for energy audit of a building. Dr Kaviraj Singh elaborated on how the audit begins with designing the boundary conditions depending on the nature of the project and the client requirements. He further elaborated on the various energy systems in a building that are evaluated, including equipment for lighting and HVAC. Dr Shukla added that due to the varied nature of energy audits, the parameters need to be identified for each project in a customized manner.

Another member from the audience enquired about the implementation of the ECBC and the lack of available choices for energy efficient central heating system in the market. Mr Mittal responded by citing systems using radiant heating, geo-thermal heating and efficient heat pumps, which are emerging technologies in the heating sector. He added that these technologies should be highlighted and consumers should be made more aware about them.



Conclusions

Mr Vikash Ranjan thanked the speakers for sharing their expertise and the audience for their presence. He added that the Bureau of Energy Efficiency (BEE) of the Government of India and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), under the Indo-German Technical Cooperation, aim to enhance the energy efficiency of HVAC and lighting equipment while providing healthy living spaces for all, across India. He concluded by stating that the use of inefficient HVAC and lighting equipment, and hazardous indoor air quality are pressing issues that need to be addressed urgently.



Thematic Track 14

Embodied Energy and the Life Cycle Approach

11th September, 2019 | 1000 hrs – 1115 hrs



Moderator

Prof P S Chani
Head of Department, Department of
Architecture and Planning, IIT Roorkee

Speakers

Dr Ashok Kumar
Chief Scientist – CBRI

Dr B V Venkatarama Reddy
Professor, Dept of Civil Engineering, Indian
Institute of Science Bangalore

Mr Cesare Saccani
Managing Director, ICMQ Certification India
Pvt Ltd

Dr Sameer Maithel
Head, Indo-Swiss BEEP/Greentech
Knowledge Solutions Pvt Ltd

Mr Shailesh Ranjan
Head – Business Planning & Operations,
Asahi India Glass

Abstract

The construction and operation of buildings require huge amounts of resources and contribute to climate change and resource depletion. Growing demand for urban built spaces has resulted in unprecedented exponential rise in production and consumption of building materials in construction, which require significant energy and contributes to pollution and GHG emissions.

The panellists debated over efforts aimed at reducing energy consumption and pollution through quantification of materials during production in the form of embodied energy. EE of building materials comprises the total energy expenditure involved in the material production including all upstream processes such as raw material extraction and transportation. Further, the life cycle energy analysis approach was discussed in detail, which clearly identifies the optimum strategies for reducing both energy demand and greenhouse gas emissions as a management tool for evaluating environmental concerns.

The session focused on exchange of knowledge and showcasing of approaches for Embodied Energy (EE) and life cycle analysis that will ultimately help practitioners in defining, calculating and assessing embodied energy and greenhouse gas (GHG) emissions.

Presentations

Dr Ashok Kumar presented on 'Life Cycle Energy Assessment of the Building Stock in India: Current Practices & the Way Forward'. He elaborated on the research domains of CSIR-CBRI, state-of-the-art current practices in Life Cycle Energy Analysis (LCEA) and practical examples for computing Embodied Energy (EE) & Life Cycle Energy (LCE). Building Materials & Housing, Renewable Energy, Vernacular Buildings and Heritage Structures, and Smart Cities & Infrastructure are the four key domains of research currently at CSIR-CBRI in alignment with Government of India's on-going initiatives. He defined LCEA as an analysis that accounts for all energy inputs to a building in its life cycle & energy used for manufacturing, operation and demolition. He opined that a building's LCE demand can be reduced by reducing its operational energy (OE) significantly through use of Passive and Active Technologies, even if it leads to a slight increase in embodied energy.

Dr Kumar further presented on mobile applications developed by CSIR-CBRI for calculating the LCE of building, based on their climatic zones, location, construction type and building material among others. These

applications include innovative interfaces which inform the user about a building's life span, energy demand and overall EE as well. He also briefed on the full-scale experimental studies being undertaken at the institute in addition to development of regression equations for estimating the quantity of building materials and research on LCE of prefab materials. Conclusively, he suggested that LCEA should be integrated within BIM for comparing the results under Simapro and other such programs to research, investigate and analyse the impact of future energy scenarios.

Dr B V Venkatarama Reddy discoursed on an overview of 'Energy in Buildings & Sustainability' with focus on evolution of building materials and their subsequent increase in embodied energy through the ages. He explained that the change in embodied energy of building materials increased with anthropogenic dependence on mined resources over the years. He briefed on embodied energy and operational energy which jointly contribute to the life cycle energy of a building over its lifetime and elaborated on the embodied energy of building materials such as cement and bricks which are major contributors to it. He compared the life cycle energy of rural and urban dwellings to indicate that embodied energy of dwellings with natural materials is an order of magnitude lower than those with conventional brick-concrete.

Dr Reddy stated that the current rating systems attempt to address site planning, location & linkages, design, materials & construction, with emphasis on energy conservation & pollution

reduction, but include limited considerations for conservation of dwindling basic material resources and environmental damage due to indiscriminate mining of materials. Possible options for addressing issues on sustainable construction materials recommended by him included judicious use of material resources, use of natural materials or effect changes with minimum energy expenditure – low carbon materials, focus on end of life utilisation, use of biomass based renewable materials and utilization of solid wastes for construction products.

Mr Cesare Sacconi elaborated on the need for Environmental Product Declaration (EPD) of products by companies in India and its co-benefits. He stated that environmental labels and declarations provide information about a product or service in terms of its overall environmental character, a specific environmental aspect or any number of aspects. The overall objective of environmental labels and declarations is to encourage the market of product and service that cause less stress on the environment, through communication of verifiable and accurate information, thereby stimulating the potential for market –driven continuous environmental improvement. He debated that there is a need to develop certification and eco-labelling with emphasis on renewable energy & sustainable resource management addressing product reuse, durability as well as secondary resource usage and to include provisions for preferential procurement of eco-labelled products through green procurement policies.

Mr Sacconi reiterated that need for EPD has been established under various government initiatives, building codes and green building rating systems and therefore should be mandated in a manner similar to nutritional value to address environmental concern associated with various products. He stated that EPD will enable product designers, manufactures and purchasers to improve environmental performance by monitoring and analysing the product data and provide external stakeholders with reliable and verified environmental impacts of a product while improving their environmental awareness. He further discoursed on the types of EPD: Individual Product EPD, Average EPD, Template EPD and Sector EPD as well as Product Category Rules (PCR) which is necessary for standardising of EPD for each sector to ensure fair comparison.

Dr Sameer Maithel presented a case study to explain the life-cycle energy of bricks and supported the need for low energy brick. His case study was based on an affordable housing project “Smart GHAR III (Green Homes at Affordable Rate)” in Rajkot under the Pradhan Mantri Awas Yojana (PMAY), Untenable Slum Redevelopment being executed by the Rajkot Municipal Corporation. In the study Embodied Energy (EE), Residential Envelope Transmission Value (RETV) and operational energy (OE) for cooling and life cycle energy for 50 years of five different bricks were calculated and compared.

Dr Maithel found that there were significant variations among the different categories of brick where the solid clay brick generated the highest embodied energy of 2880 (MJ/m³). Further, while assessing the total embodied energy by taking cement, steel and aggregate into account, it was concluded that 70-90% of the embodied energy is accounted by cement and steel whereas brick contributes approximately 5-17%. On comparing the life cycle energy over 50 years, it was found that energy generation by AAC block (7.3GJ/ m²) was 40% less than the energy generated by solid concrete block (11.7GJ/ m²). From this study, he advocated the need for a focused market transformation initiative to promote low energy bricks (e.g. hollow clay bricks, AAC blocks). He asserted that this transformation would require steps such as labelling/rating/certification, consumer awareness, skilling for application/maintenance and technical and financing support to manufacturers. He also advocated the need for industrial policy for brick and implementation of ECBC & ECBC-R.

Mr Shailesh Ranjan briefed on the advantage of glass as a building material through “Embodied Energy and Life Cycle Approach”. Glass has been considered as a preferred and sustainable building material due to its attributes like low cost, ease of off-site production, single-trade, light weight, fast envelope construction and indefinite recycling. In the presentation, Mr Ranjan, asserted that energy efficiency of glass depends on parameter like climatic condition of the location, the right orientation of the building,

surroundings of the site and active and passive design of building.

Mr Ranjan presented a comparative analysis of embodied energy and carbon emissions for different building materials and found EPD glass to be more energy efficient in combination with appropriate shading devices. Further, the Life cycle assessment model of processed glass was developed to quantify the environmental impact per square meter of processed glass. Through the presentation he concluded that by using low embodied energy material, one can reduce the impact on the environment as they conserve energy and limit GHG emissions.

Questions and comments

A number of participants enquired about reliable sources and research materials on Life Cycle Energy Analysis and Embodied Energy of buildings which could serve as a base for future studies and Environmental Product Declaration exercises. It was established that a number of materials were available on the internet through reliable sources like BMPTC, CBRI, IIT Roorkee and IISc. In addition to this several researches also accommodate the CPWD Rates which serve as the basic unit for estimating EE of different building materials. Some participants were also interested in understanding the relation between embodied energy and heat gain of materials, to which it was clarified that there is no direct relation between both. Concerns were raised regarding the way glass has been used in the Indian context, to which it was agreed upon that



incorrect use, type, orientation, and application without adherence to guidelines were all contributing factors to failure of its application in several contexts.

Conclusions

Prof P S Chani concluded the session with an appreciation for different perspectives of LCEA and EE presented in due course of the session. He reiterated the various key points of the session including the evolution of building materials and associated EE over the years as presented by Dr Reddy, a building material manufacturer's perspective by Mr Ranjan, significant research developments by Dr Ashok and Dr Maithel and the EPD initiative by Mr Saccani and concluded with an intent to bring about such collaboration between different stakeholders in the future as well.



Thematic Track 15

Entrepreneurship & Innovative Business Models

11th September, 2019 | 1000 hrs – 1115 hrs



Moderator

Dr Ashok Kumar
Director – Bureau of Energy Efficiency
(BEE), New Delhi

Speakers

Mr Amarjeet Singh
Co-Founder & CTO, Zenatix, Gurgaon

Mr Kanagaraj Ganesan
Founder and Director, Integrative Design
Solutions Pvt. Ltd., New Delhi

Mr Vedant Vijay Pujari
Managing Partner, Accures Legal, New
Delhi

Mr Gaurav Shorey
Director, PSI Energy, New Delhi

Mr Abhijeet Sinha
Program Director- EODB (Ease of Doing
Business Program) and Country Director
(INDIA & UAE) at Advanced Services for
Social & Administrative Reforms (ASSAR)

Abstract

Sustainable business models distinguish themselves by building on the principle of multiple value creation. The underlying idea is that new business models can affect not just their own operations but render positive ecological and social impacts also outside of the organizational boundaries.

Change in processes, products, production, design is picking up the pace with stress being given to innovative solutions rather than the slow, transformative solutions as the upheaval being caused by climate change, greenhouse emissions, global warming is dynamic and erratic. With the surge in start-ups working on issues from the macro level to micro level, this session showcased exemplary initiatives in the field of sustainability and brings their issues, challenges and the success to the forefront. The aim of this session was to develop practical tools and methods that can support businesses and value chains to concretize and quantify decision-making for business model design, adaptation, evaluation, and up scaling.

Presentations

With the help of digitizing infrastructures, **Mr Amarjeet Singh** elaborated that Zenatix is connecting infrastructure components for efficient building and asset management. It entails ‘asset health’ or monitoring the operations of critical assets and aids in data-driven anomaly detection. It promotes efficient workflows by providing instant information when electrical devices are undergoing degradation and require preventive maintenance. Through the connection of infrastructure operation with a focus on promoting energy savings in buildings, occupant comfort as well as maintaining the appropriate temperature for storage of different types of products becomes a priority.

Zenatix has presence in more than 200 cities with more than 15000 assets across the cities and collects more than 100 million data points. Their Wattman product delivers an enterprise IoT solution which connects the physical assets of customers and provides real time data which supports automated control. Their primary target customers are retail chains, supermarkets, and hotel chains. By connecting infrastructure, centralized visibility and control along with local gateway, intelligence is encouraged for tasks which were earlier managed manually and were hence more time-consuming. Mr Singh concluded by highlighting how these digital solutions can help in reducing the overall complexity of operations and facilitates the customers to engage in proactive interventions and decision-making to improve their energy efficiency.

Mr Kanagaraj Ganesan highlighted that the objective of the Integrated Station for Energy and Environment (ISEE) is to address the need for a platform for evidence-based informed decision-making, and to be a nexus between energy and environment parameters. It is an enabler for collaboration between the central, state and local governments and provides support to both public and private enterprises. The key drivers for the platform are that data acquisition has become more affordable, computation power has increased exponentially, and connectivity has improved over time. Moreover, the platform also addresses targets SDGs, such as SDG 6, 11, 13 and especially those of SDG 17 for partnerships. Mr Ganesan highlighted that for informed decision-making and policy development, it is important to look at the granularity of data – at the micro, meso and macro levels.

Mr Ganesan went on to add that the ISEE platform, with the help of customized dashboards that the users can utilize for monitoring purposes. The three components of the platform are – building energy optimization, geo-visualization, and data-driven policy development. For addressing the environmental impact of buildings, data would be collected on aspects such as the indoor air quality, which will contribute towards a healthy built environment. The geo-visualization component would supplement the planning approaches and provide a comprehensive picture of the impact of interventions at the macro level. The third component will help in monitoring of policy implementation.

However, as most of the data acquisition is approached on a short-term project basis, it now needs to be approached on a long-term programme basis. Mr Ganesan concluded by adding that the holistic database in the ISEE platform would also be made available to practitioners, policymakers, and academicians on a subscription basis for informed decision-making in cities.

Mr Vedant Vijay Pujari mentioned that there is a need make building performance data available on open source platforms to ensure informed decision making. Almost 32% of the population of India lives in urban areas and this percentage is constantly growing, with a density of 455 people per sq.km. Thus, by 2029, India's population will cross the 1.5 billion mark. 70% of the world's built environment is yet to be constructed to cater to the growing population by 2030. Mr Pujari added that professionals in the green building sector need to be actively involved with innovative practices to cater to this demand and ensure sustainable growth.

Cement emits 8% of the carbon emissions in the world and is the second largest consumed commodity after water leading to high carbon emissions. But the number of patent applications filed in the cement industry is not sufficient to reduce cement consumption in the construction industry. With increasing number of 'paper' patents and low implementation on ground, it poses limitations to incorporate innovative practices in buildings sector. Mr Pujari highlighted the difficulties in filing patents in India including

the fact that most of the research remains within academic institutions instead of being submitted externally for patent applications. He highlighted that innovation should not be limited to publications, but should be available for implementation at the grassroots. Moreover, for innovation to have novelty, it should not be present anywhere else in the world. It is a requirement that the innovation should provide higher output and better savings than business as usual practices. Thus, for patentability in India, an innovation should be a valid technical solution, should be non-obvious, and should be industrially applicable.

Mr Gaurav Shorey elaborated that it is important to look at the climate solutions that emerge from the grassroots in India and integrate it with the mainstream policies instead of focusing on a top-down approach. Indigenous construction practices informed by the local culture are available across countries and continents which help communities sustain themselves and be in harmony with nature. It is imperative to consider the local culture and the ideas surrounding climate change which will have implications on the decisions that future generations will make.

It is thus important to engage with the younger population and start sensitizing them to the importance of sustainable development. With the current fuel to air ratio, Delhi needs almost 46000 square kilometres of forest and green cover to offset the carbon emissions, which is 33 times the size of Delhi. With such huge consequences, it is imperative to analyse the demand-size management aspect and not just

focus on technology-intensive solutions. Mr Shorey highlighted on how it is important to promote grassroots initiatives and understand the local context to commit to a green future.

Mr Abhijeet Sinha elucidated that all the technologies and solutions that have been in discussion recently require huge capital. Only with the availability of funding can these processes and mechanisms enable the installation and adoption of new technologies. With respect to finance mechanisms, it is relevant to identify the priority interventions and work alongside government reforms. For the ease of doing business aspect in green buildings, the roadblocks that may be faced are related to compliances and licensing regulations. Thus, single window clearance is an important solution for ensuring ease of doing business with projects that require high capital investment. For example, in the case of acquiring or buying e-vehicles, specific concerns relate to the costs and accessibility to charging stations and registration processes.

Questions & Comments

An audience member enquired if there are any laws or regulations that can enable consumers to hold information and data sellers accountable if they are not providing accurate data. Mr Pujari addressed this question by stating that consumers can approach consumer courts if they come across incorrect information being shared with them. This would allow the consumers to question the credibility of the source and make informed decisions.

The audience further asked the panel how start-ups can enter the energy arena despite the industry challenges that exists. Mr Sinha responded by mentioning that there are no pre-set procurement guidelines for setting up businesses and the process is very context-specific. The acceptability is usually based on existing good practice examples, and a business that demonstrates viability along with effective principles of sustainability is rated higher. Mr Pujari added that in the energy sector, there is a high threshold for funding opportunities due to the nature of the sector, but it is still a possibility after providing just low government fees. Mr Singh also mentioned that as the government is a bureaucratic structure, it is important to have patience and prove the viability of the business.

The final audience question asked the panel if they have faced any ethical challenges in entrepreneurship and how they managed to overcome them. Mr Singh mentioned from his personal experience that a conscious effort needs to be made to not stray from ethical conduct. Mr Ganesan added that is imperative to have a long-term vision and have transparency in activities. Mr Shorey mentioned that is important to inculcate a spirit of collaborative environment and sharing resources to move beyond an individualistic approach of working towards economic growth.



Conclusions

Dr Kumar emphasized that in the current era of rapidly advancing technology it is important to stay updated and be innovative to implement energy efficiency measures in urban areas. It is further significant to utilize collective wisdom and capacities to reduce pollution in cities and to accrue other ecological benefits. Dr Kumar concluded the session by extending thanks to the speakers and audience.



Thematic Track 16

Steps towards Net Zero Energy Buildings

11th September, 2019 | 1130 hrs – 1330 hrs



Moderator

Ms Henriette Faergemann
EU Delegation to India Counselor
(Environment Energy & Climate Change)

Speakers

Dr David Goldstein
Energy Co-Director, Climate & Clean Energy
Program, Natural Resources Defense Council (NRDC)

Ms Isha Anand
Director Projects, Morphogenesis

Dr Peter Graham
International Secretariat, Renewable Energy
and Energy Efficiency Partnership (REEEP)

Prof Prasad Vaidya
Energy Consultant, zenerG

Mr Sriram Kuchimanchi
Founder & CEO, Smarter Dharma

Dr Sunita Purushottam
Sustainability Head, Mahindra Lifespace
Developers Ltd.

Dr Vinod Gupta
Principal, Space design consultants

Ms Rashmi Jawahar Ganesh
Policy Analyst, International Partnership for
Energy Efficiency Cooperation (IPEEC)

Mr Edwin Koekkoek
Counsellor, Energy and Climate Action,
Delegation of the European Union to India

Abstract

The intent of the session was to highlight the steps to achieve net-zero energy buildings (NZE), the issues, challenge and way forward. Achieving India's climate change targets will require deep emission reductions from the building sector. This is a considerable challenge, especially considering India's growing population and projected increase in total building floor area. The session aimed to discuss the possible interventions through which buildings in India can reach net-zero energy status.

Presentations

Dr David Goldstein started his presentation by defining a net zero energy building as highly energy-efficient and a facility which meets more than or equal to 100% of its annual energy from renewable sources. He said that the urgency of climate change has made net-zero energy concepts imperative. This concept is proving to be an attractive way of making efficiency visible and encourage renewable energy use. He emphasized that net zero energy will not immediately result in zero utility bills or in zero carbon emissions but continual improvement can allow zero emissions in the foreseeable future.

He mentioned that there are three complementary elements of net zero energy buildings: energy efficiency optimization, renewable energy generation and storage and grid harmonization. He also suggested that energy modelling for building design evaluation should include load shape predictions so that fixed and adjustable building fixture can be incorporated to manage load shape.

Ms Isha Anand initiated her presentation by saying that the concept of net-zero energy building is a pressing topic and is the need of the hour. She highlighted that the approach towards net-zero energy building should be four tiered; don't build, build the minimum that is required, build with the assumption that the building is self-sustainable in terms of water and energy, build to minimize the demand load of the building. Ms Anand spoke about how a combination of wisdom from our past

and today's cutting edge technology can help create exemplars of sustainable design. She further added that the aspects which impact the financial investment of a building and the type of environmental gain to be achieved in a building are microclimate, building design, efficient systems and renewable energy sources. Out of them, microclimate (orientation, vegetation, morphology, rainwater harvesting etc.) and the building design (thermal mass, insulation, shading design, natural ventilation etc.) are the passive systems and are completely in control of the architect. The remaining two, efficient systems (HVAC, control systems, active façade systems, sensors and actuators etc.) and the renewables (solar, wind, biomass and waste) are active systems and add on solutions.

Dr Peter Graham spoke about the goals, targets and integrated plans for decarbonisation. He explained that the focus should be in four primary areas: integration in planning and design, building performance, markets, and learning & innovation. He emphasized that focus should be on integration of net-zero as a system of energy service provision. Buildings act as the energy service providers in zero emission built environments. He added that the performance of the building is improved by the creation of new compliances and policies. He specifically mentioned that due to poor implementation of building codes on ground, the net-zero effect is not quite visible. Also, markets (public financing and private investments) efficiency is improving but needs further development. Dr Graham mentioned that for learning and innovation, an evidence-based approach is required which

has the following steps: peer group, internal reports, conferences and news & media. Along with these, education and training needs to be strengthened by creating small mobile apps for learning on the job and development of requisite curriculum which will eventually help in identifying net-zero energy practices.

Prof Prasad Vaidya started the presentation by giving three key messages related to net zero energy buildings: need for capacity building for developing NZEB in timely and effective manner, its successful implementation on a smaller scale, and future plans to implement it on a much larger scale.

He emphasized that there is a need to train students enrolled in architecture and engineering colleges to design and develop NZEB. Prof Vaidya elaborated on his learning from various NZEB projects. He said that a holistic building design is one which integrates affordable (cost-effective) energy efficiency with environmental and societal needs (people and comfort) of the inhabitants. Buildings must be designed keeping in mind Co2 reduction, mitigation and adaptation techniques. Net-zero energy in buildings can be enhanced with green jobs Skilling, industry partnerships and technology incubator. With enough media coverage public awareness can be raised about net-zero buildings in order to mainstream them.

Mr Sriram Kuchimanchi described the top challenges in developing net zero energy projects which require high initial investment including lack of setting proper goals, inclusion of sustainability parameters as an afterthought

and low awareness of long term benefits. He emphasized on the inclusion of buyers in the stakeholder engagement process which currently involves only architects, builders and suppliers. Mr Kuchimanchi emphasised on four objectives for developers to keep in mind while designing a building so that it becomes a net zero project. Firstly, the project should aim to ensure zero external water dependency. Water use and discharge from a project must work in harmony as a closed-loop system without any external inputs. Secondly the project should facilitate zero waste to landfill. All waste should be reused and composed with no trash to be discharged in landfills or water bodies. Thirdly, carbon neutral practices should be enabled. All embodied and operational carbon impact should be managed by measuring, mitigating and offsetting carbon emissions. Fourthly, living environments should be integrated with architectural and urban design by returning developed land areas to pre-development environment to increase green cover and lower ambient temperatures.

Dr Sunita Purushottam spoke about the strategies to move towards a low carbon world. She talked about the impact of real estate on the environment. The construction industry contributes to 40% of world's energy demand but in terms of climatic change it is responsible for half the environmental impact of human beings. It also contributes to 23% of air pollution, 40% of drinking water pollution and 50% of landfill wastes. She emphasized that developers should look at every building and development as an opportunity for sustainable development.

While technologies to achieve net-zero energy buildings are available, the adoption rate is low due to its weak implementation on ground. She concluded by listing implementation strategies for net-zero energy buildings including passive sustainable design, energy saving techniques and integration of renewable energy.

Dr Vinod Gupta reminded the attendees about the importance of inclusion of water efficiency in the net-zero energy concepts. While acknowledging that carbon emission is a global issue he added that the emphasis must be on water conservation as the threat posed by shortage of fresh water is going to destroy the environment much faster than global emissions. He further added that water efficiency is one topic which is not understood very well. An average Indian diet requires 1800 litres of water in food production. Therefore embodied water consumption per person for food accounts to around 2000 litres per day, which is 10 times higher than the established values of water consumption. So net-zero projects should include embodied water that people consume in addition to water consumption during building operation. Dr Gupta concluded that the need of the hour is to include the concept of embodied water just like embodied energy in the net zero energy projects so that issue of water can be addressed efficiently.

Ms Rashmi Jawahar Ganesh started the presentation by highlighting that buildings are some of the largest energy users in the world which accounts for over 30 % of global final energy consumption and more than 55% of

global electricity demand. At the same time there is a huge potential to save 3700 TWh through more efficient buildings. She spoke about the Buildings Energy Efficiency Task Group (BEET) whose purpose is to provide a collaborative platform for countries to research, inform and support the development and implementation of effective building energy efficiency policies, with a core focus on building rating system and building codes.

Ms Ganesh emphasized that the net zero energy building definitions are based on three parameters. Firstly, due to its outcome-based nature, it needs to consider the diversity in climate and geography across regions. Secondly, it depends on broad and long term societal benefits. Thirdly, it requires robust policies and effective voluntary codes. She said that policy implementation needs to adopt a phased approach, with combined top-down and bottom-up processes. She further added that issues related to zero energy buildings are beyond building sector and include renewables; grid integration etc. and needs coordination between different ministries while reducing the implementation gap between the central and local governments.

Mr Edwin Koekkoek started the presentation by speaking on the energy policies of the European Union. He highlighted how the focus should be on the integration of energy efficiency and the renewables in the building design to combat climate change.

Mr Koekkoek elaborated on the importance of net zero energy buildings. In European Union

buildings are responsible for 40% of energy consumption and 36% of GHG emissions. 75% of the housing stock is energy inefficient and are lost opportunities to conserve resources and reduce our environmental impact. In order to solve these issues he said that there is a need to accelerate and finance building renovation projects. He went on to add that there is a need to tap the potential of smart building technologies and increase the use of renewables.

Conclusions

In concluding remarks, **Ms Henriette Faergemann** said that the net zero energy building is one of the crucial elements in the energy efficient buildings. She added that while consumers know the importance of net zero energy they are unable to move towards it due to high upfront cost and low technological competence. However, she added that the integration of Net Zero technologies is essential to achieve sustainable development. She thanked the speakers and audience for their presence and participation and concluded the session.



Thematic Track 17

Occupant Comfort: Thermal, Visual, Acoustic, Indoor Air Quality

11th September, 2019 | 1130 hrs - 1300 hrs



Moderator

Mr Pierre Jaboyedoff
Head, Indo-Swiss BEEP/Effin'art, Lausanne, Switzerland

Speakers

Prof Vishal Garg
Professor, International Institute of Information Technology Hyderabad (IIIT) Hyderabad

Prof Rajan Rawal
Executive Director, Centre for Advanced Research in Building Science and Energy, CEPT University, Ahmedabad

Dr Ian Hamilton
Associate Professor, University College London (UCL)

Abstract

The intent of the session was to deliberate on the various factors that influence occupant comfort in indoor spaces with emphasis on effective and efficient cooling as the primary challenge in the subcontinent. As thermal comfort and energy efficiency seldom go hand in hand, the session aimed to discuss interventions that might be incorporated in order to reconcile both these aspects pertaining to the built environment.

Presentations

Mr Pierre Jaboyedoff introduced the topics of thermal, acoustic and visual comfort and spoke about his extensive involvement in the sphere of energy efficiency in India. As one of the warmest and most densely populated regions on the planet, India currently faces the challenge of providing thermally comfortable habitat even before the impacts of climate change is taken into account. Mr Jaboyedoff illustrated this by drawing comparisons between the average summer temperatures in India and the recent heatwave in Europe.

He emphasised that while incidences of “deadly outdoor climate” episodes were on the rise in the subcontinent, so were carbon emissions, creating a vicious cycle.

Mr Jaboyedoff went on to emphasize the importance of traditional passive design strategies such as evaporative cooling in a country where 90% of the population does not have access to air conditioning. He discussed in detail the results achieved in energy efficient ventilation, cooling and noise pollution control using a low cost housing prototype developed by the Municipal Corporation of Rajkot as part of the Building Energy Efficiency Project (BEEP) project.

Prof Vishal Garg spoke at length about his research into the introduction of task control and demand response in the energy usage of buildings by involving users in the loop. He outlined the factors that might result in localized thermal comfort requirements and went on to demonstrate furniture designs that had built in localized climate control systems such as fans or radiant cooling panels. These innovations can effectively allow a space to be maintained at a higher temperature while individuals might make use of these systems for spot cooling.

Professor Garg also described the development of a unified interface that would enable the smart management of supply and demand and ensure effective energy use through a hub that integrates all devices to the grid. Based on demand response, users would be able to effectively manage their power consumption

and the specific energy requirement for each individual could be analysed.

Prof Rajan Rawal illustrated the current credibility gap between how buildings are projected to perform as opposed to how they actually do. He emphasized the importance of building operators in maintaining energy efficiency. He also introduced the adaptive thermal comfort model and explained how a large number of buildings can effectively be managed through natural and mixed mode ventilation. Professor Rawal described his involvement in an ongoing effort to optimize energy and water performance through design competitions and extensive prototyping. The project aimed, eventually, to prevent 75+ gigatons of carbon emission to achieve a significant decrease in rising global temperature.

Dr Ian Hamilton began his presentation with the assertion that energy efficiency must always be a co-benefit of achieving occupant health and comfort. He described at length the factors adversely affecting human health in densely populated urban environments such as particle and heavy metal exposure due to prevalent construction, industrial and agricultural practices. Dr Hamilton elaborated on his experience with a live project in Delhi intended to understand the health and priorities of people living in informal settlements. Although the study initially assumed that ambient temperature is the primary factor that needed to be addressed, a self-assessment revealed that in truth damp, mold, heat, cold and mosquitoes were the most pressing issues,

in that order. Through a participatory research approach, housing refurbishments were designed, developed and monitored resulting in the implementation of cost effective and practical solutions with the potential to positively impact people's health and well-being in the long term.

Questions & Comments

The audience enquired about the efficient functioning of district cooling and spot cooling in tandem with each other. In response, Professor Garg provided a description of how return water of the district cooling mechanism (used for cooling spaces), which was at a higher temperature, might be utilized in spot cooling thereby ensuring the efficient functioning of the chiller. A second question was posed about how spot cooling and individual control might be reconciled with an increasing shift in policy toward utilities controlling the conditioning of spaces. The panel explained that penalties could be used to induce users to stay within the allocated energy budget, failing which the pre-programmed utility would take over. The next question was directed at Professor Rajan Rawal seeking his views on the willingness of users to switch to mixed mode ventilation from completely air conditioned spaces. Professor Rawal cited scientific data that established building occupants as being willing to open their windows when inhabiting a particular space. However, he expressed concern over aspirations which induce modern Indians to gravitate toward air conditioning because of its perceived association with power and affluence. Representative from TERI expressed

interest in learning about the incorporation of mixed mode cooling systems in row housing. Mr Rawal explained that land economics had been instrumental in ensuring that row houses were phased out across the country, even though the possibilities for incorporating mixed mode ventilation in such buildings were significant. Mr Jaboyedoff added that assisted ventilation could be used to enhance the impact in such construction and that further research was necessary.

Conclusions

Discussions held during the session addressed and identified major challenges in providing healthy living spaces in India. The sessions delved into particular projects which have been or are being implemented in diverse contexts. The specific requirements of these particular contexts were illustrated through research and empirical findings. Mr Jaboyedoff concluded the session by thanking the speakers for their valuable inputs and the audience for their presence.



Thematic Track 18

Policy Implementation and Enforcement

11th September 2019 | 1130 hrs - 1300 hrs



Moderator

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency (BEE)

Speakers

Ms Prima Madan
Lead - Energy Efficiency and Cooling, Natural Resources Defense Council (NRDC)

Prof Rajkiran Bilolikar
Associate Professor in Energy Policy, Administrative Staff College of India (ASCI), Hyderabad

Mr Hanumantharayappa
AGM, Karnataka Renewable Energy Development Limited (KREDL)

Mr Ram Kumar
Project Officer, Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA)

Mr Abdullah Nisar Siddiqui
Technical Expert, IGEN-EERB, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Abstract

Robust policies and action plans are impactful mechanisms to inculcate energy efficiency at various levels. Various standards and labelling programmes for equipment, appliances and buildings play a major role in this context. The Energy Conservation Building Code (ECBC) is one such example. Policies correlate climate change issues and their impact on national economy and society with an emphasis on energy efficiency. Community engagement and adequate human & material resources support in bridging the gap between policy formulation and implementation. Additionally, a more dynamic and evolved outlook is required towards policy formulation. The session aimed to deliberate on the policy framework and mechanisms for energy efficiency in the country to effectively address challenges, issues and opportunities.

Presentations

Ms Prima Madan set the context on the relevance of policies and programmes focusing on mainstreaming building energy efficiency measures in India. It was stated that majority of the buildings that would exist in 2030 are yet to be built. This scenario allows for sustainable planning and design of buildings from the start and incorporating energy efficiency measures from the beginning. It was emphasised that in case of the ECBC, there is a wealth of experience across states, which gives us an opportunity to share knowledge for strengthening adoption, implementation and compliance further. She further discussed the current engagements of the NRDC with the ASCI and the BEE in the states of Telangana and Andhra Pradesh. There are about 100 buildings in the states that are ECBC compliant and Hyderabad is one of the first cities to have an online ECBC building compliant system.

Prof Rajkiran Bilolikar thanked the BEE for their constant support, contributing to the successful implementation of the ECBC in Andhra Pradesh and Telangana for the past 8 years. The process of implementation and the role of various stakeholders were highlighted in the presentation. The ECBC 2007 is structured to encourage the states achieve more than the minimum energy efficiency performance standards. The ECBC 2017 aims to mainstream the compliance of minimum energy performance benchmarks across states. It was highlighted that energy efficiency policies such as the ECBC have the potential to reduce total energy use by 22% and total

electricity use by 40% in India by 2050. They are likely to reduce India's CO₂ emissions by 9% and emissions intensity per unit of GDP by 29% from 2005 levels by 2030, compared to the 33%-35% reduction goal set in the NDCs. It allows each state to highlight its contribution to the reduction of the country's overall emissions. The report brought out by the ASCI and the NRDC illustrates the status of the ECBC 2007 and 2017 in various states, which have either notified the ECBC or are in the process of notifying it. There is a need to build a pool of experts for implementation of the ECBC including requisite training of developers in the compliance process; enabling consultants to work in close coordination with the architects; and the institution of third party assessors to ensure that an effective enforcement mechanism is put in place. The compliance mechanism in Telangana is divided into two stages namely, the design stage and the occupancy stage. There is a need to build in close coordination between the municipal administration department and the state energy department to effectively implement the ECBC. The presentation was concluded by suggesting some interventions to strengthen compliance in the states such as massive capacity building to create a pool of experts, and mutual interaction of the ECBC cells in the states to foster knowledge exchange.

Mr Hanumantharayappa highlighted the steps taken by the KREDL to promote and enhance energy efficiency in the state of Karnataka. The state, in this regard, has notified the constitution of the Karnataka State Energy Conservation Fund; mandating the use

of solar water heating systems, LED lights, and BEE 4/5 star rated pump sets; and commenced decisively on the Energy Conservation Building Code amongst others. It was highlighted how these measures have contributed to achieving savings in the annual energy consumption of the state. It was informed that Karnataka leads the country in renewable energy accounting for 48.58% of the total installed capacity in the state. The state has developed the drafts of Karnataka ECBC Code 2018 and Karnataka ECBC Rules 2018, which are in the process of getting notified. The drafts include three levels of compliance to achieve higher energy efficiency standards with new specifications of building envelope for various building types based on the climatic conditions.

The reductions achieved in carbon emissions and the savings in energy were also briefed through case studies of the ECBC compliant buildings. It was informed that five ECBC compliant buildings have been constructed and occupied, and about twenty are under construction in Karnataka. The KREDL has conducted multiple training and capacity building programmes, revised the PWD Schedule of Rates with a separate chapter on energy-efficient materials, and included the ECBC in the state bye-laws. An ECBC cell also operates in the state that is currently running in its third phase to provide technical support to the stakeholders involved. It was concluded by suggesting that there is a need to firstly, fast track the process of creation of standalone State Designated Agency in each state for enhanced implementation of energy conservation measures, and secondly,

constitute a committee for monitoring, reporting and verification.

Mr Ram Kumar briefed on the implementation and enforcement of the ECBC in Uttar Pradesh. A tiered approach is adopted in UP for the ECBC compliance. Tier-1 includes requirements that are easy for market adoption, has huge energy savings potential, and is enforceable through the current building permit process. The Tier-2 and the Tier-3 include additional measures, which require further preparedness to implement and enforce through current practices. It was mentioned that there is also a provision for the Third Party Assessor (TPA) model for the ECBC compliance and enforcement. In this model, the TPA reviews each building project at two stages to determine the ECBC compliance i.e. the design stage and the construction stage. The Completion/Occupation Certificate is issued based on the recommendations provided by the TPA to the concerned Urban Local Body (ULB) and the State Designated Agency (SDA). He emphasised that the UPECBC 2018 has also been incorporated in the building bye-laws of the concerned development authorities. The roles and responsibilities of various agencies involved in implementation and enforcement of the ECBC in UP such as the Housing and Urban Planning Department, the SDA, the Renewable Energy Department/Agency, ULBs, the state PWD, etc. were briefed to the audience. Mr Ram Kumar recommended training & capacity building of ULBs, development of training modules, templates and check-list for TPAs, appointment of an examination agency to develop and administer

TPAs, and state-wise empanelment of TPAs.

Mr Abdullah Nisar Siddiqui provided an overview of how energy efficiency policies had been shaped, since 2001, for both commercial and residential buildings in India. He presented the timeline of events that marked the enactment of the Energy Conservation (EC) Act, the creation of the Bureau of Energy Efficiency, the development of rating systems such as the Indian Green Building Council (IGBC), the Green Rating for Integrated Habitat Assessment (GRIHA) and the Leadership in Energy and Environmental Design-India (LEED-India), and the launch of the ECBC. The revision of the ECBC, the launch of the BEE Energy Star Rating for commercial buildings, and the EC Act amendment, amongst others, were also highlighted in the series of events. The responsibility of the Centre is to develop guidelines to improve energy efficiency in the form of a model code i.e. the ECBC, which needs to be adapted, implemented and enforced by the states. The role of the ECBC Cells and their establishment in various states of India from 2015 were also informed. The approach followed as part of the UNDP-GEF-BEE Project for building demonstration projects in five climatic zones of India, to facilitate designing and construction of the ECBC compliant buildings, was also discussed.

Questions & Comments

The audience sought clarity on practical issues considered for the amendment of the ECBC before the issue of the notification.

Prof Bilolikar explained that the main concern was on the number of trained professionals available to guide the state on the compliance of the ECBC. Due to this reason, the date of the notification was postponed by six months to capacitate the state with a cadre of trained professionals for effective implementation. However, there were no practical issues post the issue of the notification due to presence of a technical committee and support of other departments. Mr Hanumantharayappa added that the availability of building energy-efficient materials, lack of technical knowledge and awareness and coordination between various state departments were a few concerns considered for the ECBC amendment in Karnataka. Some of the participants enquired about reasons for the lack of incentives for innovation in air-conditioning. Ms Madan responded that India Cooling Action Plan emphasises on the demand for space cooling, which would lead to the designing of incentives successively. It was informed that they were also working on the creation of platforms to encourage innovations in cooling technologies, which could be presented to the government to push for incentives.

Conclusions

The session was concluded with the release of a report on 'Towering Possibilities in India: Scaling-up the implementation of the ECBC across states' including a how-to manual that is a useful tool for the successful implementation in the states. Mr Saurabh Diddi thanked the speakers and the audience for their insightful engagement.

Keynote Address by Ar Prem Nath

11th September, 2019 | 1400 hrs – 1500 hrs



Moderator

Mr Saurabh Diddi
Director, Bureau of Energy Efficiency (BEE)

Speaker

Ar Prem Nath, Architect and Interior Designer

Mr Saurabh Diddi introduced Ar Prem Nath by recounting his many achievements and accomplishments along with all the prestigious honours he had received during his extensive engagement in the area of sustainable architecture.

Ar Prem Nath started off by thanking the audience for their presence and gave his own introduction in a poetic style. He stated that his poem reflects the soul of his inner architect and highlighted the importance of introspection for a designer/architect.

Ar Nath elaborated on the theme of the session by stating that he considers the idea of sustainability needs to integrate “smart” principles. He highlighted that India in next 30 years, by 2050, will be having 800 million people moving to urban areas. He emphasised that the impact of such migration would increase the demand in resources and the stress on our cities. However, he also highlighted that there is an opportunity for development which should be made sustainable and environment friendly. He highlighted the scenarios in

Indian cities and existing infrastructure that is being compromised like parks being converted into car parks. He stated that we need clarity on what kind of infrastructure we need as the kind of infrastructure and development that have happened in last decades have aggravated the hazardous impact on our planet. It is undisputable that our buildings have become energy guzzlers. He further explained the adverse effects of such misguided developments by highlighting the impacts of global warming. He stated how the consequence of such global warming would be severely felt in Indian plains as the glaciers in Himalayas would melt and we would be left without any rivers. The only water available to us would be through water accumulated in small ponds and aquifers.

He guided the audience through his presentation indicating the adversaries that would come upon us if sustainable architecture is not implemented and adopted immediately. Ar Nath pointed out that architecture/buildings contribute to about 30% of the total energy demand, remaining 40% and 25-30% coming from transportation and industries respectively. Hence, sustainable architecture is one major step in controlling the damage caused by man-made catastrophes.

He highlighted the importance of tradition and culture by pointing out that how we Indians have been living sustainably and in harmony with nature. The presence of verandas and louvers that promotes cross ventilation, presence of natural light etc. is an example of such indigenous sustainable practices.

*“Ghar Banata hun, gharonde banata hun;
Basti banata hun, unche makan banata hun;
Aur alishan banata hun.
Mandir banata hun, Pathshala banata hun;
Madhushala banata hun.
Muhaddis hun, naksha naweez hun;
Nakshe banata hun, nagar banata hun;
Nagri banata hun, IT banata hun, University
banata hun.
Sapne dekhta hun, sapne sochta hun;
Sapne sajata hun aur sapne dikhata hun.
Adhai akshar ka naam hai mera;
Vastu gyan shouk hai mera.
Mai geeta aur Kamasutra ka adhyan karta
hun.
Karm yogi hun, chalu hun;
Shareef hun, badmash hun;
Ashiq mizaj hun, aur ashigo ke ashiyane
banata hun”*

Ar Nath talked about the works done by Le Corbusier in Chandigarh and how he implemented principles of sustainability. The presence of deep verandas and louvers in his architecture is evidence of the same.

Ar Nath took the example of his own house and compared it to conventional residential construction. He stated a few noble techniques he has incorporated in his house like louvers in attics and verandas for cross ventilation. He stated that while one can afford the installation of air conditioning, the cost of operating it may not be feasible to incur both environmentally and economically. He stated that minimalism as a lifestyle is the new luxury that we should look forward to. He also showed some of the current project taken up by his architectural

team in Lucknow which incorporate the traditional use of jalis and courtyards.

Ar Nath stated the 4 golden rules of sustainable living and buildings: Conserve power, Conserve Water, Regenerate Power, Go Green. He stated that by following these four golden rules, sustainable architecture and living would be achieved efficiently. He elaborated his point through illustrations and images of his projects highlighting the use of green features, spaced glazing with plantation in between them and use of skylights for daylighting. He also elaborated on the use of drip irrigation and water efficient fixtures, rain water harvesting and use of condensate water from HVAC systems for conservation of water. He deliberated on the adverse effects of large glass façades and how such designs are aggravating the rise in emissions along with increasing energy consumption. He emphasised the use of renewable energy technologies and advances made in solar energy industry for the re generation of power in modern day project and there helpful impact in cutting down on GHG emissions. Furthermore, he added that organic architecture and construction elements such as green walls, green roofs and use of FSC woods in buildings are also important.

Ar Nath laid emphasis on the importance of automation and stated that the use of smart homes and automation techniques would help in reducing our energy and water consumption in buildings. Such smart homes, once integrated to one another would give rise to an urban phenomenon of smart cities. Thus the process should adopt a bottom to top approach.

Ar Nath shared many case studies of his projects in Punjab, Gujrat and other parts of India where smart use of the land and topography helped in mitigating environmental impact of development. Buildings were structured in such a way that most of the natural land forms remained intact and no land excavation or filling was required for the project. Moreover the complex was provided with deep projections and verandas for shading in addition to the insulation of building façade and roof for better thermal comfort and energy efficiency.

He concluded his presentation by pointing out that India will be building around 20 Million more homes in coming 30 years and therefore India has the potential to be the leader of sustainable architecture in the world. He expressed his desire to see an India where the thoughts of many great architects and engineers would be amalgamated with the traditional knowledge of sustainable architecture.



Valedictory Session

11th September, 2019 | 1500 hrs – 1600 hrs



Chief Guest

Shri A K Jain
Special Secretary, Ministry of Environment,
Forest and Climate Change (MoEFCC)

Moderator

Shri Abhay Bakre
Director-General, Bureau of Energy Efficiency (BEE)

Speakers

Dr Winfried Damm
Cluster Co-ordinator, Deutsche Gesellschaft
für Internationale Zusammenarbeit (GIZ)

Shri Prabhakar Singh
Director-General, Central Public Works
Department (CPWD)

Panel Discussion

Shri Abhay Bakre initiated the valedictory session by greeting all the esteemed dignitaries, delegates, industry experts and the audience. Shri Bakre explained that the focus of the panel discussion would be on the key takeaways from ANGAN 2019 and how the discussions held during the three day conference could be taken forward through effective action by various tiers of the government, building professionals and researchers. He stated that the network of stakeholders in building energy efficiency including building professionals (architects, engineers etc.) and material vendors/suppliers has increased over the years because of similar avenues created by the GIZ and the BEE.

He welcomed Shri A K Jain and requested him share his insight into the way forward for India and provide a response to the following question:

‘What is your message to different stakeholders, at implementation level, so that consumers are automatically attracted to sustainable and energy efficient buildings? What kind of policy push is required to achieve energy efficiency in buildings?’

Shri A K Jain thanked the esteemed dignitaries and everyone present in the audience. He started the discussion by appreciating the BEE’s efforts in organizing ANGAN 2019 and bringing the subject of energy efficiency in buildings to the spotlight. He also stated that topics like building materials, cooling agenda, energy efficiency, etc. that were a part of the Conference are immediate concerns that are being addressed widely. He stated that the implementation of energy efficiency in buildings has been limited because every stakeholder thinks that their role in the project is limited. This makes it imperative that a network of professionals work in collaboration to efficiently deliver maximum energy savings. According to Shri Jain, green rating for buildings would become mandatory in the near future. He went on to state that new buildings should take care of the environmental impact of development holistically by implementing sustainable strategies like resource efficiency, sustainable materials, renewable energy provision, provision for piped natural gas, LED fixtures etc.

He then responded to Shri Bakre’s question by affirming that building codes should become mandatory for all types of construction. If alternative routes to compliance are provided, people tend to opt for options requiring least

intervention. He expressed that all mandatory rules in India face challenges in adoption. However, experience of other countries also shows that once guidelines are put in force, compliance automatically increases. He also stated that when it comes to awareness of individuals, efforts need to be made to transform consumer behaviour through education in reduced life cycle costs and energy efficiency.

Acknowledging Shri A K Jain’s response, **Shri Abhay Bakre** put forward the next question to Shri Prabhakar Singh.

‘What is the importance of new sustainable materials available for construction of energy efficient buildings and how the suppliers could be motivated to sell these products? Also, how can policies enforce the usage of these materials?’

Shri Prabhakar Singh continued the discussion by thanking everyone. He stated that the CPWD has been a premier organization in construction, maintenance, policy implementation and even as an advisor to the Government of India.

He stated that the takeaway from this Conference is that the stakeholders ranging from politicians, policy makers, government, building planners to the end-users should come together to discuss and collaborate on various issues surrounding energy efficiency in buildings. He also expressed his concern that a structured integration of different processes and stakeholders need to be effectuated to support action on ground.

Shri Singh responded to Shri Bakre's question about the importance of sustainable materials by urging that it is important for government organizations like the CPWD to push unconventional technologies so that they could get market traction eventually. For e.g. LEDs were costly initially, but due to policy push by the BEE, their cost decreased. He underscored that it is imperative to use local materials and to 'think local and act global'. He stated that sensible construction planning is important to achieve sustainability and so is innovative design.

Shri Abhay Bakre posed the next question to Dr Winfried Damm.

'Do you think that saving electricity in a building is attractive enough for the consumers to adopt energy efficient buildings or should incentives be created to attract them?'

Dr Winfried Damm extended the discussion by thanking everyone for attending the Conference. He prophesied that India might be and hopefully would be leading the globe on sustainable housing in the future. It could be credited to rising awareness and institutionalization of best practices. He also explained that sustainable housing might cost a little more upfront but it compensates in the lifecycle costs of a building.

Replying to Shri Bakre's question, Dr Damm opined that a consumer should be aware of the differences between the incentives by either looking at the reduced life cycle and utility

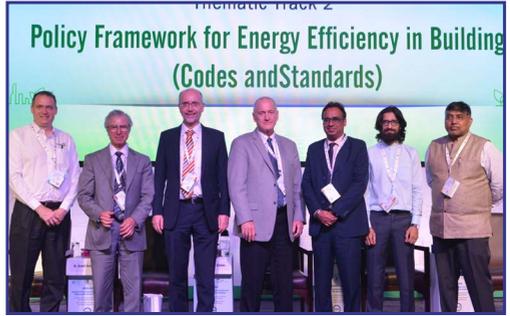
costs of a building or at the thermal comfort and the quality of living provided by green habitat.

Shri Abhay Bakre acknowledged Dr Damm's response and stated that countries like Germany claim that 55% energy consumption is in the building sector. On the contrary, in India, the domestic and commercial building sectors account for 23% and 11% energy consumption respectively, and industries are the biggest consumer. However, it is estimated that the domestic sector will surpass the industrial sector in the coming years. He then framed the next question for Dr Damm.

'How would the estimated increase in demand for electricity guide energy efficient building policy implementation in the country OR would it be 'business as usual'?''

Dr Winfried Damm stated that Germany had started implementing energy efficient building codes in the 1970s. He revealed that at the time, many stakeholders were concerned about the increase in building costs but eventually public perception changed and the reduction in lifecycle costs was acknowledged. Currently, project developers in Germany are efficiently and widely implementing energy efficient building codes because they have understood the benefits. He envisaged that India would also change in the coming future in terms of implementation of the ECBC codes as the cost advantages of energy efficient buildings would come to light.















SPEAKERS

**Abdullah Nisar Siddiqui**

Technical Expert, IGEN-EERB

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Abdullah Nisar Siddiqui is currently associated with Energy Efficiency Buildings Programme at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH as Technical Consultant. The primary objective of the project is to support Bureau of Energy Efficiency (BEE), Ministry of Power to reduce GHG emissions of building sector through the development of Energy Code (ECBC-R) and Star Labelling for Residential Buildings. He has a keen interest in exploring the use of computational techniques and data analysis for developing the building policies. He has garnered a wide range of practical experience in building energy code development and implementation framework from his prior engagements at United Nations Development Programme (UNDP) and Bureau of Energy Efficiency (BEE).

Through the UNDP-GEF-BEE project on “Energy Efficiency in Commercial Buildings”, he had initiated and worked on numerous schemes and initiatives including the Capacity development of building sector professionals through education in building physics and energy simulation, Developing State-specific Roadmaps for implementation of ECBC, Demonstration projects to showcase ECBC compliance, creation of ECBC cell in the states/UTs to assist in the notification and operationalization of ECBC, and Market Assessment of Energy Efficient building materials.

**Shri Abhay Bakre**

Director General, Bureau of Energy Efficiency

Shri Abhay Bakre is a Postgraduate (M. Tech.) in Elect. Engineering from IIT, Kharagpur. He belongs to 1988 Batch of Indian Railways Electrical Engineering Services, Ministry of Railways. He has worked in several Railway projects including Delhi Metro & Kolkata Metro extension projects. He has also worked as Joint Development Commissioner in the Ministry of Micro, Small and Medium Enterprises and was Nodal officer for National Manufacturing Competitiveness Programme. As ED PCRA, Ministry of Petroleum & Natural Gas, he has been instrumental in development and implementation of various programs. aimed at petroleum & energy conservation in industry, transport, domestic sector etc. He has also taken up nationwide mass media campaign through PCRA and other oil companies to generate awareness among consumers on adoption of simple fuel saving measures in day to-day life. Before joining BEE, he has worked as Executive Director in the newly created Environment Directorate of Ministry of Railways. He was the nodal officer for developing INDC for the Railway sector along with a roadmap for Green House Gas reduction in Indian Railways. He also participated at the transport sector events of COP 21 held in Paris and COP 22 held in Morocco.



Abhijeet Sinha

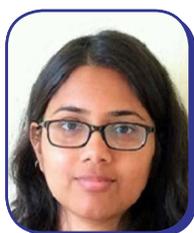
Program Director- EODB (Ease of Doing Business Program) &Country Director (INDIA & UAE)

Advanced Services for Social & Administrative Reforms (ASSAR)

Abhijeet is serving as Program Director- EODB (Ease of Doing Business Program) and Country Director (INDIA & UAE) at Advanced Services for Social & Administrative Reforms (ASSAR). Beginning his career as a corporate banker, he later stepped in the field of governmental business

consulting for grass-root initiatives on green energy and climate with national and global organisations. With his experience in delivering strategic level policy and financial advice for climate and green energy, he further served as Program Director at ASSAR in Sustainable Development Goals (SDG) across India, Pakistan, Nepal, Afghanistan, Bangladesh, Bhutan, Sri Lanka and Maldives. Extending his services to other international organisations, he worked with UNDP India, UNICEF India, Bill and Melinda Gates Foundation, CARIAA, IDRC, CRDI, Red Cross - Red Crescent in varied ASSAR projects.

Abhijeet serves as Corporate Advisor for Centre For Entrepreneurship Development – NIFTEM (Ministry of Food Processing Industry). He worked as Program Director (Execution) with OTAI & FSSAI Conference 2017-18. He is on Board of Studies of AMITY University and also a Corporate Counsel – ENACTUS (DCAC & SRCC) , Youth Advocate – Swachh Bharat Mission & Digital Bharat Mission. He is currently Project Director National Highway for Electric Vehicle 2020 #NHforEV2020 and on Advisory Board of Steel Users Federation of India, Facilitator for ISGF - India Smart Utility Week 2019 and has been consulting various corporate as an external corporate consultant for Government of India's flagship programs.



Alokandana Nath

Technical Expert, Climate Smart Cities

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Alokandana Nath is an architect - urban planner by profession and an alumnus of CEPT University. She has recently graduated from the Technical University of Berlin, Germany in Urban Management. She has been working in the development sector for last 6 years. She has worked with GIZ India and Germany for last 3.5 years. She is currently working as

a Technical Advisor with the SEIP Project. She is part of the team supporting the state industrial development corporations of Gujarat, Uttarakhand, and Delhi, as well as Ministry of Environment Forest and Climate Change, to develop the site master planning guidelines for industrial areas and sustainability standards that would be applicable in such areas.



Dr. Amarjeet Singh
Co-Founder & CTO
Zenatix

Dr Amarjeet Singh is responsible for Zenatix' technology strategy and implementation. He has co-founded Zenatix and is currently on teaching leave from IIIT Delhi, where he is working as Asst. Professor in the Computer Science Department. He has led and managed several ongoing collaborations with field partners in the Energy and Healthcare domains.

His primary research interests include pervasive computing systems that enable collection of large volumes of data and subsequent analyses. Specifically in the energy domain, he has led multiple sensing deployments on IIIT-Delhi campus towards building a sustainable and smart campus.

Dr Amarjeet Singh holds a Ph.D. and an M.S. from University of California, Los Angeles, and a Bachelors of Technology from IIT Delhi.



Anand Iyer
Chief Project Manager
National Institute of Urban Affairs (NIUA)

Anand Iyer has a Masters in Architecture & Critical Theory, University of Nottingham, U.K. and G.D. Architecture, School of Architecture, CEPT (now University), Ahmedabad, India. In addition to professional work with design firms, over the last 20 years, he has worked with Government agencies, at State and Central level on Policy issues; the Private Sector, on

Strategy & Planning in Infrastructure; and as Academic Coordinator & Associate Professor at different Universities in India.

Anand is presently Chief Project Manager, at the National Institute of Urban Affairs, New Delhi (an autonomous research & policy think-tank of the Ministry of Housing & Urban Affairs, Govt. of India), handling Program Management and aspects of Organization growth & structuring.

NIUA works only in the Urban sector in India, and the work profile lends him to work with various partner organizations at global, national and local levels; which he develops and sustains through relevant engagements and projects as per their strengths. His research interests lie in the Social, Political & Ideological perspectives in Sustainable Urban Development; which he investigates through policy, legislation and implementation aspects.



M. Anand
Principal Counsellor
Indian Green Building Council (IGBC)

M. Anand is a Green Building Professional, at the Indian Green Building Council (IGBC), Hyderabad, India. He is a Principal Counsellor and a team member of CII's Indian Green Building Council (IGBC) since its inception in 2001. He has work experience spanning over 28 years. He is with CII since, 1996. He is an Indian Green Building Council Accredited

Green Building Professional. He has been involved in helping Architects, Builders and Corporate

in designing green buildings since 2001. Thus far, he has helped more than 500 clients in incorporating green designs in building design & construction. Also involved in the development of India's first green rating for residential projects – IGBC GREEN Homes in 2008. He is also involved in developing India's first Green rating for Affordable Housing projects – IGBC Green Affordable Housing rating in 2017. He has also trained professionals in green building concepts and has thus far conducted more than 250 Training Programmes on green buildings all over the country and in Singapore & Dubai.



Dr. Anand Shukla

Senior Thematic Advisor- Swiss Agency for Development & Cooperation (SDC)
Government of India's Building Energy Efficiency Program

Dr Anand Shukla is working as Senior Thematic Advisor at the Swiss Agency for Development and Cooperation (SDC), Embassy of Switzerland, New Delhi. Having 24 years of professional experience, currently he manages the portfolio of energy projects and is responsible for the conceptualization, management, and monitoring of the collaborative projects.



Dr. Anir Upadhyay

Architect and Urban Planner, Faculty of the Built Environment
UNSW, Sydney

Dr Anir Upadhyay is trained as an architect and an urban planner. He is a Lecturer in Sustainable Built Environment program at UNSW Built Environment and affiliated with High Performance Architecture and Smart Cities Research Clusters. He is trained as an Architect and Urban Planner. He holds a PhD degree in Sustainable Design from the Faculty of Architecture, Design and Planning at the University of Sydney. Anir's research mainly interrogates real-world problems related to sustainability and energy efficiency in the built environment. His research explores fundamental issues of sustainable built environment at design and post-occupancy stages by using simple design tools and analysing big data sets. Anir was involved in a number of research projects funded by the Cooperative Centre for Low Carbon Living (CRCLCL) and worked closely with NSW Government and other industry partners.

Anir has developed a climate data analysis tool which analyses and presents climate data in graphical format to develop location specific climate design strategies. Recently, Anir has developed a visualisation tool which allows households to track their indoor environmental conditions, energy and water consumption in real-time.

Anir has published widely in the area of sustainable building design and has presented in a number of conferences nationally and internationally.

**Ashish K. Jain**

Partner

AEON Integrated Building Design Consultants

Ashish K. Jain leads the Sustainability & Green Building business at AEON. He has 16 years of comprehensive work experience in the field of Green Buildings, Sustainability, BIM, Interior Design and Architecture for projects across different countries including India, USA, Europe & Middle East. He has been leading Sustainability Groups in India and the Middle

East.

As a Thought Leader in Sustainability, Ashish has presented several papers at the various International & Domestic Forums and conducted various lectures on Sustainability at premier institutes of India.

Ashish has strong professional experience within the field of sustainable building design. He has worked on issues such as passive design strategies and energy-efficient design of various building types. His core expertise is in advising Architects, Engineers and other professionals of the building industry in sustainability and positively influencing their designs in order to reduce energy consumption and the negative impacts on the environment.

**Dr. Ashok Kumar**

Director

Bureau of Energy Efficiency

Dr. Ashok Kumar is presently working as a Director at Bureau of Energy Efficiency (BEE), Ministry of Power, and Government of India. He is primarily involved in the implementation of National Mission on Enhanced Energy Efficiency (NMEEE), a component of National Action Plan for Climate Change (NAPCC) of India in addition to other responsibilities. He

also heads the R&D related activities of BEE for accelerated market transformation for energy efficient appliances. He is also the lead for climate change activities at BEE and has participated in COP meetings of UNFCCC, BRICS and other international forums.

Prior to joining Bureau of Energy Efficiency, he was working in design and development of high field superconducting magnets and local environmental control devices as a Scientist at National Physical Laboratory (NPL), New Delhi, India. He has also worked with Energy Coordinating Agency (ECA), Philadelphia, USA, an organization that helps conserve energy and promote sustainable and socially equitable energy future in the Philadelphia region.

Dr Ashok Kumar holds a PhD degree from Center for Energy and Environmental Policy, University of Delaware, USA, in Energy and Environmental Policy with specialization in Energy Economics, Energy and Sustainability, and Sustainable Development. He carries degrees in Masters of Technology in Energy Studies and Bachelor of Technology in Mechanical Engineering both from Indian Institute of Technology (IIT) Delhi.



Dr. Ashok Kumar
Chief Scientist
Central Building Research Institute (CBRI)

Dr. Ashok Kumar, currently employed as Chief Scientist (Scientist ‘G’) w.e.f. July 2015, is Head of the Architecture & Planning, and Efficiency of Building Groups, at CSIR - Central Building Research Institute Roorkee (CBRI), Roorkee, India. He joined CSIR-CBRI as Scientist ‘B’ (Lecturer Grade) during July 1990 before working for one year as an Architect at

NBM Associates, New Delhi.

Dr Kumar is the recipient of Gold Medal in Architecture from JNTU, Hyderabad, and later on, received the MURP (Hons.) during 1998, and Ph.D. Degree 2015-16 from IIT Roorkee, while working at CSIR-CBRI.

Dr Kumar has over 29 years of research, development, & consulting experience, including about 12 years of teaching experience as a visiting faculty at IIT Roorkee during 1998 and 2010.

He has authored/co-authored over 110 research publications in International and National journals, conferences, reports, and book chapters, etc.

Dr Kumar is a Principal or Alternative member as an Expert in more than a dozen committees of BIS, National Building Code 2016, Energy Conservation Building Code (ECBC 2017 & 2018).

He is a Member of the reputed Panel of Experts from India to the International Energy Agency, France as to review a “Special Report on the Energy Efficiency Outlook for India – Sizing up the Opportunity”, for the years 2016 -17 & 2017-18.



Prof. Ashok B Lall
Principal Architect
Ashok B Lall Architects

Prof. Ashok B Lall, born in 1948, graduated from the University of Cambridge U.K. in Architecture & Fine Arts and obtained the Architectural Association Diploma in 1970. His architectural firm (estd. 1981) is committed to an architectural practice based on the principles of environmental sustainability and social responsibility. The firm has won a number of awards and its work

has been published widely. Engaged in architectural education since 1990, he has developed curricula and teaching methods to address environmental issues. He has published many articles and presented papers on environmentally sustainable design and has been an active member of institutions and groups promoting awareness and building competence in sustainable design of buildings. He has been invited to present his work on sustainable design for a developing world at various fora in India and internationally, including UK, Australia, Switzerland, Egypt, Indonesia, Sri Lanka, Nepal, Uganda, Iran, Philippines and Mexico. He was chair of the Jury for the Holcim Awards for Sustainable Construction, Asia Pacific Region. He is presently Design & Technology Chair at Kamla Raheja Vidyandhi Institute for Architecture (KRVA), Mumbai. His current interest is in developing strategies for sustainable urban development in the context of

rapid urbanization.

He is a Member of the reputed Panel of Experts from India to the International Energy Agency, France as to review a “Special Report on the Energy Efficiency Outlook for India – Sizing up the Opportunity”, for the years 2016 -17 & 2017-18.



B.V. Venkatarama Reddy

Professor, Dept of Civil Engineering
Indian Institute of Science Bangalore

Currently working as Professor at the Department of Civil Engineering and Chairman, Centre for Sustainable Technologies, Indian Institute of Science. Prof. Reddy’s research interests include structural masonry, mechanics of materials, energy in buildings, green buildings, low carbon construction materials, flowable earth mix concrete, geopolymers and recycling solid wastes into construction materials. The translational R&D, innovations/technology development and out-reach activities touch upon machines for compacted earth blocks (CEB), optimum soil grading curves for CEB, test methods for the durability of CEB, cement-soil mortars, steam cured fly ash bricks, rammed earth structures, alternative roofing systems, etc. The translational R&D is of direct relevance to the industry and practiced by many building professionals resulting in >3 million tons of carbon savings. Apart from publishing >100 papers, jointly authored a book on alternative building materials and technologies, edited a couple of books on masonry. He has served as a consultant for several innovative projects on alternative building technologies and as a member of several technical committees in the Bureau of Indian Standards and other government agencies. He was DAAD Visiting professor at Bauhaus University Germany and Visiting Professor at University of Bath UK.



Bakulesh Kanakia

Business Development Manager
National Central Cooling Company PJSC

Bakulesh Kanakia is serving as the Business Development Manager at Tabreed in Abu Dhabi. He has experience of over 16 years. Prior to this he was a financial analyst in Schlumberger.



Bali Singh

Associate Director
Namdhari Eco Energies Private Limited

Bali Singh heads the Energy Efficiency Cell and conducts Energy Audits, Energy Saving Implementation Projects in different sectors like Pulp & paper, Steel, Sugar, Captive Power Plant, Textile, Building etc.

He is a Certified Energy Manager from Association of energy Engineers, USA & Accredited Energy Auditor from Bureau of Energy Efficiency. He is the ex-Energy

Manager from Reliance Industries Ltd. He coordinates the International Technical tie ups in the field of Energy Efficiency. He is having more than nine years of experience in Energy Efficiency. He has headed more than 100 detailed Energy Audits in different sectors. He has delivered many Training and Seminars on Energy Efficiency.



Bhanu Pratap Singh

Member

Uttar Pradesh Real Estate Regulatory Authority(UPRERA)

Immediately after doing his masters in Political Science, Mr Singh, was appointed as lecturer. Meanwhile he was selected in PCS and worked as a SDM in Gonda district. He has an ample exposure of developmental revenue related and judicial work and after selection in the IPS he has worked in Agra, Allahabad, Mathura, Meerut, Bulandshahr, Kanpur etc. He

has worked in security branch, fire service, PAC and various other related sectors.



Camille Sifferlen

Project Manager

Passive House Institute

Camille Sifferlen is a graduate architect from France with experience in sustainable building in Spain, China, Australia and Germany. She is a particular advocate of the Passive House Standard because it can be implemented flexibly in different climate regions and building types. Since 2015 she has been working at the Passive House Institute in the area of

training, as well as building certification and consulting, especially for construction projects in emerging countries with warm climates. In addition to developing the e-learning platform, she holds lectures on energy efficiency and workshops on the Passive House planning tools PHPP and design. Camille Sifferlen regularly represents the Passive House Institute at national Passive House conferences and UN Climate conferences.



Cesare Saccani

Managing Director

ICMQ Certification India Pvt Ltd

ICMQ India Managing Director, President of the Indo Italian Chamber of Commerce and Director of EPD India Program Operator. Graduated in Political and Economic Sciences, 23 years of managerial experience in different industries and entrepreneur.

Member of the Italian Association of Independent Directors (NED Community) and founder of Fondazione Etica, he is EFQM (European Foundation for Quality Management) Assessor and Trainer. He is a recognized expert in process and risk management. He has deep knowledge and audit experience in management systems (ISO 9001, ISO 14001, OHSAS 18001, EN 26000, SA 8000), products, people (according to ISO 17024) Actively committed in the field of Sustainability and SR, he is coordinating EPD India Program Operator and eco product certification schemes for

building materials referring to ISO 14020 series of standards (Get It Green).

He is has been leading Get It Fair, Due Diligence scheme to support Responsible Sourcing referring to OECD Due Diligence Guidance for responsible supply chain, OECD Guidance for Responsible Business Conduct and ISO 26000. Frequently invited as Lecturer and Key Note speaker in international conferences, he is experienced in supporting Government and Authorities in setting rules and framework in the field of quality and sustainability.



Chinmaya Kumar Acharya

Chief of Programmes

Shakti Sustainable Energy Foundation

Chinmaya Kumar Acharya is the Interim CEO at the Shakti Sustainable Energy Foundation (Shakti). In this role, he leads the organization's efforts to support the design and implementation of large scale clean energy and environment solutions. He has over 16 years of experience in sustainable energy and climate change mitigation areas with responsibilities for strategy planning and execution, policy development, and program management. He works with his team to identify priority intervention areas, design and manage meaningful activities, and forge partnerships with sponsor agencies and implementing partners for smooth implementation. He has work experience with consulting firms, international donors and development agencies at international, national and sub national levels.



C K Varma

Chief Engineer

Central Public Works Department

Mr Varma has 31 years of experience in CPWD in different capacities from Assistant Executive Engineer to Chief Engineer, encompassing planning, estimation, designing, project management, contract management, financial management, maintenance management, arbitration, e-governance and administration. Previously, Mr Varma has had 5 years of experience in ONGC as Assistant Executive Engineer in Operation and maintenance of Gas turbine power plant at Bombay offshore LPG Plant. His publications include work on Artificial Intelligence in Roof top Solar, Energy Efficiency Measures in I.P. Bhawan New Delhi in ESCO Model, Internet of Things in Energy Efficiency, Robotics in Construction, Innovative Construction Materials for sustainable construction, Role of Lighting in Landscape, Green Skilling for CPWD Construction etc.

Mr Varma has been engaged in the implementation of Energy Efficiency Measures in CPWD, maintaining Govt. Buildings across India in ESCO Model along with organizing many awareness programs for Field Officers of CPWD across India & Various user Departments/ Ministries. He has also been involved in the installation of Solar rooftop in GPOA & GPRA colonies in RESCO Model across the country & helped in installing a total capacity target of more 5 MW in Govt. buildings.



Daniel Magallon

CEO

Basel Agency for Sustainable Energy (BASE)

Daniel Magallon is a sustainable energy technology, financial, and market specialist with many years of experience working for private and public organizations.

Daniel has led BASE, a Swiss-based organization dedicated to scaling up investments and finance in climate change solutions, since 2007. His work focuses on developing market-based business models and financial mechanisms.

Some of the projects and business models that Daniel has been developing and implementing include the “Energy Savings Insurance” model currently in implementation in Latin America, Asia and Europe, the “Financing RE through remittances project”, which uses money transfers from migrants to finance renewable energy systems in developing countries, and the “Cooling as a Service” model, which has been recognized by the Global Innovation Lab in 2019. Furthermore, Daniel has been developing innovative financing strategies for electric buses, minigrids, LED street lighting, CHP, EE (heating/cooling/motors), PV, wind, cogeneration, and geothermal among others.

Daniel is co-founder of the Global Infrastructure Basel (Switzerland) and has participated as an advisory board member of some initiatives and entities such as World Climate Credits, GreenTEK ventures (Swiss PE fund), and International Climate Initiative (Germany).



David B. Goldstein

Energy Co-Director, Climate & Clean Energy Program

Natural Resources Defense Council (NRDC)

David B. Goldstein has worked on energy efficiency and energy policy since the early 1970s. He currently is Energy Director of NRDC’s Climate and Clean Energy Program.

Dr Goldstein has been instrumental in the development of energy efficiency standards that are currently in effect at the regional and national level in the United States, Russia, India, Kazakhstan, and China. Dr Goldstein is a member of ISO TC 301, the committee that writes and maintains the ISO 50000 series of standards. He is a founding director of the Institute for Market Transformation, the Consortium for Energy Efficiency and the New Buildings Institute.

David B. Goldstein received a Ph.D. in Physics from the University of California at Berkeley, and is a Fellow of the American Physical Society and the recipient of its Leo Szilard Award for Physics in the Public Interest. He received a MacArthur Fellowship in 2002 and is the recipient of the California Alumni Association’s 2003 Award for Excellence in Achievement. He is also the author of “Saving Energy Growing Jobs” and “Invisible Energy.”

**Dr. Deepika Shetty**

Director- Faculty of Architecture
MAHE, Manipal Academy of Science

Dr. Deepika Shetty is presently the Director of Manipal school of Architecture and Planning, MAHE , Manipal. Dr Shetty completed her bachelors in Architecture from Kamla Raheja Vidyandhi Institute of Architecture, Mumbai University in 1998. She then obtained her P.G. in Urban Design from Centre for Environmental Planning and Technology University, Gujarat in the year 2001. She received her Ph.D in Urban Design from MAHE in the year 2015. Dr Deepika was an Urban Design Consultant as a part of CEPT team to review the town planning measures for Bhuj town after the earthquake hit in April 2001. She was also an Urban Design consultant for Comprehensive Development Plan of Udupi for the Udupi Development Authority in 2005. She was the consultant for vulnerability assessment of coastal zone of Udupi district in 2012 for Ministry of Environment and forest, Govt of Karnataka. She is a member of panel of advisors for Udupi district coastal zone management plan since 2013. She presented UDUPI 2025 vision on behalf of district administration to government of Karnataka in Oct 2017. Dr Deepika has to her credit many research papers and talks in various national and international conferences regarding sustainable development of coastal Karnataka, vulnerability assessment, defining small town morphology and study of heritage and culture of Tulunadu. She has conducted many workshops and delivered guest lectures on various aspects of architecture and urban design studies and research.

**Edwin Koekkoek**

Counsellor, Energy and Climate Action
Delegation of the European Union to India

Edwin Koekkoek is Counsellor on Energy and Climate Action in the European Union Delegation to India based in New Delhi. He is responsible for cooperation between the EU and India in the areas of Energy and Climate Action, including the implementation of the EU-India Clean Energy and Climate Partnership.

Prior to joining the EU Delegation, Edwin Koekkoek worked for 7 years in the Netherlands' Ministry of Environment, in the first 5 years as part of the Dutch delegation to the UN Climate Change negotiations (UNFCCC), the UN aviation organization (IACO) and the UN maritime organization (IMO), and in the last 2 years as senior policy advisor in the area of air quality.

He then worked for almost 5 years for the Environment Committee (ENVI) of the European Parliament, inter alia in the area of climate change and renewable energy. After that, he specialized in the legislative procedures of the European Union (EU) and the negotiations between the Parliament and the Council of the EU.



Gaurav Shorey

Director
PSI Energy

As a founding member of the GRIHA Rating system, for more than a decade, Gaurav is a zealous promoter for the cause of sustainability in the built environment in India, both at academic and industry levels. He is on the Technical Advisory Committee of GRIHA, SVA-GRIHA and GRIHA-LD. He is a GRIHA trainer and Visiting Faculty at School of Planning & Architecture, New Delhi. Currently he is supporting BEE, Government of India, in a countrywide capacity building for energy conservation as an ECBC Master Trainer.



Sri Hanumantharayappa

Asst. General Manager
Karnataka Renewable Energy Development Limited (KREDL)

Sri Hanumantharayappa joined the power sector in 1991, is having 29 years of experience in power sector in various fields like operation & maintenance of various equipment, consumer compliance, technical audit, quality control etc. He took after energy efficiency and conservation section at KREDL



Hina Zia

Dean, Faculty of Architecture and Ekistics
Jamia Millia Islamia, New Delhi

Ar. Hina Zia is currently Professor and Dean at the Faculty of Architecture and Ekistics, Jamia Millia Islamia, New Delhi, India. She is qualified as an architect and urban and rural planner and has built her career in a variety of roles. She has worked on several projects related to climate resilience, social/affordable housing, low impact development, water and waste management issues apart from several green building projects. Some of her recent work pertains to navigating the realms of low-carbon growth at sub-national and national level (for construction sector). She is currently doing a SPARC project on “Study on low-carbon pathways for building sector in India” by the Ministry of Human Resource Development in collaboration with Tsinghua University, China.

In her over 15 years of experience, she has had the opportunity to work at both macro and micro scales, from policy making to actual implementation and monitoring of the strategies/impacts to achieve contextual resource efficiency. She has developed curriculum/courses and interaction/training for practitioners and students. She has worked on several cross-cutting areas and programs. which looked at GHG inventory preparation, mitigation action plans, water and waste management, green infrastructure, energy supply and demand side management, financial promotional programs. to promote energy efficient homes, guidelines for human settlements, integration of resource efficiency in national building codes, policy interventions, institutional implementation structures and actual implementation of projects.

**Dr. Ian Hamilton**

Consultant, Energy Efficiency Division
International Energy Agency (IEA)

Dr. Ian Hamilton is a Reader at the UCL Energy Institute. His research interest is focused on the nexus between energy demand, energy technologies and energy efficiency, sustainable cities, indoor and urban environmental conditions and health. Ian's research has included: investigation on the impact of energy efficiency interventions on energy demand in the residential stock; analysis of temporal and spatial energy use within the urban environment and its impact on the local climate; the trends and impact of energy use on indoor environment; residential stock energy use modelling; and, the integration of renewable energy into the urban form. Ian is the Operating Agent for the International Energy Agency (IEA) Energy in Buildings and Communities (EBC) 'Annex 70 – Building Energy Epidemiology: Analysis of Real Building Energy Use at Scale'.

**Isha Anand**

Director Projects
Morphogenesis

With a background in architecture and a Master's Degree in Sustainable Environmental design from the esteemed Architectural Association (London), Isha focuses on bringing in an integrated design approach to Architecture and Sustainability. Her experience and expertise ranges over a variety of projects in government and private sector, with typologies varying from Hospitality ,refurbishment, adaptive reuse, boutique residences, group housing, corporate offices and master planning .

**Janhavi Parab**

Deputy General Manager – Sustainability
Mahindra Lifespace Developers Ltd

Janhavi Parab has over 12 years of experience in Corporate Sustainability, Environmental Architecture and landscaping, Environment Management, Climate change, Strategic projects/ Thought leadership initiatives (Centre of Excellence), Corporate Social Responsibility (CSR) initiatives and Community Development programs. She has been Instrumental in enabling the organization to be the first movers or early adopters of Green buildings (IGBC, GRIHA, LEED) achieving 100% sustainable housing portfolio for the organization. She buoyed the organization to rise on three pillars business responsibility, environment stewardship and community outreach through various public disclosures such as Sustainability Report (as per GRI standards), Business Responsibility Report (BRR), Global Real Estate Sector Benchmarking (GRESB), Climate Disclosure Projects (CDP), Sustainable Development Goals (SDG's), Science Based Targets (SBT), Golden peacock award, CII-ITC Sustainability Awards, Sustainability Roadmap, Climate positive Development Program (C40 Cities), Green Supply chain management, Environment and

Social Impact Assessments (EIA/ ESIA). She conducted first of its kind of a study on Living Building Assessment (LBA) and Life Cycle Analysis (LCA) to drive business decisions to bring resource efficiency.

She is recognized as Aspirational Leader in Sustainable Development and Innovator in Business by International Women Leadership Forum (IWLF) in 2018 and 2017 respectively.



Jessica Grove-Smith

Physicist & Senior Scientist
Passive House Institute

Jessica Grove-Smith joined the scientific research team of the Passive House Institute in 2008. Her areas of expertise include energy efficient building solutions around the world, interrelations between efficiency and renewable energies and deep energy efficiency for public indoor swimming pools. Jessica frequently participates in conferences internationally on technical and policy related topics with regard to high performance buildings.



Joerg Gaebler

Principal Advisor
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Joerg Gaebler, a German-American citizen, with many years of experience in the Indo-German-American business culture. He has been appointed Principal Advisor of the Indo German Energy Programm since March 2016. He is heading projects related to the distributed solar rooftop and grid integration of vRE / distributed storage / and EV charging. Prior, Mr Gaebler was the Managing Director of Wagner Solar Inc from 4/2009 – 11/2015; the US division of Wagner & Co; the German pioneer of solar energy system manufacturing. Mr Gäbler holds a BA Business Administration from Northeastern University and M Sc from the TU Vienna in renewable energy technologies. His master thesis covered the solar thermal market of North America; a process of 3 years of research and market entry preparation for Wagner Solar.



Dr. K. Vijaya Lakshmi

Vice-President
Development Alternatives

Dr. K. Vijaya Lakshmi is Vice President of Development Alternatives Group, responsible for technology innovation and research at the Group. A chemist by training, Dr Vijaya Lakshmi's main focus and achievements are in the area of water quality management, associated with development and application of innovative technologies that address the problems of women. She has been the recipient of the National Award for Women's Development through application of Science and Technology for the year 2007 granted by the President of India.

Dr Lakshmi is responsible for strengthening the organization's capability in designing green

solutions for the brown issues of the environment. Her focus was mainly on clean technologies, demonstration of the profitability of environmental management, providing tools and techniques for voluntary environmental management systems adoption, facilitation of stakeholder partnerships etc.

She has also guided teams for undertaking performance benchmarking studies and formulating ESR reporting formats, CDM credits and setting up of emission standards and advising Government of India on the same.

In addition, Dr Vijaya Lakshmi leads the resource efficiency team at the Development Alternatives Group and provides guidance to innovation in technology and delivery models for waste to wealth interventions.



Shri K K Joadder

Former Chief Planner
Town and Country Planning Organization

Shri K K Joadder is a Town Planner by profession and retired as the Chief Planner of the Town and Country Planning Organisation (TCPO), Ministry of Housing & Urban Affairs, Govt. of India in January 2018. He has 32 years of experience in the field of Urban & Regional Planning and has been actively involved in the preparation of urban & regional plans across the country besides various empirical studies in the field. He was also one of the members of the Apex Committee of Smart City and AMRUT Mission in the Ministry of Urban Development and one of the Board members of Greater Visakhapatnam Smart City Corporation Limited (GVSCCL). Shri Joadder as part of a team of Ministry of Urban Development was instrumental in the preparation of the Permanent Settlement Plan for the Tsunami affected Car Nicobar and Southern Group of Islands in Andaman & Nicobar Islands during 2005-06. He was also involved in the multi-disciplinary team in the World Bank project in Singrauli Development and Environmental Strategy. He was actively involved in appraisal and monitoring of Central Sector flagship schemes such as JNNURM and AMRUT. He is presently engaged in the preparation of the Sub-Regional Plan of NCT-Delhi for NCRPB as a project expert.



Kanagaraj Ganesan

Founder and Director
Integrative Design Solutions Private Limited

Kanagaraj Ganesan has experience in the field of 'Building Energy Efficiency'. He is a licensed architect, Certified Measurement and Verification Professional (CMVP), and Energy Conservation Building Code (ECBC) Master Trainer. He is a post-graduate from the Indian Institute of Technology, Madras, in the 'Building Energy Efficiency' domain.

Mr Ganesan is the founder of Integrative Design Solutions Pvt. Ltd. (IDSPL). IDSPL focuses on mainstreaming "integrated design" for addressing sustainability in the built environment. He is also working as a consultant to UNDP India and the All India Institute of Local Self Government

(AIIISG) for the implementation of ECBC in India. Until June 2015, he was working as a Senior Programme Officer at Greentech Knowledge Solutions Pvt. Ltd., New Delhi, which has been appointed as the Indian Project Management and Technical Unit (PMTU) for the Indo-Swiss Building Energy Efficiency Project (BEEP).



Dr. Kaviraj Singh
Managing Director
Earthood Services Private Limited

Dr. Kaviraj Singh is an exemplary social entrepreneur, visionary and innovator with close to two decades of research and functional expertise in climate change, environmental protection, and waste management.

It is this sensitization towards the need for responsible use of resources and energy conservation that inspired him to get his Masters in Energy & Environmental Management, followed by a doctorate degree from the much reputed-Indian Institute of Technology, Delhi (IITD). His in-depth knowledge of the issues of climate change and ways to counter them, made him one of the leading experts of the industry.

After working with impressive global clients and organisations like SGS United Kingdom, a leading inspection, testing and certification body tackling climate change where he led a team for 4 years, he founded Earthood Services Private Limited (ESPL) - a third-party auditing and consulting firm, assisting clients in the field of Environment, Energy, and Climate Change. His clients appreciate his subject expertise, analytical insights, and his ability to go that extra mile to deliver exceptional services. He attracted a lot of praise for his research papers that were presented at multiple conferences like Carbon Expo and workshops for the United Nations in Bonn, Frankfurt, and in New Delhi.

He is a proud recipient of several research Fellowships and has audited over 200 waste management CDM projects across 40+ countries. He has co-authored several books and has published a number of research and technical papers in International Journals.



Kunal Kumar
Joint Secretary & Mission Director (SCM)
Ministry of Housing and Urban Affairs

Mr Kunal Kumar, IAS presently holds the position of Joint Secretary & Mission Director (Smart Cities Mission), Ministry of Housing and Urban Affairs, Government of India since May 2018. Earlier, he was Municipal Commissioner at Pune Municipal Corporation, Maharashtra for close to 4 years. He has been working in the State of Maharashtra since 1999 and has

served across various cities of Maharashtra.

Mr Kumar has worked as District Collector in three districts of Bhandara, Jalgaon and Aurangabad and has also worked as Municipal Commissioner in Kolhapur Municipal Corporation. Besides travelling, he has an avid interest in reading and follows sports across the world. He is an Electrical Engineering graduate from IIT Roorkee, and has successfully completed his Masters in Public Management from National University of Singapore jointly conducted with Harvard Kennedy

School, Cambridge, USA.

He has presented various papers on e-Governance which received awards / citations like the best e-governed district award for Jalgaon district nationally, the certificate of Appreciation for being a finalist in Manthan Award South Asia 2009. Moreover, he was awarded by the Prime Minister of India for excellence in AADHAR Governance award during his stint as District Collector of Aurangabad.



Mahadev Rudrappa Kamble

Chairman

Karnataka Real Estate Regulatory Authority (KRERA)

Mr Kamble has worked as a managing director of KRDCCL where he played a crucial role in design, getting approved tendering and execution of more than 605 kms of state highways in Karnataka program. As an Executive Director at NHAI, he has supervised the national highway roads under construction and maintenance of roads in south zone. Also solved the land acquisition issue by constantly approaching the respective district administration.



Mario Schmidt

President

uPVC Window and Door Manufacturers Association (UWDM)

Mario Schmidt is Managing Director at Lingel India, a leading brand for uPVC windows and doors. He has built a core team that manages end-to-end solutions for customers from generating leads to installation.

Prior to this, he served as the youngest General Manager (factory head) in window and door field within German state.

Mr Schmidt's academic portfolio includes a Bachelor's with a German certification for 'Master Craftsman for Windows and Furniture Design' and an MBA in Business Economist from Handwerkskammer Chemnitz Germany. Specialties: general management, corporate development, product development, business operations, strategy, customer relations



Markus Wypior

Deputy Cluster Coordinator

IGEN-GIZ

Markus Wypior has over 20 years of experience in project management, bilateral and multilateral development co-operation, policy advisory and strategic planning in telecommunications, energy, environment and climate change.

At present he is responsible for the implementation of the Green Energy Corridor module within the Indo-German Energy Programme. He leads a multi-disciplinary team of experts in the field

of large scale grid integration of renewable energy and provides advisory services to various stakeholders on forecasting, scheduling, balancing and ancillary services.

From 2012 – 2015 he established the support office of the Indo-German Energy Forum in India which is Germany’s political dialogue platform in the energy sector. The support office is jointly operated by GIZ, KfW and the Indian Bureau of Energy Efficiency. From 2005 – 2012 he implemented numerous projects in the refrigeration and air-conditioning sector under the Montreal Protocol on Substances that Deplete the Ozone Layer in India and other countries in Asia.

After joining GIZ in 2003 he was responsible for the thematic areas “Environmental Protection and Energy Management”, “Management of Natural Resources and Poverty Reduction” and “Urban Development” at the China desk in GIZ’s headquarters.



Mili Majumdar

Managing Director
Green Business Certification Inc. (GBCI) India

Mili Majumdar is Managing Director of Green Business Certification Institute Pvt Ltd, India and Senior Vice President, USGBC. She is responsible for technical adaptation and customization of the portfolio of rating systems of GBCI for the Asia Pacific region. She is program lead for several programs including LEED for Cities and Communities, LEED

Residential, PEER and is working on global projects to ensure incorporation of sustainability principles at building, city and community level.

An architecture graduate and a building technologies specialist from IIT, Madras, Ms Majumdar has more than two and half decades of experience in the field of energy, green buildings, climate resilient housing, city planning, urban transportation and environment with a focus on sustainable development of habitats.

She is member of Committee for formulation of energy conservation building codes for India, Member of Committee of Bureau of Indian Standards for revision and updating of National Building Code of India. She is Advisor to Delhi Urban Arts Commission and Glass Academy of Saint Gobain. She is Founder member of the Indian Building Performance Simulation Association. She was Member of Expert Appraisal Committee (Infra-2) constituted for appraisal of infrastructure projects by MoEFCC (GoI), for two terms. She is also a board member for Global Buildings Performance Network, Paris.

**Monu Ratra**

CEO

India Infoline (IIFL) Home Finance Ltd.

Monu Ratra is a veteran in the mortgages industry with nearly two decades of experience. He has been associated with brands like HDFC Ltd., ICICI Bank and Indiabulls Housing. Prior to joining IIFL Home Finance Limited, his last assignment was with Indiabulls HFC as National Business Manager.

Mr Ratra has been a part of the pioneering teams leading various functions to provide excellence through process and quality initiatives, contributing to industry-leading growth. While with the last company, his efforts and vision led to building of a growth sales structure, starting from a scratch, in a start up like environment. At IIFL Home Loans, he brings strong focus on developing and delivering customer satisfaction with ease and low turn around time.

Mr Ratra is passionate about building stronger businesses, adapting and aligning company with new technology and digital era, and maintaining everlasting culture of customer centricity.

Nabeel Ahmad

Associate Director

Environmental Design Solutions Pvt Ltd (EDS)



Nabeel has a background in mechanical engineering with a specialization in energy engineering. Currently, he works as an Associate Director at Environmental Design Solutions (EDS) Private Limited. He has over twelve years of working experience in projects dealing with building energy efficiency, green buildings, renewable energy, and energy efficiency standards, and labeling.

Mr Nabeel currently leads the team of engineers working on building system design, Net Zero building design, energy efficiency policy development, renewable energy systems at EDS.

Neeraj Kapoor

Managing Director

Kalpakrit Sustainable Environments Pvt Ltd



Neeraj, Founder and Managing Director of Kalpakrit, is experienced in addressing issues of energy conservation, efficiency, thermodynamics, thermal comfort, reduction of CO2 emissions and environmental sensitivity in the built environment.

He brings to Kalpakrit an experience of more than 15 years in environmentally sensitive architectural solutions and energy efficiency. He has been involved with specialization in whole building energy simulation modeling, development of energy conservation and energy efficiency measures, analysis for demand-side management (DSM) incentives, facility audits, LEED® design, and documentation assistance and facility assessments for various building types.

His experience also includes modeling evaporation using CFD, doing thermal comfort assessment and daylighting analysis. He has been a presenter and published research papers in various fora.



Prof. Dr. P.S. Chani

Head of Department
Department of Architecture and Planning, IIT Roorkee

Prof. Dr. P S Chani is a Professor of Architecture and currently the Head, Department of Architecture and Planning at IIT Roorkee. He completed his undergraduate and postgraduate programme in architecture from IIT Roorkee (erstwhile University of Roorkee). He then completed his doctorate in embodied energy in buildings in 2002 from IIT Roorkee and joined as a

faculty in this institute.

His core area of research is energy in buildings, particularly low carbon construction and his research team is now venturing into the domain of life cycle energy in buildings. He has authored/coauthored more than 30 papers in journals and conferences. He has also supervised more than 25 postgraduate dissertations, 4 Ph.D. thesis and is currently supervising 9 Ph.D. thesis. He is also a member of the Project Source Committee of the Bureau of Energy Efficiency (BEE) on energy efficient building materials in India and an advisory member to the Airport Authority of India (AAI) on the design of the upcoming Dehradun airport.

His academic interests are in the area of modern architecture and he teaches the history and evolution of modern world and specifically modern Indian architecture, besides being involved in undergraduate and postgraduate design studios. He is also currently mentoring the B.Arch. I year students through an ‘Introduction to Architecture’.



Pekka Huovila

10YFP SBC Coordinator
Ministry of Environment at Finland

Pekka Huovila has over 30years of experience in sustainable building research and practice in Europe and in developing countries. He has coordinated the One Planet Sustainable Buildings and Construction Programme(SBC) since its start in April 2015 for the Ministry of the Environment, Finland, supported by Green Building Council Finland.

His areas of interest focus on circular built environment, procurement systems and sustainability assessment.

Mr Pekka runs also his own company Sustainability Laboratory. He has earlier acted e.g. at VTT Technical Research Center of Finland as a Principal Scientist and Key Account Manager for EcoCities in emerging economies, and as a Visiting Professor in University of Salford, UK. He has practical work experience from number of African countries.

**Dr. Peter Graham**

International Secretariat
Renewable Energy and Energy Efficiency Partnership (REEEP)

Dr. Peter Graham has been the Technical Advisor and past Coordinator of the United Nations Environment Programme's (UNEP) Sustainable Buildings and Climate Initiative where he has developed and managed many of UNEP's key projects and publications in the building sector. He comes to the GBPN from a position as Head of Discipline for Architecture & Design at the University of New South Wales, Sydney, Australia.

In these roles Peter worked closely with the public, civil, and private sectors to assist the global transition to a sustainable building and construction industry.

**Pierre Jaboyedoff**

Head
Indo-Swiss BEEP/Effin'art, Lausanne, Switzerland

Pierre Jaboyedoff, is an Associate at Effinart, Lausanne, Switzerland, a consulting company active in efficiency and renewable energy in building and industry. He has master degree of mechanical engineering from the Swiss Institute of Technology Lausanne (EPFL) with special focus on energy and thermal engineering. He has been active in R&D and consulting in high performance buildings since 1984. He has been associated in number of IEA (Solar and building) research projects. His experience ranges from passive simple housing up to large hospitals and watch industries.

He has been visiting India regularly since 1981 and has been a consultant for the Swiss Agency for Development and Cooperation in India in its energy and environment programme since 1992 in the small scale industry sector with organization like TERI and since 2011 as the leader of the Swiss Project Management Technical Unit of the Project BEEP (Building Energy Efficiency Project) which has been supporting the Bureau of Energy Efficiency in the development of the newly launched Energy Conservation Building Code for Residential Buildings (Eco-Niwas Samhita or ECBC-R). His main field of expertise is in simulation assisted integrated design of buildings (passive design strategies, HVAC and renewable technologies).

**Poorva Keskar**

Director
VK:e environmental

Poorva Ujwal Keskar is an architect, environment designer, quality manager, educator and author of numerous articles on the practice of environment design and environment management. Poorva headed the department for environmental planning and architecture at Dr B.N. College of Architecture, till June 2012. Currently she heads the brick school of architecture at Pune.

She has delivered expert lectures at Mejan Arc University, Sweden, IIT Powai, Cept, Ahmedabad, Rachana Sansad Mumbai, and many architecture colleges in Maharashtra, on architecture, energy conservation in buildings and environment planning. She is the Director at VK: e environmental, a consultancy firm with a mandate to consult on energy conservation, green buildings and environmental planning. Her projects have been awarded Hudco Award, Aesa Award For Green Buildings, Exemplary Award For Energy Efficiency and Water Management For Griha Projects.

She serves as a member on various boards and committees at national and local level in the areas of energy efficient buildings, green buildings and sustainable urban planning. Poorva is an empanelled expert with Bureau of Energy Efficiency, Ministry of Power, has served as a member of GRIHA technical advisory committee and is the co chair of IGBC PUNE chapter. 2 with a view to contribute towards urban sustainable development.



Shri Pramod Adlakha

Managing Director

Adlakha Associates Pvt. Ltd. & Adlakha Affordable Homes

Shri Pramod Adlakha is an Architectural Engineer, having 45 years of experience and is the Managing Director of Adlakha Associates Pvt Ltd. He is popularly known as the Father of Affordable Housing & Innovative technologies, having designed & got delivered over 50,000 low cost houses. He is the recipient of more than 25 National and International Awards.

He has been recognized by various Forums including FICCI, CII, ASSOCHAM, IGBC, IBC, CREDAI, NAREDCO, CBRI, IE, CIDC, ACCE and Good Governance India Foundation.

Mr. Adlakha is also former Advisor to NCR Planning Board. He is also Member of Technical Committee National Building Code-2005 & NBC-2015 and member of various other committees of Bureau of Indian Standards.



Prof. Prasad Vaidya

Energy Consultant

zenerG

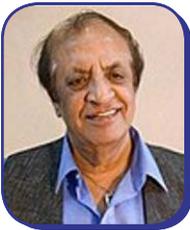
Prof. Vaidya has over 20 years of experience in working on energy policy, energy efficiency program development, and net-zero-energy building projects in the U.S., Korea, Saudi Arabia, United Arab Emirates and India.

He has consulted on over 150 building projects including net-zero energy buildings and facilitating technical analysis and decision-making. In India, he has worked on the implementation of the Energy Conservation Building Code (ECBC). He led the development of the ECONirman Whole Building Performance, an online energy simulation tool for ECBC compliance. His work in India also includes design and construction experience in passive solar design at building and urban planning scales, use of low embodied energy materials, using appropriate construction technologies, stabilized soil block and adobe construction.

Prof Vaidya has conducted research on green building rating systems, daylighting, energy efficiency, measurement and verification, and integrated design. He has also evaluated energy conservation technology implementation, program market penetration, cost-effectiveness and ongoing performance.

He has published many papers in conference proceedings and journals around the world.

Prof Vaidya is a LEED Fellow, and volunteers on committees for the US Green Building Council (USGBC). He was a member of the Technical Resources Group for the Clinton Climate Initiative. He holds a master's degree in Architecture from the University of Minnesota and a bachelor's degree in Architecture from Sir J J College of Architecture.

**Ar. Prem Nath**

Founder

Prem Nath and Associates

Ar. Prem Nath is an Iconic Indian architect with a wide spectrum of work. He is the founder of Prem Nath and Associates, an architectural firm based in Mumbai, founded in 1967.

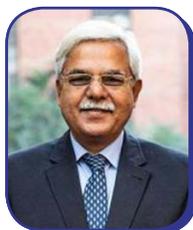
Additionally, Ar Nath is a Chartered Engineer, a Certified Valuer and Real Estate Appraiser. In a career spanning 50 long years, he has received many awards such as “Most Promising Brand” in Architecture and Real Estate at World Brand Summit, Dubai, “Life Time Achievement Award”, “India’s Top Ten Architect” award and “HUDCO Design Award for Green Architecture for HMEL Township and many more.

**Prima Madan**

Lead - Energy Efficiency and Cooling Natural Resources Defense Council (NRDC)

Prima Madan is an energy and climate change expert working with NRDC's India team. Her work in NRDC focuses on building energy efficiency and cooling related issues. She has over 13 years of experience working on policy design and implementation of projects on energy efficiency, energy access and air pollution with leading organizations in India.

Before joining NRDC, Prima worked with International Institute for Energy Conservation (IIEC)'s South Asia office as a Senior Project Manager. She spearheaded a number of IIEC's key projects including designing a national level fund for energy efficiency. Prima began her career with The Energy and Resources Institute (TERI) including working on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). She holds an M.Sc in Economics from University of Nottingham, UK and a B.A (Hons) in Economics from Hansraj College, Delhi University.



Shri R R Rashmi

Distinguished Fellow and Programme Director - Earth Science and Climate Change

The Energy and Resources Institute (TERI)

Shri Rajani Ranjan Rashmi is a former member of the Indian Administrative Service (1983) batch. He was India's principal negotiator for climate change negotiations under the UN Framework Convention on Climate Change for several years and has been part of climate change policy-making in India in the run-up to and after the Paris Agreement. As Special Secretary in the Ministry of Environment, Forest & Climate Change in the Government of India, he has been closely associated with the formulation and implementation of policies relating to Climate Change, Pollution, Montreal Protocol on ODS, and Environmental Clearances, besides being the Project Director of Green India Mission.

Besides his work in the field of environment, Shri Rashmi has served as a trade negotiator and public finance administrator. He was an Adviser in India's Mission to European Union in Brussels (2001-2005). Later, as an Additional Secretary in the Ministry of Commerce & Industry (2014), he oversaw state trading and plantation commodity exports.

He was the Finance Secretary of the state government of Manipur for almost 8 years in various stints and ended his term as state's Chief Secretary in 2018. In 2008, he was awarded the Prime Minister's Award for Excellence in Public Administration for his contribution to the management of finances in the state



Shri Raj Pal

Economic Advisor

Ministry of Power (MoP)

Shri Raj Pal, Economic Adviser, Ministry of Power belongs to the Indian Economic Service. He has done his Masters & M.Phil in Economics. He has also done Diploma in Development Studies from Institute of Developing Economics, Tokyo, Japan.

As a Member of Indian Economic Service, Shri Raj Pal has experience of about 28 years working in different Ministries of Government of India like Ministry of Finance, Planning Commission, Ministry of Industry, Ministry of Labour etc. He has also worked as Adviser, Economic Regulation in Telephone Regulatory Authority of India prior to joining his current posting as Economic Adviser, Ministry of Power.

In the Ministry of Power, Shri Raj Pal is Joint Secretary incharge for Policy & Planning, Training & Research & Coordination division. He joined our Board on 01-11- 2013.

**Prof. Rajan Rawal**

Executive Director

Centre for Advanced Research in Building Science and Energy, CEPT University

Prof. Rajan Rawal is a Professor at CEPT University and Executive Director of “Centre for Advanced Studies in Building Science and Energy” (CARBSE) at CEPT Research and Development Foundation. He teaches energy efficient built habitat, energy modelling, energy policy at postgraduate level. His work emphasis is on ‘energy performance of human habitat’ and ‘architectural science education’.

Prof Rawal led Indo-US Joint Clean Energy R & D Centre - Building Energy Efficiency Sector, and presently leading one of the project under Indo-UK project on Energy Demand Reduction and Mission Innovation challenge on heating and cooling in buildings from India side. He serves on organizing council of Global Cooling Prize. He is a active member of International Energy Agency EBC Annex 69, 79 and 80 and Chair Education at International Building Performance Association (IBPSA). He serves on various executive committees and technical committees at national and international level. He is part of editorial board of three leading journals and has several research papers, book chapters and projects to his credit.

**Rajeev Ralhan**

Executive Director – Clean Energy

PwC India

Rajeev Ralhan is Executive Director at PwC. He has developed a Business plan of 1st Super ESCO in India, which is paving way for various market transformation initiatives. He is also an International expert on advising governments on standards & labeling program designs/implementations. He has advised policymakers in India, Ghana, Bangladesh, Maldives, Egypt, Bhutan, Cambodia, European Commission and more. Rajeev has been involved in the development and implementation of S&L/energy standards programs for 15 products.

Mr Rajeev has extensive experience in designing and implementing standard & labeling programs for the air conditioner program/HVAC program in India. Rajeev is leading the “AC Challenge program” in India. This is a prestigious initiative of US-DoE as part of India- US Cooling Collaboration. This program targets to reward super-efficient air conditioners sold globally promotes innovation.

Mr Rajeev has led developing Indian Seasonal Cooling performance standards for Inverter air conditioners in India. Developed super efficiency roadmap for the air conditioner in India. He has also developed testing capacity in India and developed Energy codes and standards for buildings in Bhutan. He has led market assessment exercise for energy-efficient building materials in India to promote ECBC and developed Green building guidelines for adoption at the state level. He played a crucial role in developing M&V plan for 1st incentive scheme to promote super-efficient fans in India(SEEP scheme)

**Rajkiran Bilolikar**

Associate Professor in Energy Policy
Administrative Staff College of India (ASCI), Hyderabad

Rajkiran V Bilolikar, is currently working as an Associate Professor in Energy Area, in the Centre for Energy, Environment, Urban Governance and Infrastructure Development of Administrative Staff College of India, Hyderabad.

Mr Bilolikar has been working in various capacities from last 18 years in Electricity Distribution Management, Energy Conservation and Energy Efficiency in Buildings, Strategy and Restructuring of Power Sector Organizations, Asset Evaluations, Policy Evaluation and Impact Analysis, Techno economic feasibility studies, Regulatory affairs of Electricity Industry, Tariff analysis, Annual Performance analysis of Power utilities, IT application development in utilities and Renewable Energy and its integration in India.

He was involved in advising GoAP in bifurcating power sector, O&M planning of 1200 MW of Singareni Thermal Power Plant, Study of ICT usage in Customer Relationship Management in India, Sri Lanka and Bangladesh.

He also has to his credit a number of papers presented at seminars and conferences at national and international level. He presented papers at AEEE conference USA, IEA France, ADB Manila and other places. He is a resource person for UNDP, ADB, World Bank, SAARC Energy Centre and South Asia Forum for Infrastructure Regulators.

**Ram Kumar**

Project Officer
Uttar Pradesh New and Renewable Energy Development Agency
(UPNEDA)

Mr Ram Kumar is a Project Officer at the Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA). His efforts in the implementation of ECBC and tiered approach for the state of Uttar Pradesh has accelerated the adoption of the code in the region. Mr Kumar has a Masters from IIT

Roorkee in Water Resources Engineering.

UPNEDA is a government body responsible for development of renewable energy in the state of Uttar Pradesh.

**Rashmi Jawahar Ganesh**

Policy Analyst

International Partnership for Energy Efficiency Cooperation (IPEEC)

Rashmi Jawahar assists with the implementation of the G20 Energy Efficiency Leading Programme, in particular the work streams on transport, appliances and monitoring methods. Alongside engaging with member governments and establishing partnerships for IPEEC, she oversees IPEEC's strategic communications. Ms Rashmi brings valuable experience working with countries to advance their clean energy transition.

Most recently, Ms Rashmi has worked with UN Environment to facilitate knowledge exchange, policy development, and joint action on issues related to promoting environmentally sound technologies. Earlier, Ms Rashmi worked closely with the Renewable Energy Policy Network for the 21st century (REN21)

**Revathi Sekhar Kamath**

Principal Architect

Kamath Design Studio

Revathi Sekhar Kamath obtained her Bachelor's degree in Architecture in 1977 and a Post Graduate degree in Urban and Regional Planning in 1981, both from the School of Planning and Architecture, Delhi. After graduation, she worked with Stein, Doshi, Bhalla and with Rassik International, Architects and furniture designers in New Delhi. In 1979, she worked with The GRUP (Group for Rural & Urban Planning). She has also worked for the National Institute of Urban Affairs in 1981 as a research scholar. She was visiting Faculty (1984–87) at the School of Planning and Architecture, New Delhi and was later, Assistant Professor (1987–91).

In 1981, she started her architectural practice with Vasant Kamath. The firm was called "Revathi and Vasant Kamath". Later in 2005 the partnership firm was renamed, "Kamath Design Studio - Architecture, Planning and Environment". The studio has handled a wide variety of projects, in diverse social, economic and geographical contexts. They have more than 400 projects to their credits. She was declared Designer of the year for 1996 by Interiors & Lifestyle India. She has been felicitated by WADE India as 'Role Model' Architect for outstanding contribution in designing elegant spaces.

She has received the Jiva Leadership Award in 2016. She has been awarded the AIBD- eminent Woman Architect of India of 2018. Revathi has contributed to the exhibition – "Traditional Architecture in India" for the festival of India in Paris, in 1986. She was also on the contributing design team for the Eternal Gandhi Multimedia Museum. She was co-curator and designer for the exhibition "Craft: A Tool for Social Change" for VHAI (Voluntary Health Association of India) in 2003. She is currently working on a resort at Ranthambore, Rajasthan, Gundicha Temple at Angul, Orissa and Community Centre at Katra, Jammu.



Richie Mittal

President,
Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)

Richie Mittal is the Managing Director of OVERDRIVE ENGINEERING PVT. LTD. NEW DELHI. He has worked in the field Energy efficiency for cooling since last 33 years. He is involved as Consultant for the use of Renewable Energy for Cooling in India such as Geothermal, Solar and Wind Energy for Cooling and Heating. He also does design of Green Factory, Third Party Commissioning and TAB - Testing, Adjusting and Balancing for HVAC. He has worked in Roots Air systems Pvt. Ltd from Jan 1987 to till Apr 2012 as Director. Richie is associated with overdrive engineering Pvt. Ltd. since May 2012 and currently working as Managing Director at Overdrive Engineering Pvt. Ltd. Specializing and offering services for Engineering and Design in Cooling systems with Renewable Energy and Energy Efficient Technologies along with Green Building Services



Ripu Daman Singh

Associate Professor, GZS School of Architecture and Planning.

Ripu Daman Singh is the Head of Architecture Department, Giani Zail Singh School of Architecture & Planning, MRSPTU, Bathinda, India. He is an architect by education and has more than 20 years of experience in teaching & research.

He has contributed to numerous national and international publications and is a recipient of various prestigious awards.



S. Vikash Ranjan

Project Manager
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

S. Vikash Ranjan is presently working as a Programme Manager in IGEN, GIZ Building Project and supporting Bureau of Energy Efficiency (BEE), Ministry of Power (Government of India) in Policy Making, Climate Change, and Energy Efficiency. He is mainly involved in the implementation of the National Mission on Enhanced Energy Efficiency (NMEEE), a component of the National Action Plan for Climate Change (NAPCC). He has done extensive work in the field of Energy Efficiency and Climate change in India and South-East Asian countries in Industries and Building Sector.

Under his leadership, the flagship programme on Industrial Energy Efficiency, Perform Achieve and Trade (PAT) scheme for Manufacturing Industries, Railways, Distribution Companies, Building and Power sectors have been successfully developed. He possesses a graduate degree in Electrical Engineering and is a Certified Energy Auditor as well as Renewable Grid Manager from Berlin University, Germany.

At present, he is leading the Building Programme from GIZ in India with following objective Development of Futuristic Residential Building code and Label on Building, Implementation of code and Label in the Indian States through regulatory framework under State Authorities like MOUD, ULBs and UDDs specially designed for Smart Cities, Penetration of Energy Efficient building material in Indian market and Energy Efficient Building Material Directory for India through replicable building design and layout.



Sameer Kwatra

Climate Change and Clean Energy Policy Analyst
Natural Resources Defense Council

Sameer Kwatra specializes in research and analyses that promote clean energy, energy access, and sound climate policy in India. As a former NRDC Speth Fellow, he was tasked with analyzing India's solar energy policy, climate change initiatives, and building energy use. Prior to joining NRDC, Kwatra worked for the American Council for an Energy-Efficient Economy, where he sought to improve energy efficiency in buildings. He became interested in environmental issues while working for ICICI Prudential in rural India, where he witnessed how impoverished people are most vulnerable to climate change impacts despite contributing little to the cause. Kwatra holds a bachelor's degree in Mechanical Engineering from India's National Institute of Technology, an MBA in finance and marketing from the Indian Institute of Management, and a master's degree in environmental management from the Yale School of Forestry and Environmental Studies. He works out of NRDC's Washington, D.C., office. May 2013.



Dr. Sameer Maithel

Head
Indo-Swiss BEEP/Greentech Knowledge Solutions Pvt Ltd

Dr. Sameer Maithel is Founder Director at the Greentech Knowledge Solutions Private Limited (GKSPL), New Delhi. He is the Head of the Indian Project Management & Technical Unit of the Indo-Swiss Building Energy Efficiency Project (BEEP). GKSPL provides research and consulting services in the field of energy-efficient building design, resource-efficient building materials production, decentralized renewable energy applications, and energy-efficiency and air pollution control in small industries.

As a part of the BEEP team, he has been intensely involved in the development of the Energy Conservation Building Code for Residential Buildings for India. Sameer has an M Tech and Ph.D. in Energy Systems Engineering from Indian Institute of Technology, Bombay. Prior to founding GKSPL in 2007, he has worked at The Energy and Resources Institute (TERI) from 1994 to 2006; and at the Oil & Natural Gas Corporation Ltd from 1988 to 1994.



Samit Ray
 Director - Government Affairs
 United Technologies Corporation

A Public Policy professional with 24 years of experience in the field of engagement with the Government both at the central and state Government levels on economic policies, Governance and public procurement. Involved in policy making, regulatory guidelines in several sectors like Aerospace and Defence , National Civil Aviation Policy, Defense Procurement Policy , infrastructure (Road safety and security) , national vaccine policy etc.

Helping state Governments with City development plans and representing in Industry forums, serving on National Committees of Industry bodies. For the past 16 years have been involved in shaping Public Policy for 3M and UTC for various Business Unite like Collins, Pratt and Whitney, Carrier and Otis. He has helped in crisis management and regulatory risks and challenges, business development for the Government sector for the BU's, influencing Policy makers in India and South East Asia.



Sanjay Dube
 President & CEO
 International Institute for Energy Conservation (IIEC)

Sanjay Dube is the President & CEO of International Institute for Energy Conservation (IIEC), a not for profit agency. He has over 32 years of experience and his dynamic portfolio consists of working on clean energy and climate change related programs supported by international agencies like USAID, ADB, World Bank, UNIDO, UNEP, UNDP, SDC, GIZ, and DFID. Prior to joining IIEC, he worked as Chief of Party for Partnership to Advance Clean Energy – Deployment (PACE-D) Technical Assistance Project of USAID in India.



Ar. Sanjay Prakash
 Principal Architect
 SHiFt (Studio for Habitat Futures) Design Studio

Ar. Sanjay Prakash, B. Arch., A.I.I.A., is an architect with a commitment to energy-conscious architecture, eco-friendly design, people's participation in planning, music and production design. Over the years, he has integrated all his work with the practice of new urbanism and sustainability in his professional and personal life.

He has worked extensively to develop future scenarios and ecological planning methods. His area of practice and research over the last 39 years includes passive and low energy architecture and planning, hybrid air-conditioning, autonomous energy and water recycling and harvesting systems, bamboo, wood and earth construction, community-based design of common property, and computer-aided design. Under his guidance, hundreds of persons have developed capabilities

in performing design, conceptual or management work in these areas.

He is Principal Consultant of his design firm, SHiFt: Studio for Habitat Futures (formerly known as Sanjay Prakash & Associates), and was a partner of daat and Studio Plus, firms that predate his current firm. He is co-founder of Future Institute (FI) and Himalayan Institute for Alternatives, Ladakh (HIAL), and senior advisor, Indian Institute for Human Settlements (IHS).

His name and work is mentioned in the twentieth edition of one of the main reference works in architectural history, A History of Architecture by Sir Bannister Fletcher.



Sanjay Seth

CEO, Green Rating for Integrated Habitat Assessment (GRIHA) Council

Sanjay Seth is Senior Director & Senior Fellow of the Sustainable Habitat Programme with The Energy and Resources Institute (TERI). He is also the Chief Executive Officer of GRIHA Council which administers the Green Rating for Integrated Habitat Assessment.

Prior to joining TERI, he worked with the Bureau of Energy Efficiency, Ministry of Power, Government of India and headed the vertical on Building Energy Efficiency. He was also the interim Secretary of the Bureau of Energy Efficiency and responsible for the administration and financial management of the organization.

He also represented BEE on the Board of Energy Efficiency Services Limited (EESL) as Director. By training, he is a Civil Engineer and has more than 33 years of professional experience both on the supply side and demand-side management.



Dr. Satish Kumar

President and Executive Director

Alliance for an Energy Efficient Economy (AEEE)

Dr. Satish Kumar is an international energy efficiency expert and serves as the President and Executive Director of the Alliance for an Energy Efficient Economy (AEEE). In his current role, he has led AEEE's transformation into a leading energy efficiency policy think tank and business enabling entity through a combination of thought and programmatic leadership, collaboration and partnership with Indian and global public, private and peer organizations, and fund raising. He has served as a senior energy efficiency advisor or technical expert in energy efficiency to the Ministry of Environment, Forest and Climate Change, NITI Aayog, Energy Efficiency Services Limited, Bureau of Energy Efficiency, Bureau of Indian Standards and Department of Science and Technology (DST), Confederation of Energy Efficiency. Prior to AEEE, he was the Vice President and Energy Efficiency Ambassador and led the Energy Management business at the Schneider Electric India Pvt. Ltd., a scientist at Lawrence Berkeley National Laboratory and led a very successful, USAID-supported, bilateral energy efficiency technical assistance program between US-India Government.

In his more than 25 years of professional career, he has held leadership positions in business, policy advisory, research and non-profit organisations in the USA, India and Europe and is recognized as a triple-sector leader. He has a Bachelor of Architecture from Indian Institute of Technology Roorkee, a Ph.D. in Building Science from Carnegie Mellon University and was selected by Schneider Electric for its Business Leadership Executive Program at University of North Carolina Kenan-Flager Business School and received the LEED Fellow status from the US Green Building Council in 2014.



Saurabh Diddi

Director
Bureau of Energy Efficiency

Saurabh is working as Director in the Bureau of Energy Efficiency. Earlier he worked with PricewaterhouseCoopers and National Productivity Council, India and is having wide experience in energy/resource conservation studies. He is a Mechanical Engineer with Postgraduate Diploma in Energy Management. In Bureau of Energy Efficiency, he is in-charge of Standard & Labeling program and earlier he was instrumental in the development of Perform, Achieve, and Trade (PAT) mechanism in Bureau. He led and carried out a number of energy efficiency studies addressing various facets like Demand Side Management, sectoral studies, preparation of reference manuals, cluster and unit level projects as well as capacity building initiatives. He also conducted several studies for an organization like World Bank, United National Environment Programme (UNEP), and USAID etc.

He has wide exposure & experience in alternatives evaluations and supports energy conservation initiatives with Corporate, International & National Agencies, ensuring appropriate approval and processes



Saurabh Kumar

Managing Director
Energy Efficiency Services Limited

Saurabh Kumar is an Indian Revenue Service officer of 1992 batch. He is an Electrical Engineer from Indian Institute of Technology (IIT) Kanpur and Masters in Public Policy from National Graduate Institute of Policy Studies, Tokyo, Japan. Mr Saurabh Kumar has worked in various capacities in the Income Tax Department, Ministry of Power, and Bureau of Energy Efficiency (BEE). He was Secretary, BEE during 2007-2010. He also proceeded on a UN Deputation to Bangkok and was handling environmental issues in Asia – Pacific region. Mr Saurabh Kumar has been appointed as the Managing Director, Energy Efficiency Services Limited by the Ministry of Power and he took over as the Managing Director of EESL on 6th of May 2013.

**Shailesh Agarwal**

Executive Director

Building Materials & Technology Promotion Council (BMTPC)

As Executive Director of BMTPC since 2008, an apex organisation under Ministry of Housing & Urban Poverty Alleviation, Govt. of India, presently working towards a mandate of Affordable Housing for All through Pradhan Mantri Awas Yojna (Urban) of the ministry and also operationalizing Technology Submission under PMAY to bring new housing technologies for faster & sustainable development at the grass root level for the common people of India. His current areas of work are alternate building materials & construction technologies, Disaster Mitigation & Management, Skill development & Capacity Building and Project Management & Consultancy.

Prior to this assignment, Dr Agarwal devoted 20 years to provide S&T backup in the area of building science & technology in the capacity of scientist at CSIR-CBRI with special emphasis on earthquake engg., structural dynamics, distressed structures, repair & rehabilitation, computer aided structural analysis & design through continued R&D with quality objectives in applied research, societal based R&D programmes, resource generation, and publications. Published around 100 research papers in journals, conferences, five books and a few dissemination & training CDs. Widely travelled in India and abroad for various national and international missions

**Shailesh Ranjan**

Head - Business Planning & Operations

Asahi India Glass Ltd

Shailesh Ranjan is Head – Business Planning & Operations Asahi India Glass Ltd (AIS). He has work experience of over 14 years. in glass industry for handling different profile like Business Intelligence, Product management, Project Management, Marketing, Strategy, Technical marketing, Business Planning & Operations. He has participated in various exhibitions and seminars as a keynote speaker delivering lectures on different dynamics of glass. He is certified trainer and evaluator for national green building rating system GRIHA. His key areas of expertise are in promoting energy efficiency in Architectural segment for different climatology and type of buildings.

**Shikha Bhasin**

Program Lead

Council on Energy, Environment and Water (CEEW)

Shikha Bhasin is a researcher on climate change mitigation policies with a keen interest in innovation systems of low-carbon technologies. She is currently leading The Council's research on cooling and phasing down hydrofluorocarbons (HFCs). She has previously worked on regulatory frameworks required to meet India's Kigali Amendment commitments, and the institutionalisation of an R&D platform for supporting the phase-out of HFCs in India. A

co-author of the India Cooling Action Plan (ICAP), she continues to serve as a member on the implementation committees for the ICAP on R&D and the servicing sector. A graduate of Delhi University and the London School of Economics and Politics, Shikha has worked extensively on policy-focused international technology cooperation research projects on climate change for over seven years with the German Development Institute (Bonn), the Energy Research Centre of the Netherlands (Amsterdam), and Radboud University (Nijmegen). Her research lies at the interface of policy and academia, and has been used to ascertain strategies in various governments, international organisations, and philanthropies. Shikha has served as an Advisory Board member to the Climate Technology Centre and Network (CTCN) instituted by the UNFCCC, and contributed to the inception and working of the UNFCCC's Technology Mechanism.



Shyama Agarwal

Founder
JOP Group

Shyama Agarwal, is the co-founder and Director of JOP International Ltd. along with her husband Mr Bharat Agarwal. The young couple founded JOP in 1989 led by their innate passion and love for building world-class buildings. Today, JOP is an organization of zealous engineers and space planners, rich in experience and high on commitment, which has helped the group to sustain professional excellence for more than 3 decades. It is a 30-year old real estate developer having completed 100+ projects in Delhi NCR and towns of Haryana. JOP has footprints across all verticals be it malls, townships, residential and group housings. JOP is committed to provide a lifestyle backed by the highest standards of construction, design ethics, product quality and the best of amenities and facilities.

Ms Shyama, is an Economics honours graduate from St. Xavier s college, Kolkata with also a diploma in interior design and planning. A third generation entrepreneur, she is one of the first few women to be an active contributor in the male focused real estate market.



Siddharth Singh

Lead India Analyst and Coordinator (Consultant)
International Energy Agency

Siddharth Singh is the Lead Country Analyst and Coordinator – India (consultant) for the International Energy Agency (IEA) based in New Delhi. He is the author of ‘The Great Smog of India’ (Penguin 2018), a book on India’s air pollution crisis. He was previously a German Chancellor Fellow at the Wuppertal Institute in Berlin, Guest Researcher at Nansen Institute in Oslo, and Associate Fellow at The Energy and Resources Institute (TERI) in New Delhi.

**Sivaram Krishnamoorthy**

Operations Officer

International Finance Corporation (IFC)

Handled donor relations and projects of at the green business centre of Confederation of Indian Industry (CII), India's apex industry association. Projects were in the domain of resource efficiency especially industrial energy efficiency and Green Buildings. Projects executed for World bank (IBRD) , IFC, Bureau of Energy efficiency (BEE) Govt of India,

UNDP, USAID DFID /British High commission, SDC etc. Sustainability services - Cleaner Production, Sector level sustainability studies, Energy Audits, Water audit, Energy Policy & GHG services. Specialties: clean tech projects, energy policy advisory, Industry association, Business development in Energy sector, Government liaison on Energy policy, Energy efficiency services

**S.M.H. Adil**

Simulation Specialist - Built Environments

Global Evolutionary Energy Design

Adil is a Built Environment Simulation Specialist he has 16 years of research, consultancy, training experience in Mathematical modeling for infrastructure design/optimization fields. Besides this he has served as a visiting faculty in School of Planning and Architecture ITO New Delhi, ISHRAE Education Research Foundation, Middle East Centre

for Sustainable Development (UAE), Center for Environmental Planning and Technology, Ahmadabad, and Jamia Millia University. He also authored and published research papers in national and international conferences in the related fields. He is one of the founding members of IBPSA (I) International Building Performance Simulation Association - India chapter. Where he along with other members, generate awareness of simulation-based engineering and design passionately. Currently, he serves as a Director in GEED Simulation Pvt. Ltd, beside his consultancy and research engagement with other bodies and institutions through his proprietary firm. His active engagement and interest include simulation of built environments for energy optimization, comfort and life safety. Further, his life safety work portfolio includes Fire/Smoke Modeling for NFPA 130, Tenability compliance, Evacuation and agent-based egress simulations for buildings and transit spaces.

**Sonam Wangchuk**

Founder-Director

Students' Educational and Cultural Movement of Ladakh (SECMOL)

Sonam Wangchuk was born in the trans-Himalayan region of Ladakh in J&K, India.

Though a Mechanical Engineer by education, he has been mostly working in the field of education reform for more than 27 years. In 1988, just after he finished his engineering studies he founded SECMOL (Students'

Educational and Cultural Movement of Ladakh) which aims to bring reforms in the government school system in Ladakh. In 1994 he was instrumental in the launch of Operation New Hope, a

triangular collaboration of the government, village communities and the civil society to bring reforms in the government schools system. The programme involved formation of Village Education Committees to take ownership of state schools, training of teachers in child friendly ways and re-writing and publishing localised text books for Ladakh. As a result the pass percentage at 10th grade (matriculation) rose from the dismal 5% to 55% in seven years and 75% these days.

For students who still failed in their state exams he founded the SECMOL Alternative School Campus near Leh, a special school where the admission criteria is failure in exams and not grades. However with the supportive and creative environment at the school, the so called failures have excelled in their chosen fields and risen to international acclaim as entrepreneurs, film makers, politicians, teachers and so on.



Dr. Soumen Maity

Team Leader - Technology
Technology and Action for Rural Advancement

Dr. Soumen Maity holds a Ph.D. in Materials Science from Central Glass and Ceramic Research Institute (CSIR). After a brief stint in CSIR, he joined Development Consultant Limited, Kolkata and was instrumental in managing an R&D Group on developing low-cost building materials.

During this period, he had set up two start-up companies, producing studio potteries and alternate building materials. Presently he is with TARA (Development Alternatives Group) leading the Innovation-Incubation-Multiplication value chain. His current sectors of interest are industrial waste utilization, resource efficiencies of small scale technologies, alternate building materials and technologies in producing them and water purification systems. He has also successfully transferred homegrown Indian technologies to Asia and Africa supporting them in the development process. Presently he is leading the development and application of Low Carbon Calcined Clay Cement (LC3) in India, Africa, and Southeast Asia.



Spondon Bhagowati

Green Building Consultant
International Finance Corporation (IFC)

As a Green Building Consultant for IFC's EcoCities Program in India, Spondon Bhagowati supports Government departments, Developers, Architects, Technology Providers, etc. in meeting energy-efficiency targets, such as the Nationally Determined Contributions which focus on reductions in emission levels and climate-resilient development. His work involves creating an enabling environment for the affordable housing sector to embrace low-carbon strategies and green building technologies. In addition, he is actively involved with identifying and supporting new and innovative technologies that may be scaled up for use in green buildings.

Spondon graduated from the School of Planning and Architecture, New Delhi. He's been working in the field of green buildings for over 9 years. His areas of expertise include sustainability

masterplans, net-zero buildings, green building certifications, and low-carbon technologies.



Sriram Kuchimanchi

CEO

Smarter Dharma

Sriram is an Ashoka Fellow and heads the leadership team at Smarter Dharma. He founded Smarter Dharma to inspire and enable organisational change towards sustainability.

Prior to founding Smarter Dharma, Sriram spent a decade building solutions for the telecom industry. He has served as the Fundraising Director of Association for India's Development, an NGO which played a crucial role in helping him imbibe the social angle to sustainability. Among his other initiatives are 500gallons and 500eco in the space of action for climate change.

Sriram envisions a world where every individual has the will and the choice to make socially and environmentally supportive decisions. He wants to see progress on the Global Goal #12 – Responsible Consumption and Production where businesses and governments naturally make sustainable choices. A USGBC LEED GA certified professional, Sriram has a master's degree in Sustainability from Presidio School of Business, San Francisco.



Dr. Sunita Purushottam

Head of Sustainability

Mahindra Lifespaces

Dr. Sunita Purushottam heads Sustainability at Mahindra Lifespaces. She is Certified GHG Emissions Inventory Quantifier and Fellow of the Royal Meteorological Society London. She is a PhD in Environmental Science and Engineering from IIT Bombay in Air pollution modelling and meteorology.

She has over 20 years of Sustainability Strategy and Environmental consultancy experience in areas of Environmental Impact Assessment, air emissions monitoring, modelling and meteorology, GHG Emissions Inventory and Carbon Offsets, carbon neutrality strategy and waste management strategy, and water risk. She has worked with regulatory bodies in the UK and India in various infrastructure development projects with a specific focus on air pollution modelling and defining air quality action management plans for rural and urban areas.

She has helped large companies globally to streamline their sustainability strategy through a systematic process oriented approach and enabled selection of right tools for the same for systematic sustainability disclosure management. She is well versed with use of data and technology in Sustainability management and has been associated with a startup for creation of a platform on ESG performance management. She has helped companies develop an understanding of ESG risks and importance of embedding in ERM systems.



Swati Puchalapalli

Director

TerraViridis Sustainable Design Consultants

Swati Puchalapalli is a Sustainable Design Consultant with 20 years of experience in Sustainable Habitat Design, computational analysis and environmental policy research. She is a founder director at TerraViridis, a Sustainable Design Consultancy, and the director of Sustainability at VeraTatva, a collaborative engineering consultancy specializing in ultra-high-performance design. TerraViridis works extensively with computer based building analysis to help architects make informed design decisions to maximize energy efficiency, improve comfort, integrate sustainable water management practices, Waste engineering, etc.

TerraViridis works with several of the country's leading architects and multi-nationals such as Infosys and Manipal Education and Medical Group helping them achieve best practice benchmark performances. Their iconic projects include the upcoming 1500 acre Government complex in Amaravati, High Court and Legislative Assembly.

Swati is a visiting faculty at CEPT Ahmedabad, Manipal Universities at Manipal and Jaipur, JNTU Hyderabad, RCEUS, Osmania University Hyderabad, TISS Hyderabad, etc. Swati has been associated with GRIHA for several years as a Founding Member as well as a TAC member. She is also on the informal advisory board for LEED India



Swayan Chaudhuri

Managing Director & CEO

Imagine Panaji Smart City Development Limited

Swayandipta Pal Chaudhuri is an Economist by training and Administrator having experience in the areas of economic growth, urban and regional development, public finance, poverty alleviation, innovation and public policy. He has been helping to create sustainable, equitable and economically vibrant cities and city-regions across several national as well as international assignments.

In his current capacity as the Managing Director & CEO of Imagine Panaji Smart City Development Limited (IPSCDL), the Smart City Special Purpose Vehicle (SPV), he is entrusted with the responsibility of the implementation of the Smart Cities Mission in Panaji City under the aegis of Ministry of Housing and Urban Affairs, Government of India.

Additionally, Mr Chaudhuri has been entrusted with the responsibility of implementation of AMRUT Mission in the State of Goa, as the Mission Director, for enhancement of quality of life of its citizens with special focus on providing basic services along with an emphasis on pedestrianisation and development of citizen centric infrastructure, ensuring universal access service for all.

Recently he has conceptualised the idea of Creation of an Urban Living Lab that is poised to address the complex challenges of Urban Development in India integrating global sustainable solutions and local innovation and entrepreneurship.

**Tanmay Tathagat**

Director

Environmental Design Solutions Private Limited

Tanmay leads the Environmental Design Solutions [EDS] team of consultants working on climate change policies, energy-efficient building design, building code development, energy efficiency policy development, energy simulation, and green building certification process. Since 2003 EDS has worked on hundreds of green buildings, energy efficiency, and policy research projects worldwide.

**Tanya Spisbah**

Director

Australia India Institute, New Delhi

Tanya Spisbah is a renowned and influential expert on Australia India relations, particularly with respect to health and sustainable development. A career diplomat with the Australian Department of Foreign Affairs and Trade for more than a decade, Ms Spisbah served from 2014-17 at the Australian High Commission, New Delhi, specialising in health and technology diplomacy for inclusive, sustainable growth. She notably led the health agenda resulting in the Australian and Indian Prime Ministers exchanging an MoU for Health and Medicine and facilitating Prime Minister level attention for research on e-waste and micro factories, leading to Australia-India collaborations. Other areas of policy leadership include smart cities, solar energy, infrastructure, governance and investment. She has negotiated free trade agreements with a number of Asian partners, including China, South Korea and ASEAN, led Australia's environmental goods negotiations in the Asia Pacific Economic Cooperation and represented Australia at the World Trade Organization on intellectual property and environmental goods. Ms Spisbah was formerly a lawyer with Minter Ellison, specialising in IP and technology. Most recently, Ms Spisbah was Head, Strategic International Engagement, at the University of New South Wales, Sydney, where she led international partnerships in renewable energy and other sustainable technologies. Ms Spisbah is passionate about the Australia-India relationship and sustainable development. She holds degrees in law, philosophy and economics and a Masters of Laws from University of Melbourne in International Trade and Development.

**Prof. Dr. Uta Pottgiesser**

Chair Heritage & Technology

OWL University of Applied Sciences & Art

Prof. Dr. Uta Pottgiesser is an architect and Chair of Heritage & Technology at TU Delft (Faculty of Architecture and the Built Environment) in the Netherlands since 2018 and Professor of Building Construction and Materials at OWL, University of Applied Sciences and Arts (Detmold School of Architecture and Interior Architecture) in Germany since 2004. She was appointed Professor of Interior Architecture at University of Antwerp (Faculty of Design Sciences) in Belgium from 2016–2019. She studied architecture at TU Berlin (Germany) from

1984-1991 and obtained her PhD (Dr.-Ing.) from TU Dresden (Germany) on the topic of “Multi-layered Glass Constructions. Energy and Construction” in 2002. Next to this she had several academic positions at OWL, University of Applied Sciences and Arts where she served as Vice-President for Research, Development and Internationalization from 2006-2011 and as Dean of the Detmold School of Architecture and Interior Architecture from 2012-2016. In 2012 she was a Visiting Researcher at the Getty Conservation Institute (GCI), Los Angeles.

Dr Pottgiesser has more than twenty-seven years of experience as a practicing architect and research scientist concerned with the protection, reuse and improvement of the built heritage and environment, in particular of 20th century architecture, its building envelopes, interiors and indoor comfort. As vice-chair of DOCOMOMO Germany, chair of the DOCOMOMO International Specialist Committee on Technology (ISC/T) and a member of the European Facade Network (efn) she researches, teaches and lectures internationally and is responsible for several international academic cooperations. She continues to be a reviewer and (co-) author of international journals and publications with a focus on construction and heritage topics.



Vaishali Nandan

Project Head
Climate Smart Cities
GIZ

Vaishali Nandan is Head, GIZ- Climate Smart Cities Project in India and has over 22 years of experience on various issues related to urban planning, climate change and urban basic services. She has worked with the government at national, state and city level, private sector, NGOs and the Academia across 10 states in the country. She is a member of several expert committees, including the expert committee for the Climate Smart Cities Assessment Framework with the Ministry of Housing & Urban Affairs.

Ms Nandan holds a Masters degree in Geography from the Delhi School of Economics and has studied Urban & Regional Planning from CEPT, Ahmedabad



Dr. Vasanti Rao

Director General
Centre for Media Studies (CMS)

Dr. Vasanti Rao is founder member and currently the Director General of CMS (Centre for Media Studies) - a research based think tank in India, since 1991. She also directs CMS VATAVARAN – Asia’s largest international film festival and forum on environment & wildlife.

She has completed her PhD in Media Studies from Jawaharlal Nehru University and has double Masters degrees in Psychology and Management. Dr Vasanti specializes in strategy development, designing, researching and evaluating development communication initiatives. She often gives advises, lectures, writes on the current Media Scene and Trends in India; Use of Mass Communication in Development Programs; Role and Impact of Mass media; Communication

Research; Behavior Change Communication and Entertainment Education Strategies.

Gender, Children and Conservation are three key areas of her concern and expertise. She has been part of number of government and non-government bodies / committees (including the Ministry Committee in drafting the Content Guidelines for the Broadcast Sector, Ad-hoc task force of the Cabinet Secretariat, Prime Minister's Office, etc.). She has to her credit numerous policy inputs, designing and organizing multi stakeholder events and research based publications.



Vedant Vijay Pujari

Managing Partner
Accures Legal

With a dynamic professional experience spanning over 15 years, Vedant is a well-known figure in the intellectual property (IP) legal circle in India. He founded Accures Legal in the year 2014 and in just 5 years has made notable value additions to the IP ecosystem in general. In February 2019, Accures Legal was awarded by the then Hon'ble Minister of Commerce & Industry and Civil Aviation, Mr Suresh Prabhu for its contribution to Strengthening Start-up Ecosystem in India.

Vedant was a part of the team appointed by the Department of Pharmaceuticals, Ministry of Chemical and Fertilizers to assess the impact of creation of IPR facilitation center at Hyderabad. He is also an IP consultant to the Federation of Indian Small and Micro & Medium Enterprises (FISME). He also sits on the Board of a public listed company Precision Camshaft Ltd. Vedant has trotted the globe as a speaker in several conferences and seminars of international repute. He has also conducted training programs in association with eminent industry organizations.



Smt Vineeta Kanwal

Joint Director
Bureau of Energy Efficiency

Smt Vineeta Kanwal is working as a Director in the Bureau of Energy Efficiency (BEE). She has been graduated from Delhi University in Economics and has also obtained Post graduation in Economics and M. Phil (Economics) in Higher Education. She has been working in the Bureau of Energy Efficiency for more than eight years and at present handling BEE's financing schemes as well as trading of ESCerts under PAT scheme. Before assuming office in the Bureau of Energy Efficiency, she had been working in respected organizations like National Council of Applied Economic Research, National Institute of Public Administration, Confederation of Indian Industry (CII), Pricewater House Cooper for ten years. She has experience of approximately 18 years in policymaking, research and analysis in infrastructure areas such as power, telecom, aviation, urban transportation and energy efficiency.



Vinod Gupta
Principal Architect
Space Design Consultants

Graduated in architecture from School of Planning & Architecture, New Delhi in 1969. He spent two years studying pre-fabricated housing in Denmark. From 1973 to 1989 he was full-time faculty of architecture at School of Planning & Architecture, New Delhi. In 1984 he completed his work for Ph.D. at the Center for Energy Studies, Indian Institute of Technology, Delhi. Among the special findings were the use of texture on buildings and the fragmentation of form to achieve cooling in the desert city of Jaisalmer.

He initiated the teaching of passive solar architecture and energy conservation in buildings at the School of Planning & Architecture, New Delhi. He continues to be a visiting professor in architecture and industrial design at the School of Planning & Architecture, New Delhi, advisor to the Delhi Urban Arts Commission and member of the Board of Studies and the Committee on Doctoral Programmes at SPA. He has been at the forefront of the green /energy-efficient building movement in India and is a member of the Technical Advisory Committee for Griha- the national green building rating system. He is also a founder member of the Association for Development and Research of Sustainable Habitats (ADaRSH)



Dr. Vishal Garg
Professor
IIIT Hyderabad

Dr. Vishal Garg is associate professor and head of the Center for IT in Building Science, International Institute of Information Technology (IIIT), Hyderabad, India. His current research interests are in the areas of energy simulation and cool roofs. He teaches building automation and controls, energy simulation and lighting design and technology. He has conducted several national and international workshops on intelligent buildings, green buildings and energy simulation. He holds a BTech (Hons.) degree in civil engineering from MBM Engineering College, Jodhpur and a PhD from the Indian Institute of Technology, Delhi, India.

Dr Garg is actively involved in the green building movement, development of eTools and educational platforms for advancing energy efficiency in buildings and energy efficiency building code and its implementation. He was the founding president of the Indian chapter of International Building Performance Simulation Association and chaired the organizing committee of the international conference - Building Simulation 2015.

**William Prindle**Vice President
ICF

William Prindle helps lead ICF's growing Energy Efficiency business within the Energy and Resources practice. He supports various programs in U.S. EPA's Climate Protection Partnerships Division, leads the firm's tracking initiative for the American Recovery and Reinvestment Act's energy efficiency provisions, works with utility clients on energy efficiency programs and regulatory issues, and supports other ICF climate policy and strategy efforts.

Prior to joining ICF in 2008, Mr Prindle served as Deputy Director at the American Council for an Energy-Efficient Economy, a leading policy research and advocacy non-profit group founded in 1980 by leading research scientists to articulate the policy case for energy efficiency. He directed ACEEE's energy policy program, conducting policy analysis and advocacy on energy efficiency issues at the national and state levels, and also oversaw internal operations. Prior to joining ACEEE in 2002, he directed buildings and utilities programs for The Alliance to Save Energy for several years.

**Dr. Winfried Damm**Cluster Coordinator
GIZ

Dr. Winfried Damm graduated at FU Hagen, Germany, received an MBA from Michigan State University (USA) and a Ph.D. from FU Berlin. He worked for two years as a consultant, four years for a member of the national parliament in the energy sector and joined the municipal utility (Stadtwerke) of Leipzig in 1992. There he headed sales, marketing, PR, strategy, controlling, M&A, international department and was responsible for external relations among others. He had been involved in many national legislative outcomes starting with the first feed-in-law for renewables up to capacity market discussions and pushed Leipzig to one of the leading cities in e-mobility.

Dr Damm started working with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in December 2014 and joined the GIZ India office in January 2015 as Director of the Indo-German Energy Programme



Dr. Yashkumar Shukla

Technical Director (Energy Systems)

Center for Advanced Research in Building Science and Energy (CARBSE)
CEPT University

Dr Yashkumar Shukla is Technical Director (Energy Systems) at Centre for Advanced Research in Building Science and Energy (CARBSE). He has more than fifteen years of international experience in building energy-efficiency research and serves as a lead on several energy-efficiency research projects at CARBSE. His current research includes calibration of simulation models, performance characterization of envelope and HVAC systems, net-zero energy buildings, and development of next-generation control algorithms. He has extensive experience in the building management systems, building energy analysis, HVAC system operation, component characterization facilities, development of test chambers, building simulation modeling, and energy efficiency control algorithms. His prior work experience also includes providing technical support in designing and implementing commercial and residential energy-efficiency programs throughout the US. He possesses several professional certifications including certified measurements and verification professional (CMVP), Home energy rating system (HERS), GRIHA Trainer, and ECBC Master Trainer. He has also served on technical committees at various national and international forums.



EXHIBITOR

■ About the Exhibition

The ANGAN International Exhibition was organized at Hotel The LaLit, New Delhi from 9th – 11th September, 2019. The Exhibition was endorsed by 71 representatives from 39 organizations (29 national and 10 international). The objective of the exhibition was to provide a platform for various stakeholders from the demand and supply side of the building and construction industry to connect. The exhibition showcased emerging, innovative and indigenous solutions relevant to the construction industry from an energy efficiency standpoint.



■ About the Exhibitors

Exhibitor: **AGV ALFAB LTD.**

Exhibit: **Pre-fabricated Aluminium Façade, Doors and Windows; Construction Technology/ Material**

AGV ALFAB LTD has been a leading Aluminum Facade Contractor and manufacturer of pre-fabricated doors & windows in India with experience of more than 25 years. Their manufacturing unit is in Kala Amb, Himachal Pradesh, India which has the required infrastructure for Aluminum fabrication unit including surface treatment plants for powder coating and PVDF coating using Akzonobel paints with a capacity of 8 tones/8 hrs. Their projects not only range across multiple cities in India but also extend to Bhutan, Africa, Nepal and Brunei. Their products include Curtain wall systems, Structural Glazing systems, Aluminium doors and window, Aluminium Thermal break Window and Door, ACP cladding systems, Aluminium Louvers, Spider Glazing, Automatic Sliding doors, Frameless Glazing and doors.

Exhibitor: **Alien Energy Pvt. Ltd.**

Exhibit: **Solar, LED Lights, Energy Audit; Building System/ Technology**

AGC is the leader in Energy Efficiency measure's and manufacturing of Energy Efficient products. Alien energy operates in business areas of Energy Efficiency, Energy Audit, Luminaries, Lighting Electronics, Automotive and Special lighting with Energy saving potential up to 70%. Alien Energy is also the largest solar rooftop developers in Delhi NCR region, and has successfully installed solar roof top power plants of capacity more than 1 MW. They also organize green awareness programmes for Resident Welfare Associations (RWA) and provide installation of LED and energy efficient lighting.

Exhibitor: **Armcell India Pvt Ltd**

Exhibit: **Insulation Products; Construction Technology/ Material**

Armcell, the successor company to Armstrong World Industries' insulation products division, was founded in 2000 following a management buyout. As an independent company with financially strong investors, Armcell is expanding into new markets. In addition to strengthening its position as global leader in the market of technical insulation materials the company has successfully tapped into new fields of business, such as manufacturing and marketing foam plastics for a wide variety of applications. In addition to conventional thermal insulation materials to protect against heat and cold, the company today offers a wide range of covering systems, fire protection and noise control solutions, pre-insulated pipes, special insulation systems for applications in different industries. Armcell's insulation materials are designed for both new and existing installations, and they are used in residential and nonresidential buildings, process industries, transportation and the oil and gas industry.

Exhibitor: **Asahi India Glass Ltd (AIS)**

Exhibit: **Glazing; Construction Technology/ Material**

AIS is India's leading integrated glass solutions company and a dominant player both in the automotive and architectural glass segments. It commands over 70% share in the Indian automotive glass market. Established in 1984, AIS' footprint today spans the entire spectrum of the automotive and architectural glass value chains. Formed by the merger of AIS Float and Glass Solutions SBU's (Strategic Business Unit), AIS Architectural Glass Solutions manufactures quality float glass, provides captive supply to AIS Auto Glass Business unit, and creates its own processing requirements for a range of high-end architectural glass products.

Exhibitor: **ASSOCHAM**

Exhibit: **Green Building Rating System; Ratings, tools and metrics**

ASSOCHAM is the oldest apex chamber of India started its endeavour of value creation for Indian industry in 1920. Having in its fold more than 100 National Councils, National and State chambers, Trade Associations and serving more than 4 lakh direct and indirect members from all over India. They have presence in almost all the states through direct regional offices and regional chambers. ASSOCHAM has taken a Green Initiative and formed a Council for Green and Eco-friendly Movement (CGEM) that executes "GEM Sustainability Certification Program" with an objective to promote environment friendly green building design and construction. Through this initiative, ASSOCHAM awards GEM Sustainability Rating to buildings and related developments. GEM Rating System has made rapid strides in the Green Building Sector which covers 20+ projects across India and 100+ GEM Certified Professionals.

Exhibitor: **Bharat Bricks**

Exhibit: **Bricks and Tiles, Construction Technology/ Material**

For more than 24 years, Bharat Bricks, manufacturing a wide range of machine made bricks has helped build better, more stylish and more secure homes. The machine made bricks use de-airing pug-mill, which is latest innovation in the clay processing industry. Products include perforated clay bricks, solid and extruded blocks and roofing tiles with varying sizes and density. The bricks provide resilience to weather, heat, cold, water and wind, resulting in year round protection and energy savings. Buildings constructed using these products can achieve an average energy savings of 5% per year compared to homes with other siding.

Exhibitor: **BNAL PREFABS PVT.LTD.**

Exhibit: **Insulation Products; Construction Technology/ Material**

BNAL PREFABS Pvt. Ltd. Is a registered MSME unit based out of Chandigarh with manufacturing facilities at Barwala – Haryana and Baddi – Himachal Pardesh. BNAL Prefabs Pvt. Ltd. Manufactures a large range of PUF insulated sandwich panels with a variety of outer finishes and insulating core of Polyurethane Foam (PUF) of PUR/PIR Grade as per specification and requirement. The steel skin on both the sides is pre-painted with a variety of

finishes over hot dip galvanized / galvalume steel. Architectural coatings include polyester, poly vinyl di fluoride and many other options in a wide range of colors and finishes. BNAL uses foaming systems that are 100% free from CFC and HCFC which are known Ozone depleting substances.

Exhibitor: **Bureau of Energy Efficiency (BEE), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), The Energy and Resources Institute (TERI)**

Exhibit: **Energy Efficient Building Materials Directory; Ratings, tools and metrics**

GIZ has contracted TERI for conducting a comprehensive study on the status of Energy Efficient Building Materials in India to assist BEE. The lead executing agency and implementation organization for the above study will be BEE on behalf of the Ministry of Power, Government of India. The foremost project activity covers mapping of 5000 building materials across India along with their manufacturers and suppliers and conducting its market assessment and techno-economic analysis. This directory would eventually be hosted as a tool on ECO-NIWAS Portal of the BEE, Ministry of Power, Government of India. The objective of the materials tool is to assist the building practitioners, developers and policy makers, in taking informed decision w.r.t material selection.

Exhibitor: **Bureau of Energy Efficiency (BEE)**

Exhibit: **Awareness Programme; Books and publication on sustainable building**

The BEE of the Government of India and GIZ under the Indo-German Technical Cooperation, have jointly agreed to promote the “Indo-German Energy Programme” (IGEN) with the aim to promote Buildings Energy Efficiency, which is aligned with the commitments made by the Government of India to meet its objectives submitted under NDCs.

Exhibitor: **Campus France**

Exhibit: **Academic Counseling**

Campus France is a government agency that operates under the French Ministry of External Affairs. Campus France provides personalized counseling sessions and organizes various workshops throughout the year for students looking to pursue education in France. These sessions’ help students acquire relevant and necessary information about the programs offered by different French institutions. They also organize events like Choose France Tour with French Institutions representatives, Tech Fair, other international fairs and pre-departure sessions.

Exhibitor: **CII - Indian Green building Council (IGBC)**

Exhibit: **Green Building Rating System; Ratings, tools and metrics**

The rating systems evolved by the IGBC over the last 17 years are based on a long-term strategy for promoting green buildings in India. The broad approach has been to facilitate the movement by creating a committed fraternity of green building champions, prepare the market for materials & capacity building and most importantly demonstrate the benefits of green buildings through actual implementation. The Council draws its strength from a large

member base including architects, developers, consultants, manufacturers who have been supportive of all the green building initiatives of IGBC, since its formation in August 2001. Today more than 5,400 IGBC green buildings, with a built-up area of over 702 Crore sq.ft., are being constructed all over India using the rating system.

Exhibitor: **Daikin Airconditioning India Pvt Ltd.**

Exhibit: **Magnetic Levitation Centrifugal Chiller Technology; Building System/ Technology**

Magnetic Levitation also known as Maglev chillers are oil free chiller operate on magnetic bearing technology. Like other centrifugal compressors, the Magnitude compressor utilizes centrifugal energy, imparted on refrigerant gas by a rotating impeller, to increase pressure. However, unlike a standard centrifugal chiller in which the compressor shaft/impeller assembly rides on conventional bearings, in all Magnetic Levitation products, a magnetic bearing system levitates the shaft/impeller assembly inside of the compressor body and the shaft practically rotates in air. Having no surface contact, no friction in Magnetic bearing systems, leads to infinite life of the bearing with no wear & tear. Maglev chillers have integrated variable frequency drives. The VFD is integral to the compressor body either inside the compressor enclosure or housed in a separate panel mounted on the chiller. The integrated VFD is a significant contributor to the industry-leading efficiency of the magnetic bearing chillers.

Exhibitor: **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Greentech Knowledge Solutions Pvt. Ltd. (GKSPL), Bricks by Dadoo, Jindal, Prayag Clay and Wienerberger**

Exhibit: **Resource Efficient Brick (REBs), Construction Technology/ Material**

REBs are defined as burnt clay perforated and hollow bricks or clay fired bricks having holes. There are multiple environment benefits of burnt clay REBs, which range from savings of fuel and clay, reduction in emission of particulate matter, black carbon and GHG emissions during manufacturing. There are additional benefits in the form of savings in mortar, plaster, faster construction during construction and the walls made from burnt clay fired bricks have better thermal insulation properties.

Exhibitor: **Earthood Services Private Limited (ESPL)**

Exhibit: **Environmental Services; Services, Design, Construction Consultancy, etc**

ESPL which is founded by a dynamic group of professionals who have academic background from the institute of national and international repute (IIT Delhi, IIT Bombay, and IIM Calcutta) and rich professional experience in the field of energy, environment, climate change, water resources and sustainable development. ESPL offers various services in the field of EIA, Environment Due Diligence, Hydrogeology, Rainwater Harvesting, Water Auditing, Green Building, Industrial Hygiene, Electrical Safety Audit and Investment-grade Energy Audit. ESPL also offers numerous services & solutions in the field of Climate Change, Environment, Remote Sensing, GIS and Occupational Industrial Hygiene. The experts at ESPL have helped more than 450 projects to achieve substantial energy savings across the world.

Exhibitor: **Econaur**

Exhibit: **Sustainable Building Product Directory; Services, Design, Construction Consultancy, etc**

Econaur is a platform which sells and showcases new and sustainable products catering to the construction industry by directly partnering with the sustainable product companies. Econaur is the only comprehensive sustainability platform which showcases as well as provides customization of sustainable products for the building and construction industry. Econaur aims at making our lifestyle more sustainable by introducing sustainable practices which aim to save natural resources, reduce energy consumption and decrease pollution. The vision of the organization is to support & reach targeted customers in rural as well as in urban areas. Other targeted customers are from various industries from the hospitality & commercial sector that can implement sustainable practices to save money & make self-sustaining buildings.

Exhibitor: **Everest Industries Limited**

Exhibit: **Boards and Panels; Construction Technology/ Material**

Everest has been a pioneer in developing new age building products which help build with Strength, Speed and Safety. Everest Boards adequately fulfill the promise of “One Board Many Applications“. These boards offer superior resistance to moisture, termite and fire unlike other conventional wood based material like Plywood, Gypsum, Particle Board and MDF. That makes it an ideal for variety of applications in residential, commercial and industrial segment. These are 100% asbestos free product, energy efficient and environment friendly. This is certified by IGBC and GRIHA. The Boards and Panels are used in walls, wall linings, partitions, false ceilings, claddings, floors and pre-fabricated shelters.

Exhibitor: **GL Enterprises**

Exhibit: **Thermal and acoustic Insulation products; Building System/ Technology**

The company displays a full range of Thermal and acoustic Insulation products which are necessary for thermal comfort and building envelope for energy conservation. Focus is on providing right solution for each application and geographical location. GL Enterprises help designers select materials and thickness as per ECBC/ GRIHA for various weather zones. They also provide insulation audit services in accordance with Indian and international codes including National Building codes and requirement of Green Buildings. Products include Fiberglass wool, Rockwool, Nitrile RUBBER, EPDM, Cross Linked Polyethylene foam, PUF, Expanded polystyrene, Extruded Polystyrene, Ancillaries and Low VOC Adhesives.

Exhibitor: **Global Association for Corporate Services (GACS)**

Exhibit: **Industry Association & Platform; Services, Design, Construction Consultancy, etc**

GACS is an association passionately driven by leaders in the field of corporate services across the globe. This is a forum of working professionals from across various sections of corporate services, providing Knowledge Management, Crisis Support and Networking opportunities to its members. In its larger role, this domain can provide governance support

structure & guidance to various governmental / non-governmental organizations to ensure ease of doing business. The mission of the organization is to be the voice of corporate services fraternity across the globe and to cut across geographies and create an interactive platform for professionals around the globe.

Exhibitor: **Green Rating for Integrated Habitat Assessment (GRIHA)**

Exhibit: **Green Building Rating System; Ratings, tools and metrics**

The GRIHA Council is an independent, not-for-profit society jointly setup by The Energy and Resources Institute (TERI) and the Ministry of New and Renewable Energy (MNRE), Government of India to promote and administer green buildings in India.

PRAROOP, a simulation tool developed by GRIHA, along with banners and case studies on affordable strategies to improve energy efficiency, reduce fresh water consumption and increase renewable energy usage in buildings. PRAROOP was to demystify the myth that sustainable is not affordable. PRAROOP will allow users to choose materials to design a G+1 virtual green building for themselves. The simulation model will generate a green-score to indicate the level of sustainability and cost effectiveness of the building. “PRAROOP” is instrumental towards helping users understand the relationship between sustainability and affordability.

Exhibitor: **GreenJams Infrastructures LLP**

Exhibit: **Hempcrete Blocks, Agrocrete Blocks; Construction Technology/ Material**

GreenJams Infrastructures is an award-winning construction-based startup founded with a vision to integrate the built environment with the natural environment. To achieve this foundational goal, GreenJams is innovating technologies that use agricultural wastes such as hemp stalks, wheat straws, etc., and industrial wastes such as slags, pulverized fuel ashes, clays, etc., to develop a bio-based building material that competes with conventional materials such as AAC blocks, concrete blocks, etc.

Hempcrete is a type of vegetal concrete building material that utilizes the stalks of the hemp plant and a low carbon limebased binder. Agrocrete is made up of the residues of fiber crops such as jute/kenaf/nettles stalks and a low carbon lime based binder. Blocks made up of Agrocrete and Hempcrete is available in the form of lightweight blocks compatible with traditional masonry practices for interior and exterior walls as both walling and insulation.

Exhibitor: **Gujarat Guardian Limited**

Exhibit: **High Performance Glazing, Construction Technology/ Material**

Gujarat Guardian Limited, a Joint Venture between Guardian Industries Corp. and Modi Rubber Limited, is one of the India’s leading manufacturer of float, coated and mirror glass products. At its facility in Gujarat, Gujarat Guardian Limited produces high performance glass for use in exterior facades of buildings (both commercial and residential), interiors and automotive applications. One can find Gujarat Guardian Limited glass in homes, offices, cars and some of the India’s most iconic architectural landmarks. Guardian Industries, a global

company headquartered in Auburn Hills, Michigan, employs 18,000 people and operates facilities throughout North America, Europe, South America, Africa, the Middle East and Asia.

Exhibitor: **Indo-Swiss Building Energy Efficiency Project (BEEP)**

Exhibit: **Insulation Products, External Shading; Construction Technology/ Material**

The Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation project between the Federal Department of Foreign Affairs (FDFA), of the Swiss Confederation and the Ministry of Power (MoP), Government of India. The Bureau of Energy Efficiency (BEE) is the implementing agency on behalf of the MoP while the Swiss Agency for Development and Cooperation (SDC) is the agency in charge on behalf of the FDFA. The Project Management and Technical Unit (PMTU) are responsible for programme implementation which includes selected technical work, management tasks and programme outreach. The theme of the exhibit was “Building Technologies for an Energy Efficient Building Envelope”. The technologies exhibited included building insulation products and external movable shading in buildings.

Exhibitor: **ISHAAN INDUSTRIES**

Exhibit: **Heat Resistant Tiles, Mortars and Paints; Construction Technology/ Material**

ISHAAN INDUSTRIES has emerged from parts of and as a spin-off from the activities of the Parshuram Potteries Ltd, the pioneer in the manufacture of ceramic-ware in India. The Company, with the best-of-breed technology, offers fresh and sophisticated cool solutions to any type of project. Their ethos is one of continual research and development reflecting the radical innovation occurring within high-performance building movement. This allows them to provide access to their mainstream product, THERMATEK® Heat Resistant Terrace Tile, complemented by listed product set that include THERMATEK® Cool Mortar and THERMATEK® Colored Heat Reflective Paint. These patented products keep the building structure cool by not absorbing/conducting heat. It reflects the heat and infrared rays from the sun and has the capability to reduce the slab temperature by up-to Twenty-two degrees during peak summers.

Exhibitor: **Jindal Mechno Bricks Pvt Ltd**

Exhibit: **Roofing Tiles, Hollow Clay Blocks, Fly Ash Products; Construction Technology/ Material**

Jindal Mechno Bricks Pvt Ltd is a leading manufacturer of machine made bricks, unglazed ceramic cladding tiles, brick pavers & hollow blocks. After manufacturing handmade bricks since 1972, Jindal Mechno Bricks Pvt Ltd, an ISO 9001: 2008 certified company, was founded by Late Shri HansRaj Jindal & sons in 1996 to manufacture machine made bricks which are ideal to be left exposed, need not be plastered or painted. Today, bricks and related products are manufactured using both technologies of press and extrusion. We are using the latest European machines & technologies and raw materials are thoroughly tested and processed in a systematic way so that the finished products have the best quality.

Exhibitor: **KCBROS**

Exhibit: **HVAC Equipment and Insulation; Building System/ Technology**

KCBROS have been in the HVAC & R field for the last 70 years. They have offices in three different cities in India and a good network of dealers and distributors for their 8000+ products with more than 100,000 customers. KCBROS exhibited their ventilation equipment which could improve the Indoor Air Quality in buildings and provides thermal comfort and thermal insulation products which holds the potential of increasing building energy efficiency up to 50 %.

Exhibitor: **LLOYD INSULATIONS (INDIA) LTD.**

Exhibit: **Insulation Products; Building System/ Technology**

Thermal Insulation system is an important component for Green Construction. Thermal Insulation materials are Green products and suitable for construction of buildings. Rockwool insulation material is the greenest insulation product made partially from waste and consumes very less energy to produce. The product is CFC HCFC free and does not contain any harmful substances. The product is suitable for application in building roof and walls. In addition Rockwool is noncombustible and of a water repellent grade which makes it very safe to use in human habitat. Rockwool can be used in conjunction with building RCC and brick components. Rockwool is also used for manufacturing prefabricated panels used for building construction as well as commercial establishments, airports, ware houses etc.

Exhibitor: **Mahindra Lifespaces**

Exhibit: **Research and Development; Ratings, tools and metrics**

Mahindra TERI Centre of Excellence for Sustainable Habitats was set up in partnership between Mahindra Lifespace and The Energy and Resource Institute. The COE aims to engage with various stakeholders in the ecosystem such as suppliers, architects, technical experts to leverage the outcome of this research in designing buildings with low embodied carbon, better visual comfort and ensuring water conservation. The CoE creates an enabling environment for adoption of green material by developing a credible database /inventory of sustainable materials which should also be readily available for use through various online platforms like apps, websites etc. Mahindra Lifespace Developers Ltd. is one of the leading real estate development companies in India.

Exhibitor: **Namdhari Eco Energies Pvt Ltd**

Exhibit: **Chiller Optimizer; Building System/ Technology**

Eco Energies specializes in solving energy efficiency challenges in today's highly demanding environments by helping companies improve their energy efficiency by auditing their site and identifying the energy saving opportunities. They take up the consulting as well as the turnkey projects for implementation of Energy conservation measures. They have also designed online Energy Management systems like Energy Log, Solar Energy Log, Chiller Optimizer etc. These tools make sure that the site maintains its energy efficiency level even after years. The chiller optimizer is an online automatic monitoring and controlling

tool which gather all performance parameters from the centralized Air conditioning plant, analyzes it and gives certain commands.

Exhibitor: **Passive House Institute**

Exhibit: **Research and Development; Ratings, tools and metrics; Books and publication on sustainable building**

The Passive House Institute (PHI) is an independent research institute, who developed the international Passive House standard to achieve high performance buildings. Thanks to a high quality building envelope and suitable mechanical systems, Passive House buildings consume up to 90% less heating and 80% less cooling energy than existing buildings, depending on climate. At the same time they provide better living and working conditions (comfort, good air quality).

PHI has played a crucial role in the development of the Passive House concept. Following the construction and monitoring of the first pilot project (Darmstadt, Germany, 1990), PHI has assumed a leading position with regard to research on and development of construction concepts, building components, planning tools and quality assurance for especially energy efficient buildings. PHI has been responsible for the building physics related consultancy and technical guidance on a number of firsts (offices, factories, schools and gymnasiums, indoor pool halls, retrofits).

Exhibitor: **Pilkington Glass India Pvt Ltd**

Exhibit: **Glazing; Construction Technology/ Material**

Founded in 1826 and a member of NSG group, Pilkington is recognized as the world's technological leader in glass. The Float Process was invented by Sir Alistair Pilkington in 1952. Over the past 50 years almost every major advance in glass has come from Pilkington. Pilkington products help control energy usage, protect against fire, insulate against noise, provide safety and security, afford decoration and privacy and are used to build all-glass façades. Pilkington is a market leader in the use of large-scale coating, laminating and silvering processes. The Pilkington Building Products range of high performance glass includes products for just about every application. The float glass process, developed by Pilkington in 1952, is now the world standard for high quality glass production. Float glass is often processed further before being fitted into buildings and vehicles.

Exhibitor: **Rockwool India Pvt Ltd**

Exhibit: **Insulation Products; Construction Technology/ Material**

Rockwool (India) Private Limited, incorporated in 1987 manufactures stone wool insulation under the brand name of ROCKINSUL and TUFFINSUL for Thermal Insulation (Hot and Cold), Acoustic Insulation and Fire Safety applications in buildings and industries. They are a leading insulation solution provider in India, Middle East, Africa, the Far East and other Asian countries. It has been servicing various industries including power plant, refineries, petrochemicals, sugar mills, cement plants, textile mills and other processing industries. The products are used for thermal insulation and energy conservation in hot and cold pipe lines

and in equipment like ESP's, chimney, tanks, boilers, ducts, ovens, etc. The products are also used in building applications for partition walls, sandwich panels, wall & roof Insulation in PEB structures and in commercial building like hospitals, shopping malls, offices spaces, airports, metro rail systems etc.

Exhibitor: **Rothenberger India Pvt Ltd**

Exhibit: **Refrigeration & Air-Conditioning technology; Construction Technology/ Material**

For more than 60 years, ROTHENBERGER has been a worldwide leader in producing innovative, technologically demanding insulation and building technology. With more than 5,000, ROTHENBERGER offers the world's most complete line of modern premium pipe tools and machines, as well as environmental technology. Exhibited products included lightweight recovery unit for the recovery of refrigerants of the class A1, A2L and A2 (including R32), suitable for all unit sizes thanks to its high recovery rate.

Exhibitor: **SAVITA POLYMERS LIMITED**

Exhibit: **Ester Oil, Building System/ Technology**

bioTRANSOL HF is an indigenously developed Natural Ester based di-electric fluid manufactured from vegetable oil (Soybean Seeds). It is made from Soybean Oil (>98%), contains no petroleum, silicones or sulfurs and is non-toxic to aquatic life and soil. The product also biodegrades in less than 28 days (as per OECD 301B). With its chemistry; it has capability for faster moisture extraction from paper insulation over the winding while maintaining its electrical breakdown voltage (BDV) value thereby increasing performance and extending life of the Transformer. Life of the solid insulation with Natural Ester fluid will be 5 to 8 times more than MO filled Transformer.

Exhibitor: **School of Planning and Architecture, New Delhi (SPA New Delhi)**

Exhibit: **Shading Device; Building System/ Technology**

SPA New Delhi is a premier higher education federal institute located in New Delhi, India specializing in education and research, and serving as the national center of excellence, in the fields of Planning and Architecture. The 'Universal' M.A.A.S.C Shading Device is a low-cost, sustainable, readily available reckoner that can be installed on multiple building typologies, window configurations, & facade directions helping to regulate the sun light in a way to provide ambient comfort to the users for both thermal & visual conditions and thus also save energy consumption for the same. The Products have been developed under the aegis of Design Innovation Centre. Design Innovation Centre (DIC) which was set up at SPA New Delhi as a part of National Initiative of Design Innovation (NIDI) with the mandate to spread design education and propel R & D activities in Design.

Exhibitor: **SEE-Tech**

Exhibit: **Energy Saving Performance Contracting (ESPC), Implemented Projects**

It is an Energy service company (ESCO) operating all over India, accredited By Bureau of Energy Efficiency (BEE): as “Grade-I”. It has carried out more than 500 Assignments in the field of energy conservation since last 20 years. SEE-Tech has received the Award for excellence in energy conservation and management, AEE-USA, BEE, EESL, MEDA and MSME. The approach to ESPC Projects focuses on savings, not project or products. It provides a One Stop Solution and Total Integration of Product, Project & Services for long term returns. Through transparent Measurement & Verification (M&V) and access to almost all technologies, energy efficiency specialist deliver energy cost savings for all projects.

Exhibitor: **Smart Joules Pvt. Ltd.**

Exhibit: **The Internet of Things (IoT); Retrofitting for Energy Efficiency; Building System/Technology**

Smart Joules makes it easy and profitable for businesses to eliminate wasted energy consumption. The JoulePAYST[™] (Pay-As-You-Save) model guarantees commercial buildings a 15% reduction in energy in return for a high percentage share of the delivered savings under a five to seven-year contract. These savings are delivered by redesigning their cooling systems, retrofitting key equipment with best available technologies, and optimizing operations with DeJoule[™] technology. DeJoule[™] comprises a web based architecture, high-performance IoT hardware, intuitive user interface and a powerful data processing engine configured with energy saving algorithms (called Joule Recipes) to continuously identify and correct for hidden inefficiencies. In addition to 0.5-1% bottom line improvements, clients enjoy greater reliability, trouble-free data-based maintenance and boosted reputation as sustainability champions.

Exhibitor: **Technology and Action for Rural Advancement (TARA)**

Exhibit: **Limestone Calcined Clay Cement (LC3); Construction Technology/ Material**

Society for TARA is a social enterprise set up in the year 1985 at New Delhi, India. It is an “incubation engine” of the Development Alternatives Group which has been providing development solutions in India and elsewhere. In recent years, LC3 has emerged as one potentially viable solution in addressing the looming environmental and resource crisis. LC3 is an innovative cement variety that is composed of a ternary blend of Portland cement clinker, limestone and calcined clay. It has been developed through sustained, collaborative efforts of multiple organizations namely EPFL (École Polytechnique Fédérale de Lausanne) Switzerland, TARA India, CIDEM Cuba, Indian Institute of Technology (IIT) Delhi and IIT Madras, with support from the Swiss Agency for Development and Cooperation (SDC).



Exhibitor: **The Energy Resources Institute (TERI)**

Exhibit: **Publications; Books and publication on sustainable building**

TERI Press, the publishing arm of The Energy Resources Institute (TERI), is one of India's first green publishers, produces high quality text, reference, and popular books and magazines in the areas of environment, energy, and sustainable development. TERI Press has excellent publications that sensitizes the readers on environmental issues and prepare them for a 'green' future as well as inform them about the latest environmental research.

TERI is one of the most active environmental education providers in India. Every year, we bring out new, updated titles of our knowledge books on environment and sustainable practices providing you with better content, current topics and reading resources. The TERI higher education and reference book catalogue presents book for every type of reader interested in field of sustainability. We provide the best peer-reviewed, knowledge materials to engage professionals and students on different environmental topics.

Exhibitor: **The FIRST Construction Council (FCC)**

Exhibit: **Magazines; Books and publication on sustainable building**

The FIRST Construction Council (FCC) is an infrastructure think-tank, focused on providing the latest updates on the construction industry in India, and dedicated to promoting its causes and needs. FCC provides a platform to promote the adoption of best practices, and be the torchbearer for all policy initiatives that are needed to enhance the importance and welfare of the construction industry and the industry's unified voice. FCC, through its various resources, is in constant dialogue with state and city governments, and leaders from the industry in order to identify opportunities to improve its state.



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