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Government of India

Azadi Ka Amrit Mahotsav

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Swiss Agency for Development and Cooperation SDC

ANGAN 2022

AUGMENTING NATURE BY GREEN AFFORDABLE NEW-HABITAT

Making the ZERO Carbon Transition in Buildings

COMPENDIUM

An International Conference on Building Energy Efficiency
14th - 16th September, 2022 | New Delhi, India

BEEP
BUILDING ENERGY EFFICIENCY PROJECT

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List of Abbreviations

- AAC - Autoclaved Aerated Concrete
- AC - Air Conditioning
- AEEE - Alliance for an Energy Efficient Economy
- ANGAN - Augmenting Nature by Green Affordable New-habitat
- ASHRAE - The American Society of Heating, Refrigerating and Air Conditioning Engineers
- BEE - Bureau of Energy Efficiency
- BEEP - Building Energy Efficiency Project
- BMS - Building Management System
- BMTPC - Building Materials and Technology Promotion Council
- BRT - Bus Rapid Transit
- C&D - Construction and Demolition
- CCS - Carbon Capture and Storage
- CECP - Clean Energy and Climate Partnership
- COP - Conference of the Parties
- CPWD - Central Public Works Department
- CRCAPs - Climate Resilient City Action Plans
- CSEB - Cement Stabilised Earth Blocks
- DISCOM - Distribution Companies
- ECBC - Energy Conservation Building Code
- ECBC-R - ECBC- Residential (or, ENS)
- ECSBC - Energy Conservation and Sustainable Building Code
- EESL - Energy Efficiency Services Limited
- EMSYS - External Movable Shading Systems
- ENS - Eco-Niwas Samhita (or, ECBC-R)
- EPBD - Energy Performance of Buildings Directives
- EPD - Environmental Product Declaration
- EPI - Energy Performance Index (kWh/m2/year)
- ESCO - Energy Service Company
- ESG - Environment, Social and Governance
- EU - European Union
- EV - Electric Vehicle
- FSI - Floor Space Index
- GABC – Global Alliance for Buildings and Construction
- GHG - Greenhouse Gas
- GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit
- GRIHA - Green Rating for Integrated Habitat Assessment
- GWP - Global Warming Potential
- HVAC - Heating, Ventilation and Air Conditioning
- ICAP - India Cooling Action Plan
- IEA - International Energy Agency
- IFC - International Finance Corporation
- IMAC - India Model for Adaptive Comfort
- IMAC-C - IMAC Mix Mode
- IMAC-R - IMAC Residential
- IoT - Internet of Things
- ISA - International Solar Alliance
- KWh - Kilo Watt Hour
- LC3 - Limestone Calcined Clay Cement
- LiFE - Life Style for Environment
- MEA - Ministry of External Affairs
- MHT - Mahila Housing Sewa Trust
- MLDL - Mahindra Lifespaces
- MoHUA - Ministry of Housing and Urban Affairs
- MoP - Ministry of Power
- NEERMAN - National Energy Efficiency Roadmap for Movement towards Affordable and Natural habitat
- OSOWOG - One Sun One World One Grid
- PAT - Perform Achieve and Trade
- PCM - Phase Change Materials
- PCS - Personalized Comfort Systems
- PMAY - Pradhan Mantri Awas Yojna
- RoI - Return on Investment
- SDC - Swiss Agency for Development and Cooperation
- SDG - Sustainable Development Goals
- SEC - Specific Energy Consumption (GJ/ton)
- SHEMS - Smart Home Energy Management System
- SRI - Smart Readiness Indicator
- TERI - The Energy and Research Institute
- TOD - Transit Oriented Development
- YoY - Year-over-year

Message

Honourable Prime Minister of India in CoP- 26 announced the Panchamrit - India's five-point action plan to reduce the energy intensity of its economy by 45% by the year 2030 compared to 2005, signaling an extraordinary example of setting ambitious targets backed by strong action and achievements. At the same time, he also propounded the philosophy of LiFE (LifeStyle for Environment).

It is in the backdrop of this commitment that ANGAN 2022 was organised with the intent to deliberate on the issue and come forward with actionable points. Since then, India has enhanced its decarbonisation commitment by launching its long-term low carbon development strategy (LT-LEDS) at COP-27 to the UNFCCC. The LT-LEDS provides a roadmap for sectoral transitions needed for India's transition to the goal of net-zero emissions by 2070. India's LT-LEDS rests on seven key transitions to low-carbon development pathways. In the context of energy security, it calls for low-carbon development of electricity systems consistent with growth, development of an integrated, efficient and inclusive transport system, promotion of energy and material efficiency in buildings, sustainable urbanization, economy-wide decoupling of growth from emissions and development of an efficient, innovative low-emission industrial system.

The Ministry of Power (MoP) in association with the Bureau of Energy Efficiency (BEE) is taking cogent measures toward India's decarbonisation goals. It is also recognized that sustainable urbanization and low/ net-zero carbon buildings are integral elements to achieve this goal. The Energy Conservation (Amendment) Act 2022, has incorporated renewable energy and green building requirements into the Energy Conservation Building Code (ECBC) so that it becomes Energy Conservation

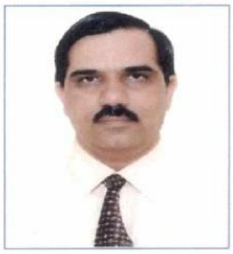
& Sustainable Building Code (ECSBC), with the objective of incorporating various sustainability aspects like materials and resource efficiency, deployment of clean energy etc. The amendment also requires all residential buildings with a minimum connected load of 100 kW or contract demand of 120 kVA, to adopt ECSBC norms henceforth.

The deliberations of ANGAN 2022 have presented us with certain challanges, as well as possible solutions in decarbonising India's building sector. I encourage all to take urgent action.

(Ajay Tewari)
Additional Secretary
Ministry of Power

अभय बाकरे, आईआरएसईई
महानिदेशक
ABHAY BAKRE, IRSEE
Director General

ऊर्जा दक्षता ब्यूरो
(विद्युत मंत्रालय, भारत सरकार)
BUREAU OF ENERGY EFFICIENCY
(Ministry of Power, Government of India)



Message

We are in the decade of action if we have to decarbonize our buildings in the next few decades. Bureau of Energy Efficiency (BEE) is actively working towards implementation of its energy conservation building codes as well as making them more stringent towards achieving this target. BEE's bi-annual ANGAN conferences are a crucial part of setting the agenda for BEE regarding its work in the building sector.

The Swiss Agency for Development and Cooperation (SDC) has been a steady and valuable partner for BEE that not only supported in the development of Eco-Niwas Samhita but was also a great supporter of BEE in initiating the discourse on residential building energy efficiency in India. The second edition of ANGAN with the theme "Making the Net-Zero Transition in Buildings" is also an outcome of this long-standing partnership that is focused on making path-breaking interventions. I thank SDC for the support extended for organizing this conference and exhibition.

I would also like to thank the Ministry of Power (MoP) for their support and guidance for making the conference a success. I extend my deepest gratitude to our various stakeholders, the building industry at large, all bi-lateral and multi-lateral partners and the team members from BEE and the Indo-Swiss Building Energy Efficiency Project (BEEP) for the meaningful interactions that happened during the course of the 3-day conference. It was especially heartening to see the exhibition with innovative products and technologies that assure us that India is ready to make the shift to near zero buildings.

I would urge all stakeholders to deploy the action points that have emerged from this rich interaction.

अभय बाकरे
(Abhay Bakre)

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of self and Nation
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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Climate change is the biggest challenge humanity has ever faced, and our ability to respond to it in the future will depend on goals and actions taken today. Switzerland is committed to action both at the domestic front - through more stringent policies - and internationally, notably through mainstreaming climate change into its cooperation projects.

The Swiss Agency for Development & Cooperation's (SDC) portfolio in India has been primarily focused on climate change mitigation and adaptation. Particular attention has been given to the built environment with projects proposing concrete solutions to reduce the operational energy in new buildings while improving thermal comfort, developing low carbon cement (LC3), integrating renewable energy in buildings, and mainstreaming climate change adaptation and mitigation into urban planning and development. The Building Energy Efficiency Project (BEEP) has been a lighthouse project for SDC in India and globally, leading to significant achievements during its 11 years of existence. These achievements have been possible only with the support of the Ministry of Power (MoP) and Bureau of Energy Efficiency (BEE) and the excellent working relationship we have developed in the last decade.

ANGAN 2022 was the third conference on Building Energy Efficiency, and the second International Conference organized by BEEP on behalf of BEE. While the previous conference in 2016 shared BEEP's experiences in its various pilot programs and deliberated on how they can be mainstreamed in the Indian building sector, ANGAN 2022 focused on finding solutions to make the net zero transition in India. The themes of both the conferences are a testament to the progress that India has made in these last 6 years.

The 3-day conference deliberated on multiple themes ranging from technical innovations to capacity building of various stakeholders and policy interventions. It was a key step in taking the India story on Net-Zero Transition forward. I am glad that so many stakeholders joined us during the conference, which showed the commitment towards this goal. I hope the learnings and action points from the conference will be actively implemented and disseminated, in order to create today a better, more resilient and more sustainable future.

Dr. Jonathan Demenge,
(Head of Cooperation, Swiss Agency for Development & Cooperation)

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

आज़ादी का अमृत महोत्सव

Acknowledgement

ANGAN (Augmenting Nature by Green Affordable New habitat) is the flagship event of BEE on buildings and the built environment. Today the efficiency conversation is not just based on energy but carbon. And it is not enough to talk about reducing energy use and carbon emissions. We have to aim for net-zero energy and net-zero carbon. Thus, the theme of ANGAN 2022- Making the Zero-Carbon transition in buildings. The conference brought together experts, policymakers, and stakeholders to deliberate on various thematic tracks leading India on the road to net-zero energy and low-carbon buildings, addressing the crucial issue of reducing GHG emissions in the country.

I express my heartfelt gratitude to Shri Alok Kumar, Secretary, Ministry of Power; Shri Ajay Tewari, Additional Secretary, Ministry of Power; Shri Kuldip Narayan, Joint Secretary, MoHUA; and Shri Abhay Bakre, Director General, BEE. Their participation added immense value to the discussions and deliberations.

I would like to extend my sincere thanks to the Swiss Agency for Development and Cooperation for their invaluable support in organizing this conference. I am especially grateful to Dr Jonathan Demenge, Head of Cooperation, and Dr Anand Shukla, Senior Thematic Advisor Energy at SDC for their support.

I would like to acknowledge the efforts of the Indo-Swiss Building Energy Efficiency Project, in organising the conference, bringing together an esteemed group of speakers and participants as well as colleagues at BEE for their continuous support.

I would like to express my sincere gratitude to all the distinguished keynote speakers, thematic speakers and panelists who made this conference such a success. Their expertise and insights have helped to enrich our understanding of the challenges and opportunities facing us. Their contribution to the conference was invaluable, and I hope that they will continue to engage with us and share their expertise in the future. Many thanks to the exhibitors for showcasing their products and services and contributing to the overall success of the conference.

I would like to express my gratitude to all the participants who attended the conference and contributed to its success. Your active participation and engagement helped to make the conference a fruitful one.

I hope that you will find these proceedings informative and stimulating, and I look forward to continuing the dialogue and collaboration in the future.

(Saurabh Diddi)
Director, Bureau of Energy Efficiency

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of self and Nation

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Executive Summary

The IPCC report of 2021 makes it clear that "global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO2) and other greenhouse gas emissions occur in the coming decades". In the recent COP 26 there was growing acknowledgement that the 2°C target of the Paris agreement was no longer enough; that wide-sweeping measures for a 1.5°C target will be needed to stop irreversible damage.

India enhanced its commitment to climate action at the COP 26 in Glasgow, announcing its 5-point climate target – "*Panchamrit*", aiming to become "Net-zero by 2070". Globally, buildings consume 40% of the total energy and are responsible for 1/3rd of the total emissions. In India, the construction sector accounted for around 44% of all material demand in 2013. Buildings are also the second-largest consumer of electricity (33% in 2017). Considering that buildings are major consumers of electricity, cement, and steel and each of them have a large share in GHG emissions, it goes without saying that construction and operation of buildings is a substantial contributor of GHG emissions in the country.

India and the Global South, where most of the new development will unfold, must go for a trajectory of low-carbon development across all sectors, and not repeat the mistakes of the developed world. Low-carbon sustainable development will require human-centric, collective efforts and robust action. As a call for action toward this, the Hon'ble Prime Minister, Shri. Narendra Modi also announced the LiFE (Lifestyle for Environment) movement which seeks to transform persons into 'pro-planet people', who would adopt sustainable lifestyles.

The Bureau of Energy Efficiency (BEE) and the Indo-Swiss Building Energy Efficiency Project (BEEP) organised the second edition of ANGAN, the international conference and exhibition on building energy efficiency in New Delhi from 14th – 16th September 2022. Indo-Swiss BEEP is a bilateral cooperation project between the Ministry of Power (MoP), Government of India and the Federal Department of Foreign Affairs (FDFA) of the Swiss Confederation with a focus on mainstreaming energy- efficient and thermally comfortable building design for commercial, public and residential buildings.

With the conference theme being "Making the zero-carbon transition in buildings", the objective of ANGAN 2022 was to deliberate on various thematic tracks leading India on the road to Net Zero Energy and Low Carbon Buildings and develop a discussion paper. The two-and-a-half-day conference consisted of 15 sessions, including thematic tracks, keynotes and panel discussions, with 80 speakers from 15 countries. It was attended by more than 900 participants and media people.

The discussions at ANGAN 2022 underlined the urgency of integrated and collective action across all levels- geographically, across different government levels, private sector, think-tanks, academic institutions, civil organisations and the society to make the decarbonisation possible. Inclusivity, across social and gender lines, as well as across all scales of entrepreneurs and innovators, will be vital in effecting the change. It also brought into focus the need to address embodied carbon, in addition to operational carbon.

The exhibition accompanying the conference showcased around 20 companies with products and services which included, low-carbon building materials, external movable shading systems, and energy-efficient space cooling technologies.

The compendium documents the discussions, opinions, perspectives and information shared by international experts and the participants during the event.

CONFERENCE AGENDA

Conference Agenda

Augmenting Nature by Green Affordable New-habitat (ANGAN) 2022
Making the Zero-Carbon Transition in Buildings
2nd International Conference on Building Energy Efficiency
14th – 16th September 2022 | The Ashok Hotel, New Delhi

DAY 1 (14th September 2022)		
09:30 - 10:30	Registration	
10:30 – 10:45	**Inauguration of Exhibition by Shri. Alok Kumar, Secretary- Ministry of Power** Exhibits will include various low-carbon products, technologies and innovations applicable in the building sector	
10:45 – 11:45	**Inaugural Session**	
10:45 - 10:50	Lighting the Inaugural lamp	
10:50 - 10:55	Welcome Address by Shri. Saurabh Diddi, Director, BEE	
10:55- 11:00	Address by Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development & Cooperation	
11:00 - 11:05	Address by Shri. Kuldip Narayan, Joint Secretary, MoHUA	
11:05 - 11:15	Address by Shri. Abhay Bakre, Director General, BEE	
11:15 - 11:30	Key-Note Address: Dr. Brian Motherway, Head of Energy efficiency, IEA (Virtual)	
11:30 - 11:40	Inaugural Address by Shri. Alok Kumar, Secretary, Ministry of Power	
11:40 -11:45	Felicitation of Chief Guest & Speakers	
11:45 - 11:50	Vote of Thanks by Ms. Saswati Chetia, Indo-Swiss Building Energy Efficiency Project	
11:50 - 12:15	**Tea / coffee**	
12:15 - 13:30	**Plenary Panel Discussion 1:** Decarbonisation of the building industry	
13:30 - 14:30	**Lunch**	
14:30 - 15:45	**Thematic Session 1** Circular Economy and Life Cycle Approach for low carbon buildings	**Thematic Session 2** Net-Zero Carbon Buildings
15:45 - 16:15	**Tea / coffee**	
16:15 - 17:30	**Plenary Panel Discussion 2:** Unlocking Finance for low-carbon buildings	

DAY 2 (15th September 2022)		
10:00 – 11:00	**Plenary Panel Discussion 3:** Women in the resource efficiency conversation	
11:00 - 11:20	**Tea / coffee**	
11:20 - 11:30	Reassembly for Keynote Session	
11:30 - 13:00	**Keynote Session**	
11:30 – 11:35	Lighting the Inaugural lamp	
11:35 - 11:40	Welcome Address by Shri. Abhay Bakre, Director General, BEE	
11:40 - 11:55	Address by Shri. Ajay Tewari, Additional Secretary, Ministry of Power	
11:55 – 12:00	Address by Dr. Olivier Fink, Deputy Head of Mission, Embassy of Switzerland	
12:00 - 12:30	Keynote Address by Dr. Richard de Dear, Professor at The University of Sydney School of Architecture, Design and Planning	
12:30 - 12:50	Distribution of NEERMAN Awards Distribution of certificates and awards to 15 awardees	
12:50 -12:55	Felicitation of Chief Guest & Speakers	
12:55 - 13:00	Vote of Thanks by Shri. Saurabh Diddi, Director, BEE	
13:00 – 14:00	**Lunch**	
14:00 – 15:15	**Plenary Panel discussion 4:** Accelerating Policy Implementation for Resilience, Affordability and Climate	
15:15 - 15:45	**Tea / coffee**	
15:45 – 17:15	**Thematic Session 3** Thermal comfort and climate resilience in residential buildings	**Thematic Session 4** Climate Strategies for Cities

DAY 3 (16th September 2022)		
10:00 – 11:15	**Plenary Panel Discussion 5:** International initiatives for sustainable habitat: The way forward	
11:15 – 11:45	**Tea break**	
11:45 – 13:00	**Thematic Session 5** Reengineering traditional & indigenous design, materials, and construction practices	**Thematic Session 6** Emerging Low-Carbon Cooling Practices and Technologies
13:00 – 14:00	**Lunch**	
14:00 – 15:15	**Thematic Session 7** Emerging Construction Practices and Technologies	**Thematic Session 8** Entrepreneurship and Innovative Technologies & Business Models
15:15 – 16:15	**Special session:** Conversations with students & next-gen building professionals	
16:15 – 16:30	**Valedictory Remarks** ○ Dr. Jonathan Demenge, Head of Cooperation, SDC ○ Shri. Saurabh Diddi, Director, BEE	
16:30 – 17:00	**High tea**	

PROCEEDINGS

Inaugural Session

14th September 2022; 10h45 - 11h50

Speakers:

- Welcome Address by Shri. Saurabh Diddi, Director, BEE
- Address by Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development & Cooperation
- Inaugural Address by Shri. Alok Kumar, Secretary, Ministry of Power
- Key-Note Address: Dr. Brian Motherway, Head of Energy Efficiency, International Energy Agency (Virtual)
- Address by Shri. Kuldip Narayan, Joint Secretary, MoHUA
- Address by Shri. Abhay Bakre, Director General, BEE
- Vote of Thanks by Ms. Saswati Chetia, Indo-Swiss Building Energy Efficiency Project

Proceedings:

Mr. Saurabh Diddi welcomed the Chief Guest, dignitaries, speakers, and all the participants. He informed that the objective of ANGAN 2022 is to deliberate on various thematic tracks leading India on the road to Net Zero Energy and Low Carbon Buildings. He said that based on the deliberations of the conference, a discussion paper will be developed which will guide the Bureau of Energy Efficiency in policy formulation in the building sector.

Dr. Jonathan Demenge informed that this is the second international conference that the Swiss Agency for Development and Cooperation (SDC) supported Indo-Swiss Building Energy Efficiency Project is organizing in collaboration with the Bureau of Energy Efficiency. He said that human civilization is facing an existential environmental crisis. But every crisis also brings in opportunities. He gave the example of the first oil crisis of 1973, which threatened economic prosperity in Europe, which at that point in time was largely based on the availability of cheap oil. The crisis gave rise to new opportunities and actions in the form of significant improvements in the efficiency of cars, expansion of solutions like solar water heating, heat pumps, etc. It also led to building energy efficiency programmes in his country Switzerland. A large programme to retrofit existing buildings was launched along with new building energy codes and labelling programme for new buildings. This led to fast penetration of heat pumps in residential buildings and increased adoption of the

MINERGIE label in new buildings. SDC is actively working in India for the last 60 years and during the last 10 years, it has mainly focused on GHG mitigation and adaptation projects. He briefed about the ongoing SDC projects which cover building energy efficiency, renewable energy integration in buildings, sustainable cities, low carbon cement, solar irrigation pumps, etc. He observed that as all of us stay in buildings, each one of us can contribute to reducing energy use and carbon emissions from buildings. He emphasized on the need to strike a balance between “Ecology” and “Economy”. He congratulated MoP, BEE, and the BEEP project for organizing the conference.

The Chief Guest Mr. Alok Kumar started his address by referring to his visit to the very impressive exhibition organized as a part of the conference. Referring to the ongoing energy transition globally and said that India is a shining example of strong actions and achievements and as a country, India has already achieved the targets that it had pledged in 2015. He referred to the Nationally Determined Contributions released by India in COP 26 and pointed towards India’s commitment to reduce the energy intensity of its economy by 45% by the year 2030 compared to 2005. He also referred to the Honorable Prime Minister’s call for LiFE (Life Style for Environment), which in his view is a key strategy in meeting the net zero carbon commitments. He mentioned that improving building energy efficiency is an important component of the India Cooling Action Plan. He informed that the MoP has introduced a bill to amend the Energy Conservation Act in the Indian Parliament. One of the amendments seeks to extend the scope of the building energy conservation code to large residential buildings This is significant as India

is poised for fast urbanization which will result in a sharp increase in the construction of large residential buildings. He also pointed out that several Indian states are seeing a sharp increase in peak electricity demand driven primarily by the cooling requirements of the buildings.

Mr. Alok Kumar referred to successful energy efficiency initiatives of BEE like the Standards & Labelling programme, Perform-Achieve-Trade (PAT) scheme for large industries, and efficient lighting programmes for houses and streetlights and said that now the energy efficiency programme for buildings is poised for a take-off. However, he pointed out that buildings are a more challenging sector. While in other programmes the benefits of energy efficiency accrue to the investor directly, this may not be true in case of buildings. He also pointed out that the buildings' programme will also have to work closely with multiple stakeholders including other ministries like MoHUA, urban local bodies, builders and developers, architects, researchers, and home buyers and occupants. In the context of the building energy efficiency programme, he emphasized the need for two actions:

- A critical need to create awareness about energy-efficient buildings. He informed that MoP has decided to create awareness by coming up with an independent system of green rating of buildings.
- Rational pricing of electricity is necessary for the adoption of building energy efficiency by building occupants. He emphasized the need for a competitive full tariff for electricity, coupled with effective targeting of subsidies to the low-income population by states.

Mr. Alok Kumar informed that the MoP has decided to set up an "Energy Management Data Unit" at the BEE to provide granular and credible data which is essential for policy design and monitoring the effectiveness of policies. He ended his address by extending his best wishes for the conference and requesting all the participants to promote the concept of LiFE.

Dr. Brian Motherway delivered the keynote address. He started by referring to the dual challenges of energy security and cost crisis as well as global climate crisis and made a strong case for energy efficiency as being an important tool in dealing with both crises. He referred to some of the positive developments during recent years, such as the rapid deployment of renewable energy for electricity production, adoption of heat pumps, and adoption of electric vehicles. However, he said that though we are making progress in energy efficiency, that is not sufficient and there is a need to double our efforts. He complimented the Government of India for its net zero pledge as well as BEE for its successful initiatives like PAT and Standards & Labelling programs. Referring to buildings, he shared that as per IEA projections, the building stock in India is likely to double in the next 20 years. He complimented BEE on its work in the area of building energy efficiency and stressed the need for having not only a properly formulated building energy code but also the importance of the need to have robust implementation mechanisms. He said that around 80 countries worldwide now have some form of building energy codes, 120 countries have standards and labelling programs for appliances, and there is a great deal of cross-learning possibilities. Coming back to the issue of buildings, he said that there is a need to emphasize the co-benefits of building energy efficiency, which *include improved health and productivity of the* occupants, climate resilience, improved energy security, creation of new jobs and economic development, reduction in air pollution, etc. He ended his address by stating IEA's desire to work closely with India on the issue of energy efficiency as India takes over the Presidentship of G20 later in the year.

Mr. Kuldip Narayan appreciated the title of the conference ANGAN. He said that ANGAN in Hindi means courtyard and in a traditional Indian house, the courtyard is not only the center of daily activity but also an important energy efficiency strategy to ensure daylighting and improved ventilation. He informed that MoHUA is implementing an ambitious PMAY-Urban programme under which the ministry has sanctioned the construction of 12 million affordable homes. He pointed out the instances where the citizens when given a choice have opted for traditional climate-responsive design and materials for the construction of their homes under the programme. He said that while working and proposing new materials and technologies we should not lose sight of traditional knowledge. He informed that MoHUA is working with GIZ on Climate Smart Buildings Project, under which around 75 training programmes have been organized for stakeholders focusing on climate resilience and thermal comfort. He stressed the need to increase awareness on building energy efficiency. While it is important to reach out to the organized building industry, this awareness needs to reach the common citizens constructing their own houses. He also said that the software available for designing energy-efficient buildings, ventilation, etc., should be made available

under a service model, so that common architects are able to benefit from this software and do not necessarily have to buy and develop skills to use the software. In the end, he thanked BEE for coming out with the Eco-Niwas Samhita and assured the full cooperation of MoHUA.

Mr. Abhay Bakre thanked SDC for partnering with BEE for organizing the conference. He also commented that this is the first large seminar being organized by BEE after COVID. He said that the decade of 2020-2030 is the decade of action and deployment as far as energy efficiency and reducing GHG emissions are concerned. To achieve our medium and long-term goals, we should focus on identifying intermediate goals (2- to 5-year time frame) and detailed action plans with clearly defined roles and responsibilities. Regarding energy efficiency in buildings, he emphasized on few issues:

- The need to increase awareness. He said that we should ask ourselves whether every person who matters in the building value chain has realized the importance of energy efficiency options and solutions available. Creating awareness among the entire building value chain should be taken on priority and he suggested that BEE can think of constituting a task force to achieve this goal.
- He also suggested coming up with comprehensive guidebooks on best solutions for building energy systems and passive design strategies and suggested that BEE can think of constituting a task force for the purpose,
- He informed that out of 1 billion tons of CO2 emission reduction pledged by India by 2030, around 170 -180 million tons of CO2 emission reductions are targeted from the building sector by the implementation of building energy codes and efficient building materials. To achieve this target, he suggested identifying the fast-growing segments/building typologies within the building sector and concentrating our efforts to improve energy efficiency in these segments.

He ended his address by emphasizing the need to focus on deployment during the remaining 8 years of the decade.

Ms. Saswati Chetia proposed a vote of thanks.

Plenary Session 1

Decarbonisation of the Building Industry

14th September 2022; 12h15 – 13h30

Chairperson:

Shri. Abhay Bakre, Director General- BEE

Speakers:

- Dr. Anshu Bharadwaj, CEO, Shakti Sustainable Energy Foundation
- Dr. Satish Kumar, President & Executive Director, AEEE
- Mr. Nicolas Schenk, Chief Development Officer, Noida International Airport
- Mr. Guruprakash Sastry, Regional Head-Infrastructure at Infosys
- Mr. Girish Sethi, Senior Director, TERI
- Mr. Sanjay Dube, CEO, International Institute of Energy Conservation

Session objective:

The buildings sector emits nearly 40% of global CO_2 emissions, of which two-third comes from the operation of buildings and one-third from building materials and construction. Decarbonization of buildings needs action across building design & construction, materials & product industry as well as in the energy sector. Actions through policies, product & technology choices, and energy-efficiency measures have been implemented. However, a lot more needs to be done.

This discussion focussed on:

- Discussing various aspects of decarbonizing the building sector
- Examples of action across building design, materials, and clean energy use
- Challenges in implementing these actions and ensuring their effectiveness
- The side-effects of the transition to a low-carbon building sector and managing them

Discussion:

Mr. Abhay Bakre touched upon the key role of decarbonizing buildings in the overall decarbonization agenda. He then introduced the speakers and invited them for opening remarks of 3-5 minutes.

Dr. Anshu Bhardwaj explained the Indian context by stating that the electricity consumption in buildings is expected to increase by 8-10 times by 2050 and the demand for steel, cement, and bricks by 3-4 times by 2050. So far, in India, we were looking at buildings mainly from an energy efficiency lens to reduce operational energy. From a decarbonization agenda, reducing embodied carbon would be equally important and hence we would have to look at the industrial supply chains to make available low/zero carbon construction materials at affordable prices. Increasing the recycling of materials and advocacy to create awareness amongst the public would also be important.

Dr. Satish Kumar said that as per AEEE projections, the building footprint in India is likely to double from around 15 billion m^2 in 2020 to around 30 billion m^2 by 2037. In the Indian context, of the total carbon emissions from buildings, almost 50% are embodied carbon emissions and 50% are operational carbon, and hence focusing on embodied carbon is important. He referred to the speech by Secretary MoP in the inaugural session and welcomed the MoP initiative to establish an energy data management cell at BEE, which he hoped would help with benchmarking of energy performance of buildings. He was of the view that India should actively participate in the ISO standard formulation process. He mentioned the joint initiative launched by AEEE, WRI, MLDL, and Eco-Collab named “Value-chain approach to decarbonizing the building and construction sector in India” which is aimed to engage

the private sector in the decarbonization of the building sector.

Mr. Nicolas Schenk spoke about decarbonization in the context of the construction of a greenfield airport (Noida International Airport). He said that decarbonization in an airport goes beyond the terminal building and covers other services like supplying power to the aircraft and an integrated approach is required while designing a greenfield airport. Talking specifically about the terminal building design he mentioned the passive architecture features, such as covered walkways, shaded forecourt, courtyard for bringing in fresh air and light, façade, and roof design. He also informed about the global airport carbon accreditation programme methodology which is being followed by the Noida International Airport.

Mr. Guru Prakash Sastry informed that Infosys has become carbon neutral in its operations in 2020 and has maintained this status in 2021 and 2022. The Infosys approach consists of three steps a) energy efficiency to reduce the operational energy b) generating/ sourcing renewable energy to meet the energy requirements and c) offsetting residual carbon emissions through a carbon offset program. A software company has a large building stock. Improving energy efficiency of the building stock has been a central strategy. The Energy Performance Index (EPI) of Infosys buildings was 200 kWh/m^2/year before 2008, this has been reduced to 65-70 kWh/m^2/year for new buildings. The per-employee electricity consumption has been reduced by 55% from 2008 values. This energy efficiency programme has resulted in savings of 2.36 billion kWh over the 12-year period or a saving of USD 200 million in electricity bills.

Mr. Girish Sethi informed that a recent report by TERI shows that around 50% of the industrial GHG emissions in India are contributed by industries producing construction materials -- steel, cement, and brick. If one adds the GHG emissions from other industries like ceramics, aluminum, and glass, which are also important construction materials, this percentage would be higher. TERI has recently prepared a roadmap for reducing carbon emissions in steel production and it suggests a three-step approach a) energy efficiency; he indicated that this potential could be significant as the average SEC in India is around 6-6.5 GJ/ton of crude steel compared to the global best practice of 4-4.5 GJ/ton of crude steel b) demand optimization by reducing the wastage of the steel through efficient design, etc. c) use of green hydrogen in the steel manufacturing process. In case of cement, the solutions are likely to be in the form of increasing the resource efficiency of cement use through efficient design and reducing the wastage through pre-fabrication as well as through the application of Carbon Capture and Storage (CCS) technology.

Mr. Sanjay Dube stressed the need for good data on building energy performance for different categories (around 26-27 categories) of buildings. The availability of the data will be critical for increasing competition to achieve better building energy performance. India has almost 20 years of experience in running building energy efficiency initiatives, the time has come to consolidate our knowledge and learnings. On renewable energy integration in buildings, he stressed the need to integrate renewable energy technologies during the early design phase. He also gave an example of a housing project with Mahindra Lifespaces where both energy efficiency and renewable energy integration in a housing project are being planned.

Q&A

Q. What kind of challenges can be foreseen in the formulation/implementation of policy measures for the decarbonization of the building sector?

Dr. Anshu Bhardwaj: The concept of net zero carbon building is still very new and needs to be fully understood. However, defining or quantifying the net zero-carbon building would be a necessary requirement. Incentives for builders and homeowners need to be an important part of the policy package.

Q. Does the complete value-chain exists for delivering net zero carbon buildings?

Dr. Satish Kumar: Currently we don't have the complete value chain to deliver net zero carbon buildings covering both embodied and operational carbon. "Environmental Product Declarations" by the building material producers would play an important role. In India, which government agency would regulate EPD is still to be discussed.

Q. Is the incremental cost to make large infrastructure projects like airports net-zero financially attractive?

Mr. Nicolas Schenk: In case of "brownfield" projects, the incremental cost may be higher and the pay-back period much longer. On the other hand, in case of "greenfield" projects like the Noida International Airport project, where the concession period is 40 years, there is a strong business case for developing a low-carbon project.

Q. With the available experience of constructing highly efficient IT buildings, is the time right to move towards a mandatory regime for building energy efficiency codes for IT buildings?

Mr. Guruprakash Sastry: It is time now to have mandatory building energy efficiency codes for IT buildings. Organisations like Infosys have now almost 15 years of experience in implementing energy efficiency strategies and as these are applied during the early design phase, they have not resulted in any increase in the cost of construction.

Thematic Session 1

Circular Economy and Life Cycle Approach for Low Carbon Buildings

14th September 2022; 14h30 – 15h45

Chairperson:

Dr Anand Shukla, Senior Thematic Advisor, Swiss Agency for Development & Cooperation (SDC)

Speakers:

- Mr. Christoph Ospelt, CEO, Lenum AG Switzerland
- Mr. Hemant Chaudhary, Executive Director, Circular Economy Alliance Australia (Virtual)
- Dr. Sameer Maithel, Director, Greentech Knowledge Solutions
- Dr. Soumen Maity, Chief Technology Officer, Technology and Action for Rural Advancement

Session Objective:

In India, so far, the discussion and policy action on low carbon buildings has mainly focused on reduction in operational energy (energy-efficient buildings, energy-efficient appliances, etc.) and meeting this operational energy through on-site or off-site renewable energy. Upfront carbon emissions (caused in the materials production, transportation and construction phases) and end of life carbon (carbon emissions associated with deconstruction/demolition, transport from site, waste processing and disposal phases) have not been adequately addressed. A more holistic life cycle approach and circular economy model of production and consumption is needed for a truly low carbon and resource efficient building sector.

This discussion focussed on:

- Introduction to the concepts of life cycle analysis and circular economy
- Case studies on life cycle carbon analysis of buildings and systems
- Challenges in carrying out life cycle carbon analysis in India/developing countries context
- Case studies on innovative low carbon and resource efficient building materials and renewable energy systems to facilitate transition towards circular economy in India.

Presentations:

Dr. Anand Shukla started the session by pointing out the importance of life cycle carbon assessment in the context of buildings. He mentioned some of the SDC projects in India which have focused on reducing carbon footprint in buildings and cities, such as, Low Carbon Cement (LC^3), Building Energy Efficiency Project (BEEP), etc. So far, a lot of focus has been on operational energy and it is time now that embodied carbon, end-of-life carbon and other components of building life cycle also gets due attention.

Mr. Christoph Ospelt explained the different components of the building life cycle environmental information that is needed according to DIN EN 15978 standards. He introduced the concept of "Total embodied carbon of a building per year" and explained that it can be reduced through three types of strategies: a) reducing the quantity of the materials (kg) used in building construction through designing material efficient structures and using lightweight materials b) using materials with less embodied carbon (MJ/kg) by increasing the energy efficiency of the building materials production processes and use of alternative materials and c) extending the life time of the building through good design from construction detail to urban level. He also provided example of building projects where such strategies have been used. At the end he also pointed out that with economic development the built-up area/capita can

increase sharply, and avoiding over-construction can also help in reducing the embodied carbon.

Mr. Hemant Chaudhary focussed his talk on circular economy. He pointed out that the annual global material extraction has reached 100 billion tons/year during 2020, which is an almost four-fold increase since 1970 and in business-as-usual scenario is likely to double by 2060. Material extraction has reached finite limits, and while the material extraction is increasing, the productivity and circularity have been stagnant during recent years. He then provided an example of progress made in transformation towards circular economy in south Australia over last 30 years. As a result of these actions, 84% of the waste generated now is being diverted from landfills, nearly 50% of wastewater and storm water is recycled and reused and 70% of south Australia's energy comes from renewables. He touched upon the key strategies used to bring about this transformation, such as, polluter/producer pays, demystifying and simplifying the process and the need of collaboration between a wide variety of stakeholders. He also emphasised the need for looking at the entire value chain and systems thinking. He ended his presentation by saying that it is important to explain to community the "Why" of circular economy. If we are successful in this, then the community will figure out the "How" to achieve it.

Dr. Sameer Maithel started his presentation by presenting life cycle carbon analysis of a Net Zero Energy Building (NZEB) located at Ahmedabad. The analysis showed that though the building is net zero energy in terms of operational energy, it is not net zero carbon and to make it net zero carbon would require significant addition to solar photovoltaic capacity or plantation of trees. The analysis also showed that it is steel and cement, which contribute most significantly in the upfront embodied carbon. He then presented a case of typical low-rise urban housing construction (3-4 stories) and showed that by shifting to confined masonry and waffle slab construction using hollow clay blocks, almost 50% reduction in upfront embodied carbon is possible through designing material efficient structure, use of lightweight material (thus reducing the steel and cement) and improving the energy efficiency of the brick making process. He pointed out that using commercially available building material and tested technological solutions, 30-50% reduction in upfront embodied carbon in low-rise urban housing is possible and this should be a priority as a large part of the new urban housing stock falls under this category. He pointed out towards the need for improving the data base on embodied energy/carbon of building materials and building components. He recommended a decentralised regional approach to move towards net zero carbon goal in buildings in India.

Dr. Soumen Maity informed that concrete is the most used material in the world and cement production is responsible for 7-9% man made global CO_2. The demand for cement is estimated to grow. In India the demand for cement is growing at 12% YoY and cement production contributes to 7% of the CO_2 emissions. 1 tonne of cement leads to emission of 650 – 900 kg CO_2, a significant part of this is "chemical" CO_2, the remaining being linked with emissions due to fossil fuel use. Use of calcined clay in blend with limestone helps in changing the chemistry and reducing the CO_2 emissions. This type of cement is called Limestone Calcined Clay Cement (LC^3) cement. Raw material for LC^3 cement includes clay having >40% kaolinite as well as industrial wastes/low grade limestone having >35% CaO. In India LC^3 has potential in Rajasthan, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh & North Eastern states. Dr. Maity presented a case study of a cement plant in India where the CO_2 emissions for LC^3 production was found to be 475 kg of CO_2/ton of cement, compared to 695 kg CO_2/ton of cement for the OPC cement. LC^3 cement technology is a practically feasible and easy to adopt technology for existing and new cement companies and could be the preferred choice of cement companies across the world – if Chinese clay is available within a radius of 200 km. He recommended immediate policy action, such as, fast track publication of LC^3 standards by BIS, notification on use of LC^3 in public construction and public procurement and incentives on use and production of green cement.

Q&A:

Q. As limestone is also required for Flue-gas desulfurization (FGD) in thermal power plants, whether enough raw material will be available for LC3 production?

Dr. Soumen Maity: Rejected limestone (high silica content, high MgO content) can be used in the production of LC3 cement

Q. Is LC3 production cost lower than the present production cost of cement?

Dr. Soumen Maity: In India, production trials have been conducted in 3 cement plants, with clay brought in from different distances (50km, 100 km and 150 km). The trials show that if the distance of

transportation of clay is less than 200 km, then the cost of production of LC3 cement is lower.

Q. Traditionally in India the lifecycle assessment for buildings was limited to “cradle to gate”, in the case study presented it has been expanded to “cradle to cradle”, what are the challenges?

Dr. Sameer Maithel: Even in “cradle to gate” analysis, there are challenges in getting accurate data e.g. manufacturing energy/carbon data for building materials. There is diversity in terms of raw-materials, process and technology. When the analysis is extended to “cradle to cradle” the challenge of getting accurate data becomes even more e.g. the energy for maintenance over 60 years’ lifetime. In the case studies presented, various assumptions are made. To carry out such analysis we would require more accurate data and this data collection will require involvement of multi-disciplinary teams e.g. industrial process engineers, facility managers, etc.

Q. Is there an agency to certify the carbon offset from buildings?

Mr. Christoph Ospelt: In the developed countries the work on life cycle carbon calculations of buildings and calculating carbon offset, started with creating of public database on embodied energy/carbon. Now it has moved to manufacturers going for Environment Product Declaration (EPD). Life cycle carbon calculations are also now being used for rating/certification of buildings. It is not mandatory by law.

Concluding Remarks:

Mr. Hemant Chaudhary: Focus on communication. If we are able to communicate to “people” our message they will find a way for implementing circular economy concepts. In the context of buildings, sharing of unused buildings and increasing the life of existing buildings in also important.

Dr. Soumen Maity: Need to work with various government ministries to create the market for LC3 cement. Industry is ready for the manufacturing of LC3 cement.

Mr. Christoph Ospelt: Focus on creating “beautiful buildings”, which offer flexibility and thus enable increasing the life of the buildings to reduce life cycle carbon emissions.

Dr. Sameer Maithel: To address carbon emissions from the building sector involvement of millions of building industry small enterprises and the end-users is essential.

Dr. Anand Shukla thanked the participants and the panellists and concluded the session.

Thematic Session 2

Net-Zero Carbon Buildings

14th September 2022; 14h30 – 15h45

Chairperson:

Sanjay Seth, Senior Director- Sustainable Habitat Division, TERI

Speakers:

- Mr. Edwin Koekkoek, Counsellor on Energy and Climate Action in the European Union Delegation to India
- Mr. Oliver Rapf, Executive Director, Buildings Performance Institute Europe (Virtual)
- Mr. Christian Richter, International Knowledge Exchange, Energiesprong (Virtual)
- Dr. Stijn Verbeke, Senior Researcher, VITO (Virtual) & Mr. Gopal Np, Manager (Clean Energy), PwC
- Ms. Sonia Shukla, Senior Project Manager, International Institute for Energy Conservation
- Mr. Pankaj Sharma, Project Engineer, BEE

Session objective:

Net-zero carbon buildings are about reducing energy, both operational and embodied, with offsetting the last resort for residual emissions. There's greater understanding of operational energy use in buildings and hence, the roadmaps to reduce this is clear. Embodied energy has only started to be addressed and the scale of reduction required for net-zero carbon is still unclear.

Achieving net-zero carbon or even near-zero carbon buildings is a challenge, one that requires industry-wide action and among all stakeholders in the building design, construction and operation.

This discussion focussed on:

- Case studies of near-zero carbon buildings
- Design process, challenges in achieving near-zero carbon buildings
- Enablers for net-zero carbon buildings in their geographical context

Presentations:

The moderator, Mr. Seth started the session by reminding the audience of the five-point commitment made by India at the COP 26. When the attention is

on net-zero, net-zero carbon buildings are important where commitment and collaborations are required.

Mr. Koekoek explained about EU's work in India. He also talked about EU priorities of energy efficiency and diversifying the EU's supply chain. In 2016, EU had a high-level partnership with India called the Clean Energy and Climate Partnership (CECP), which works on energy efficiency, renewables, and financing climate mitigation and adaptation. In the area of energy efficiency in buildings, the partnership's activities include a study at 5 tourist locations on transitioning to net-zero energy tourist locations, and work on a strategy paper. EU is also working on Smart Readiness Indicator (SRI) that provides information on technological readiness of buildings to interact with occupants as well as with the energy grid. The SRI indicates how capable the building is of improving performance through the newest smart technologies.

Mr. Oliver Rapf talked about the current policy context and framework driving Net Zero carbon buildings and neighbourhoods in the EU. In 2021, the EU committed to cut its net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels) and to become climate neutral by 2050. The Energy Performance of Buildings Directives (EPBD) is one of the sectoral legislative pieces to achieve these goals. The EPBD defines the future decarbonisation and future energy efficiency pathway of the building sector. The EPBD revision proposed in 2021, defines the term zero-emission building for the first time and proposes to apply the definition to all new buildings

from 2027 and to all renovated buildings from 2030. It also promotes the uptake of renewable energy in buildings as well as high energy efficiency performance. This proposal takes into account existing policy instruments like energy performance certificate and building renovation passport. Information from these existing initiatives is proposed to be fed into a digital building logbook. The new EPBD also proposes mandatory minimum performance standard to renovate worst performing buildings and national building renovation plans for EU members. In addition, in the past EU has had voluntary initiatives like the Level system, New European Bauhaus initiative. He also presented three case studies of positive energy buildings and neighbourhood in Europe funded by EU Horizon 2020. He concluded with the EU Mission on Climate Neutral and Smart Cities where 100 European cities have committed to become climate neutral and smart cities by 2030.

Mr. Richter presented on the how renovation of existing residential building stock is being made net-zero in Europe. The Energiesprong approach has been that of high-quality retrofit solutions for residential buildings in the first phase and bringing them to scale. High-quality retrofit signifies achieving Net Zero standard after renovation, long-term warranty of the retrofit, minimum invasive renovation for the tenants and a final retrofit product that has maximum likeability. This requires massive innovation in the supply chain including digitalisation, pre-fabrication and a shift from project-based renovation to product-driven approach. The initial cost of planning and construction is offset through the resultant energy savings, savings in maintenance cost, cost of PV energy sale, increased rent value and some subsidy. As the renovation is done with the use of prefab modules with industrial standard, it also comes with long term warranty of 30 years.

However, there are challenges, mainly due to the high cost of the prefab modules, lack of plug and play solutions that are mass market ready, and lack of labour in Europe. Energiesprong is responding to these problems by trying to organise initial market volume, working as a matchmaking platform through neutral market development teams and by create an innovation-friendly environment. He concluded by emphasising that net-zero renovation needs a technical and business approach and that it must be treated as an integrated whole-house approach with the creation of renovation packages.

Dr. Verbeke presented the Smart Readiness Indicator (SRI) which is a common EU scheme for rating the smart readiness of buildings. There is untapped potential of smart controls in buildings for energy savings, giving users more control over their comfort and health. Smart controls in buildings also allow more energy flexibility and improved planning of energy performance upgrades and urban energy transition pathways. The Smart Readiness Indicator (SRI) is defined in legal acts, establishing it as an official common EU instrument and EU Member States can implement on a voluntary basis. The indicator assesses buildings (or building units) on their readiness in providing three things- energy savings, adapting the operation to the comfort, health and other needs of the occupant, and adapting to signals from the grid (or providing energy flexibility). The methodology for calculating the SRI is based on the assessment of smart-ready services that the building has or could use, which are grouped into nine technical domains.

Mr. Gopal presented the results of a survey conducted on if something like SRI was relevant in India and how to implement it in India. The survey found that the technology providers indicated that most of the smart services under each domain are either not well established or only have a low or medium functionality level, although for each smart service there is some presence of technology. A push from both regulatory and financing bodies would make the availability wider and encourage further market adoption. The perspective of the developers was that the demand of smart technologies in commercial buildings would be higher than for residential buildings, and as there is a demand for green buildings in India and a SRI framework would act as a catalyst to achieve further energy efficiency in buildings. An SRI rating can also determine convenience, which is often demanded by consumers. In order to be adopted in India, the SRI framework should not be a complex affair and the SRI catalogue should be modified to suit the Indian context. The consumer survey showed that making today's technology-savvy consumers aware about energy savings potential via use of smart technologies will ensure uptake of SRI. This stakeholder group also said that incentives should be provided to residential consumers by the Government to ensure better adoption of SRI framework. However, data security and privacy are a major concern for them.

Ms. Sonia Shukla presented the case study of a net-zero energy residential building in India. The Mahindra Kanakpura project in Bengaluru is conceived as India's first net-zero energy homes. Its

design incorporated passive and climate responsive design features like appropriate orientation, improving natural ventilation, as well as use of energy efficient equipment and practices to minimise energy demand. This resulted in 15% reduction in energy demand. Next, on-site renewable energy resource potential was assessed, which was around 10% of the total requirement. The remaining energy requirement was offset with green energy procured from BESCOM. This process entailed around 6-7 months of working out the strategies, integrating them, convincing the various stakeholder teams. This process showed that energy efficiency and renewable energy integration interventions need to be done at the project design for maximum potential and intense collaborative effort is required for accepting and integrating sustainability elements. Financial viability of all proposed options also need to be worked out to convince clients and other stakeholders.

Mr. Pankaj Sharma talked about the efforts by the Bureau of Energy Efficiency (BEE) to transition the building stock to net-zero energy. The last few years has seen a surge in the interest from government and private organisations about the buildings label programme. BEE launched the star-labelling programme for buildings in 2009, starting with office buildings. In 2019, star labelling for residential buildings was introduced. In 2021, the Shunya labelling programme was launched, which is for net-zero and net-positive buildings. The Shunya label is for buildings with EPI <10 kWh/m2/year and Shunya plus for net-positive buildings. The star-rating programme has also been revised, such that the current 5-star building will be very close to net-zero buildings. Feasibility studies are being done to convert existing buildings to net-zero buildings.

Q&A:

Q. The difficulty in purchasing green power procurement especially in the eastern part of India.

Ms. Sonia Shukla: The Ministry of Power has released rules of Green Energy Open Access which allows consumers having connected load between 100 kW to 1 MW to have open access and buy green power from open market i.e., independent renewable energy generators, and get that powered by a DISCOM. Earlier open access was provided to industrial consumer with a threshold of 1 MW connected load. As electricity is a state subject, the state energy regulators need to include it in their open access policy.

Request for BEE- to put up case studies on net-zero retrofits on the BEE website.

Q. Does any subsidy framework for the capital cost of net-zero buildings exists and what the presenters see as the way forward for net zero buildings?

Mr. Pankaj Sharma: BEE does not have plans for subsidy for net-zero buildings. BEE's main instrument is to encourage building owners through the labelling programme.

Mr. Oliver Rapf: In EU, each member state has its own subsidy scheme defined depending on national circumstances. The EU is making funding available for the EU member states to access and decide how they want to design their subsidy scheme.

Plenary Session 2

Unlocking Finance for low-carbon buildings

14th September 2022; 16h15 – 17h30

Moderator:

Shounak Ray, Business Development Lead, IFC

Speakers:

- Mr. Daniel Magallon, CEO, Basel Agency for Sustainable Energy, Switzerland
- Mr. Franco Alexander Piza Rondon, Head of Corporate Sustainability, Bancolombia Group
- Mr. Deo Shankar Tripathi, MD / CEO, Aadhar Housing Finance Ltd
- Mr. Mridul Upreti, Sector Lead – Tourism, Retail & Property, MAS Upstream, Asia Pacific at IFC
- Mr. Sarada Kumar Hota, MD, National Housing Bank
- Mr. Sanjay Joshi, Addl. Sr. General Manager, HDFC Ltd.

Session objective:

Low-carbon, "Green" buildings represent one of the biggest investment opportunities of the next decade—$24.7 trillion across emerging market cities by 2030. The investment opportunity in residential construction, estimated at $15.7 trillion, represents 60 percent of the market. This is about $2 trillion opportunity in South Asia.

Most of this growth will occur in residential construction, particularly in middle-income countries. Besides lowering energy consumption, and therefore operational costs, greener buildings typically achieve higher sale premiums and attract and retain more tenants, ensuring a more continuous revenue stream. In addition, green buildings can help investors and owners manage the risks associated with a transition to a lower carbon economy. This transition will bring regulatory, economic, and resource changes, and some energy inefficient assets will no longer be profitable.

This discussion focussed on:

- Has green building finance been successful in other countries, and is India ready for it?

- How can we best communicate the value of green finance to developers, occupiers, home-buyers?
- What are the key opportunities and challenges in mainstreaming green building finance in India?

Discussion:

The moderator, Mr. Shounak Ray, started the session by highlighting that while low-carbon or green buildings are estimated to be a big opportunity, there are hurdles to overcome before this opportunity can be unlocked.

Mr. Hota stated that despite understanding the importance to move toward net-zero buildings, there is a lack of action. A conflict between affordability and sustainability of buildings, especially residential sector is perceived, which prevents us from seeing that the life-cycle cost of a "green" home is lesser than a conventional home. While housing finance companies are coming forward with tie-ups with green rating agencies, the supply of green housing units remains inadequate and there is a lack of marketing strategy. There is positive traction as far as demand is concerned. What is required is awareness creation, followed by incentivisation. Housing has to be thought as a 30–40-year investment, with the foresight of upcoming regulations that will become more stringent with respect to energy and carbon emissions. In response to Mr. Ray's question on the immediate steps that can be taken to improve demand of green housing, Mr. Hota replied that the benefits of a green home must be demonstrated,

concessional funding must be provided and green rating of homes has to scaled up significantly, which could reduce the cost of rating. Green retrofitting also needs to be looked at and made affordable.

Mr. Magellon noted that an important component that can influence the decision maker to shift to a green technology or products, is the business model or financial structure. Giving the carrot and stick analogy, if there's no strong stick (or policy) to force the donkey then we must have some attractive carrots to move the donkey. The challenge is to make the green or low carbon "carrot" more attractive to nudge decision makers toward that route. Here we need to think out of the box. All stakeholders, including the bankers and financiers need to change the way of doing green financing to scale up. He gave the example of the net zero banking alliance signed by 160 banks from all over the world. Their commitment of this alliance is to be net-zero by 2050, for Scope 1, 2 and 3. Scope 1 and 2 are their own operations. Scope 3 is their portfolio meaning they'll not be able to lend to customers that has high carbon footprint. Banks are thinking along this innovative approach of tackling the issue.

Mr. Tripathi introduced his company Aadhar, which is the largest housing finance company in the low-income segment. In this segment, 95% demand by volume is from EWS and LIG. Aadhar has 89% customers from this group. Most of these customers are constructing their individual homes and this is where he feels lies the opportunity to go toward large-scale green housing. In this segment, adaptation of passive strategies like appropriate orientation, daylighting etc., means long term energy savings, which is also not difficult to adopt. This requires massive awareness-building. In this regard, Aadhar has engaged with IFC to guide and train their team, especially the 350 civil engineers in the company. These engineers, in turn, guide the customers on the passive design principles which reduces their operational cost, gives them the pride of living in a green home and fulfils the government's objectives. The focus is also to coach the women of the household as in most cases they are the co-borrowers of the loans. They are also planning to meet other low-income housing finance companies to enable more self-constructed housing to convert to green housing.

Mr. Upreti said that the investment opportunity in the "green" residential sector is significant in India. The time is ripe for green investment in India as there's extensive participation from private equity and institutional investors, large new capex that needs to be created and most of the technology solutions can be onboarded in the country. The challenge in adoption rates of green construction and monitoring and reporting etc. is that the residential end-user is still not accepting the fact that the daily operations of living in a house needs to be decarbonised and buying property that is green or low carbon is to their benefit. He compared this to Electric Vehicle (EV) adoption, which has not faced similar challenges as it has a high adoption rate in the minds of the consumer. Even in large office buildings, the occupier is fairly focussed on a green outcome as it is part of their reporting and hence this building segment has seen better adoption of green construction. The end-user's movement in adoption is important in adopting green technologies.

Mr. Joshi underlined that decarbonising the building sector is the need of the hour. He noted that combined effort is required from all stakeholders to achieve net-zero emissions from the housing construction sector. He suggested that regulators may promote low-carbon housing by lowering risk weightage for such housing and permit easy financing. Policy-makers must take steps to mandate all housing to be green right from planning stage and uniform policies and incentives must be in place in all states for builders to build green housing. Financial institutions and banks can prioritise their financing for green housing through special financial products and by improving awareness. While developers will be ready to take the benefit from incentives, it is important to improve awareness to create demand among end-users. He summed up his suggestions with the acronym, BEER: Better technology for construction and materials, Easy and economical finance for end users, Education and awareness, and Regular review of reforms and regulation.

Mr. Rondon, representing the Bancolombia group, stated that green or sustainability is good business. Bancolombia with IFC worked on the three aspects of transitioning to green buildings in Colombia and other South-American countries they work in: raising awareness levels, supporting capacity building through certification, and finally, driving the transition through special credit lines. He informed that Bancolombia has supported 232 projects of which 72% were housing projects, disbursed 500 million USD, impacting 2000 beneficiary families. This transition is an important opportunity for different actors: The Colombian government has the opportunity to achieve their CO2 commitment and it assists the builder association in Colombia to move toward its commitment of 20% of new construction

being green certified. Bancolombia has also committed 20% of the 140 billion USD finance to be mobilised in this decade will be linked with green construction.

Q&A:

Q. What is the opinion of the panelists on the fact that housing loans are only given for pucca housing, not for kachcha housing, which is traditional, uses local materials, is more sustainable and near zero carbon?

Mr. Sanjay Joshi: Long-term housing loan cannot be given for kachcha housing, as it alludes to temporary housing. Mr. Hota explained that as financial product can be developed only if they know the life of the asset, durability and comfort. Kachcha housing cannot avail housing loans. Mr. Upreti also added that kachcha housing doesn't match the resilience index of financial institutions. All of them agreed that green financiers will be happy to financing housing that uses local materials and low-carbon materials like bamboo. Mr. Ray emphasised that green funds already prefer use of sustainable local materials as they have the highest chance of getting successfully implemented.

Q. Do the panelists think all future financing will be green housing?

Mr. Sarada Kumar Hota: Green certification has not kept up with the increase rate of the home loan market. Deepening the debt market for green funding is required, going beyond traditional funding through banks and HFIs. He informed that NHB is working on developing a mortgage platform for residential mortgage based securities. He also said that we need to channelise money from the many interested foreign investors.

Mr. Daniel Magallon: We need innovative business models. In Haiti and pacific islands, the remittances of the emigrants are invested in the financing of renewables and sustainable social housing. Servitization model for assets like highly efficient cooling systems have been developed. He informed that the payback period for such efficient cooling service provider is estimated to be 4-5 years, on a contract for 6-7 years. Another example of out-of-the box thinking was taken from Mexico, where PV Companies were interested in signing long term PPAs with home owners. However, in some cases, there was some reluctance on the long period of 20 years. The solution was to offer a 3-year subscription model which can be renewed. A cancellation rate of only 1% was seen among the subscribers. Banking also needs to look at things differently. For building energy interventions, bank takes long to evaluate, with large interest rate and multiple collaterals. On the other hand, banking has changed for other sectors like car loans. Such change is required for building energy too and this requires standardisation and development of secondary market, among other things.

Q. Is it really difficult to sell the concept of green homes to builders and home-buyers Tier-II and Tier-III cities?

Mr. Deo Shankar Tripathi: Yes, there is a deep lack of awareness in these locations.

Mr. Autif Sayyed, Project Lead: Green Buildings (South Asia) at IFC, concluded the session by summarising the discussion points of each panellist.

Plenary Session 3

Women in the resource efficiency conversation

15th September 2022; 10h00 – 11h00

Moderator:

Dr. Veena Joshi, Independent Expert

Speakers:

- Mr. Siraz Hirani, Senior Program Management Specialist, Gujarat Mahila Housing SEWA Trust
- Ms. Swati Puchalapalli, Director, Terra Viridis
- Dr. Sunita Purushottam, Head of Sustainability, Mahindra Lifespace Developers Ltd.
- Ms. Neetu Jain, Founder & MD, Panache Greentech Solutions

Session objective:

Women are disproportionately impacted by the negative effects of climate change. The challenge of decarbonization requires transformative on-ground action and women are indispensable to achieving this. However, there are many gaps in harnessing this influential force. Gender-disaggregated data is limited. Knowledge-sharing, awareness-building and training is needed. There is also the need for representation on the right platforms.

This session explored the role of women in resource efficiency and decarbonization in buildings and the built environment, through international and national research and experience sharing.

This discussion focussed on:

- How women view the impact of climate change in buildings and the built environment
- Instances of women-led action
- Real, practical enabling actions, especially in developing economies, to be more inclusive

Discussion:

The moderator, Dr. Veena Joshi, commended the organisers for choosing this topic as this is not something normally seen in building conferences. She felt that this is a new conversation strand where we'll see how women are being impacted and how some of the solutions are being shaped in this space. She hoped that this conversation is continued as she

firmly believes that in a sustainable world, women will have much more leadership roles which are acknowledged and are at the forefront than we see today.

Ms. Jain said that women can take the baton better in the sustainability arena as she feels that living and promoting sustainability requires an emotional quotient. She brought the attention to the increasing surface temperatures and growing heat waves. The building roof surface heats up to 70°C and the buildings remain heated till midnight. With 65% women being home-based workers with dual responsibility, they are more prone to bear the brunt of the adverse health, psychological and social affects. As the leader of a company producing cool surface finishes, she enumerated the various solutions that can reduce the surface temperature of buildings leading to better comfort inside. These solutions exist not just for building surfaces but also pavements and roads which could be deployed at the city level. These solutions are an easy and relatively affordable step toward addressing climate change by reducing surface temperatures and reducing CO_2 emissions associated with fossil fuel-generated electricity used for AC.

Mr. Hirani shifted the focus to the comfort needs of the 30% of the Indian population that resides in slums and faces the extreme brunt of heat waves. He said it is extremely important to have the perspective of women when talking of transition to green buildings and creating homes. He presented their work in

Ahmedabad where they worked with the women in urban slums on cool roofs. In their initial discussion, they realised that while the women are not aware of the global climate change issue, they are acutely aware of the impact on health and livelihood. Two solutions were demonstrated in pilot projects. One is a coof roof solution called Mod Roof. A comparative demonstration was done where one home used Mod Roof and the other similar home had the usual tin roof. Thermometers were installed in the homes and the women were trained to take the temperature six times a day. This demonstration was carried out over a year to see how the product stood up in all the seasons. Post that, a joint discussion resulted that the women could feel and "see" the decreased interior temperatures and the ability to work more hours in summer. They also gave feedback that the sloped roof installation should be changed to a flat roof and the blue colour of the product be changed to white, for the roof to be more usable. After the changes were made, there was a great demand from the urban slums' community in Ahmedabad. As the product was expensive for the community, a financial product was also designed to enable its use.

A second cheaper Pro Poor was solar reflective white paint. This solution was included, and budgetary provision was made for it in the second version of the Ahmedabad heat action plan. This was done after the municipal corporation officials had a discussion with the women in the slums who explained the benefits of the solution to these officials. This showed that engaging with women in a serious way for designing the Pro Poor, not only are they able to work with the private sector, but they are also able to influence the policy of the local administration.

Ms. Puchalapalli believes that there are specific concerns of women in the field of sustainable building design. Starting with comfort, where it is known that thermal comfort for women is different from thermal comfort for men. Women are usually more comfortable and more productive at temperatures 3°C higher than men. This does not get reflected in the design and operation of buildings even in spaces that have 50% or more women. This happens because decisions on what defines comfort are mostly taken by men. She suggested that thermal comfort bands can be improved with more personalised solutions, and that varied thermal comfort spaces, while challenging, could see better results that one would expect. In residential spaces too, the kitchens, where Indian women spend most of their time, are the most neglected areas with respect to comfort, daylight, views out and ventilation.

Another aspect she talked about was transportation. In the conversation of net-zero carbon we know that we need to reduce personal motorised transportation. We have tried to achieve this by creating safe and well-lit cycle and pedestrian pathways, improve public transportation stations, separate buses and coaches for women etc. Equally important for more women to use public transportation is to design for safety in numbers.

She concluded by stating that to be really net-zero in action, we must go beyond just net-zero design and look at other aspects like social inclusiveness, ecological regeneration, food self-sufficiency etc. And here, women are more sensitive than men. Traditionally women have always been responsible for energy, water, food and waste management and with the right tools to make decisions at home, it could a go a long way in achieving a net-zero life.

Dr. Sunita Purushottam spoke about how climate action and waste is very integrated together. She shared an example of women led action in her own housing society who translated the segregation guidelines into actual objects that they were throwing. Tower champions in the housing society, who were women volunteers, worked together with the housekeeping staff to segregate waste at source and this is vital to actually implement city-level waste management plan. The second point she talked about the decreasing open spaces in the design of our homes as we give in to the pressures of FSI and high density. This has resulted in not only the weakening of community, easy areas of interaction, but also make us vulnerable to the flooding that occurs after any intense rainfall. Third, she talked about the disheartening design of new homes with very high glass, less shading and windows that are not conducive to opening and hence reduce ventilation. Aspects like daylight, ventilation and access to green, open spaces make up the environment of the home, and she noted that women are highly intuitive to these aspects. Referring to the co-panellists in the session, she said women are highly tuned to how the warming climate is affecting their life and livelihoods and can take decisions on solutions to adapt to it, and even help improve those solutions.

Q&A:

Q. While it's nice to share experiences of mitigation, what about intervention by women at the at regulatory, legislative and other structural levels?

Dr. Sunita Purushottam: While this session did not include this aspect, there are women working toward

pushing policy and regulation toward inclusive sustainable change.

Dr. Veena Joshi: This was an important point and should be addressed in future discussion of women's role in the efficiency and net-zero conversation.

Q. What are the discussions that were held between the manufacturers and the women of the community, and whether the toxicity of the product was checked as the roof is also used for food drying etc.

Mr. Siraj Hirani: The role of MHT was to build the awareness about climate change within the community and to facilitate the implementation of feasible solutions by getting the solution-provider and the women together. The women had many technical questions to manufacturer including about how the product is produced and what will be its effects.

Ms. Neetu Jain: Green-pro certified cool roofs are normally made with water-based products and is a safe and food-grade product.

Concluding Remarks:

Dr. Veena Joshi concluded by noting that entire session built the conversation from the bottom-up. In future, the bottom-up conversation should join with the top-down conversation. We should look at the areas where conflict exists between the on-ground demands – of thermal comfort, safety issues, products in the market- and then see how the rules are being formed and implemented. There is a need to have women centric panels with mixed panellists.

Keynote Session

15th September 2022; 11h30 – 13h00

Chief Guest:

Shri. Ajay Tewari, Additional Secretary, Ministry of Power

Panelists:

- Shri. Abhay Bakre, Director General, BEE
- Dr. Olivier Fink, Deputy Head of Mission, Embassy of Switzerland
- Dr. Richard de Dear, Professor at The University of Sydney School of Architecture, Design and Planning
- Shri. Saurabh Diddi, Director, BEE

Welcome Address:

Shri. Abhay Bakre welcomed all the dignitaries, speakers, and participants to the conference. He hoped that the discussions at the conference would lead to an effective trajectory toward sustainable habitat and a way of life where we would have less impact on our environment. He noted that the eminent speakers in the keynote session would be expressing their thoughts and opinions on how we encourage all stakeholders to travel the path to decarbonization. He concluded by inviting everyone to contribute to the deliberations at the conference.

Special Address:

Dr. Olivier Fink stated that making the zero-carbon transition in buildings is highly pertinent. All countries have to act, communicate and inspire to mobilise individually and collectively in our response to climate change. He congratulated BEE on the passing of the Energy Conservation Bill 2022 in Lok Sabha, which he said would contribute to driving India toward its net zero commitment.

He talked about various actions that Switzerland has taken for climate action. In its latest Nationally Determined Contributions, Switzerland is aiming at a 50% reduction in CO2 emissions, below the 1990 levels, by 2030. He reminded the audience of the historic resolution adopted in June 2021 by the UN General Assembly declaring access to a clean, healthy, and sustainable environment, a universal human right, the text for which was presented by a small group of countries including Switzerland. Switzerland will also be joining the UN Security council for the first time in January 2022 and addressing climate security is one of their four priorities. They've taken steps to reduce emissions and energy consumption domestically too. Buildings constructed today in Switzerland consume 75% less energy than they consumed in the late seventies. The Swiss administration would like to reach net-zero not by 2050, but by 2030.

He highly commended India's flagship PMAY scheme providing a better quality of life to millions and the efforts of the private sector in developing various built infrastructures in India. He said that the conference will demonstrate that construction on such a massive scale is sustainable and resource-efficient. Among the many fruitful Indo-Swiss projects, he highlighted the innovative Limestone Calcined Clay Cement (LC3) that produces up to 40% less CO2. He concluded by highlighting the 75 years of friendship and cooperation between India and Switzerland and expressed Switzerland's continuing commitment.

Keynote Address:

Dr. Richard de Dear began his presentation by noting that the average global temperature has now reached 1°C above the pre-industrial baseline, and we are not on track to meet climate protection targets and rein in temperature increases. Superimposed on that is the urban heat island effect and a sizeable contribution to the urban heat island effect is the waste heat from air conditioners. As we cater to an ever-increasing demand for air conditioning, we are also exacerbating the very problem that we are trying to solve with air conditioning. Space cooling energy is projected to triple by 2050, with ~70% of the increase coming from

the residential sector. The convergence of climate change, population growth, economic development, and rapid urbanization means countries like India will be facing a "cooling crunch" in the coming years. This poses a daunting challenge to India's CO_2 emission abatement pledges, impeding the building sector's transition towards zero-carbon.

Most response strategies have focussed on building envelope efficiency and efficiencies of the mechanical services, which is important, but he warned that expected AC energy savings are often thwarted by the "rebound effect". The assumption that improving efficiency will cause energy consumption to reduce is undermined by the behaviour of the occupants who use the improved efficiency to expand their comfort demand.

He emphasized that more attention is required on the occupants, which brings us to the question of thermal comfort. While conventional practice among HVAC engineers and facility managers suggests a narrow, static band: 21~23°C as the comfort band, a majority of comfort research in recent years has challenged this orthodoxy. In the adaptive model of comfort occupants and their indoor climate are viewed as an integrated, self-regulating feedback system- "If a change occurs that produces discomfort, people tend to respond in ways that restore their comfort." Driven largely by concerns about global climate change the focus in the last two decades has been to bring adaptive comfort into practice through standards and guidelines. He gave examples of several adaptive comfort standards that already exist or are in the works, including the India Model for Adaptive Comfort (IMAC),

The implications of the adaptive comfort model for the "Cooling Crunch" are that as people are comfortable in wider temperature ranges in naturally ventilated buildings, comfort setpoints for AC should be nudged closer to outdoor temperatures, and mixed-mode designs and "part-time-part-space" AC practices should be encouraged. He also touched upon other comfort-related demand-side management strategies. In his opinion demand side response is of particular value to the Indian context given the explosive demand that AC would be placing in the electricity grid. The second strategy he mentioned was personal comfort systems to deliver comfort to occupants, not the unoccupied space.

He summarised his talk saying that in preparing for the imminent cooling crunch, apart from the engineering, design, and policy responses, more attention is required on the demand side of the energy equation – namely adaptive thermal comfort.

Address by the Chief Guest:

Shri. Ajay Tewari dwelled on the name of the conference, ANGAN or a courtyard, which is a green, open-to-sky, well-day-lit, well-ventilated, and exuberant space seems to aptly summarise concepts of green building, energy conservation, and zero-carbon transition.

He referred to the concept of LiFE or "Lifestyle for Environment" mentioned by the Prime Minister, Mr. Narendra Modi, at COP 26 and then launched as a global initiative in June 2022. The vision of LiFE is to live a lifestyle that is in tune with our planet and does not harm it. He added that a mass movement for 'LiFE' can play a critical role in achieving a "zero-carbon transition in buildings". He stated that addressing CO_2 emissions in the building sector is crucial in achieving India's Nationally Determined Contributions. The building sector represents about 33% of electricity consumption in India and about two-thirds of total buildings are yet to be built. At this pace, the country will face higher energy costs and extremely high consumption for decades.

He highlighted significant recent efforts by the Indian Government in achieving our climate commitments. One of the amendments proposed in the amended Energy Conservation bill 2022, which was passed in the Lok Sabha, is to move from ECBC to Energy Conservation and Sustainable Building Code (ECSBC), thus opening the opportunity to provide norms not only for energy efficiency and conservation but also for the use of renewable energy and other requirements of green buildings. There has been a stupendous growth in the uptake of renewable energy in the last decade. There has been a plethora of green initiatives like the National Green Hydrogen Mission, One Sun One World One Grid (OSOWOG), International Solar Alliance (ISA), Green energy corridor, production-linked incentive schemes for solar PV, Faster Adoption and Manufacturing of Electric vehicles and the ubiquitous LED bulb scheme, UJALA.

He congratulated the winners of the first NEERMAN awards, who would be awarded in the session. He also acknowledged the Indo-Swiss Building Energy Efficiency Project (BEEP), the Ministry of Power's 10-years old collaboration with the Government of Switzerland. He congratulated BEE and partners for organizing the conference and invited all participants to join hands with the Government and take India to

a leadership position in developing sustainable habitat.

Vote of Thanks:

Mr. Saurabh Diddi thanked each of the esteemed speakers for their insights and their valuable time. He acknowledged the foresight of the Ministry of Power, especially with the Energy Conservation and Sustainable Building Code. He also thanked all the NEERMAN awardees, experts, conference speakers, participants, conference partners, and the Bureau of Energy Efficiency.

Plenary Session 4

Accelerating Policy Implementation for Resilience, Affordability and Climate

15th September 2022; 14h00 – 15h15

Moderator:

Ms. Aarti Khosla, Founder Climate Trends

Speakers:

- Dr. Sunita Purushottam, Head of Sustainability, Mahindra Lifespace Developers
- Mr. Gaurav Jain, Joint Vice President (North)-NAREDCO
- Mr. Stefan Kessler, Associate Partner, INFRAS, Switzerland
- Mr. Rajkiran Bilolikar, Director, Centre for Energy Studies (CES), ASCI
- Ms. Meenal Anand, Sector Expert, BEE

Session objective:

The road to India's commitment of achieving net-zero carbon emissions by 2070 will need transformative changes across various sectors, including the building sector. Several policies have been introduced in our efforts to transition to low-carbon development, and more are being planned. Implementation of these policies requires coordinated action at different levels of the government, industry stakeholders, down to the end-users. This is especially relevant for Indian cities and buildings to move toward low-carbon and resilience while remaining affordable.

This discussion focussed on:

- Current policies: What works and what hasn't? What is needed to implement policies?
- Expectations and commitment of different stakeholders for the implementation of policies

Discussion:

Ms Aarti Khosla provided a brief context to the discussion referring to the large energy and carbon footprint of the building sector. She observed that given the importance of the building sector in climate change, the stakeholder conversations/engagement seems low, compared to other similar sectors such as renewable energy or electric mobility. She then invited the panellists to make the initial remarks.

Mr. Gaurav Jain said that as of today, building industry has very little awareness on both embodied carbon as well as operational energy/carbon of the buildings being constructed by them. He gave example of the airlines industry, where now it is common that at the time of booking a ticket, a person is able to see the GHG emissions associated with taking the flight. He referred to building codes in Haryana and said while the building codes now addresses the issue of water through mandatory provision of rainwater harvesting and sewage treatment plant, no similar provisions exist for energy. Air conditioning is a big energy guzzler, and he was in favour of building code specifying the mandatory requirement for thermal transmission/conductivity value.

Dr. Sunita Purshottam informed that Mahindra Lifespaces is committed to making all its new developments net zero in energy, water and waste by 2030. She said that Mahindra Lifespaces has adopted a codified approach for energy efficient building design, which consists of climate responsive building design, energy efficient building systems and renewable energy integration. She emphasized the need for adopting "climate responsive design" and use of passive techniques. She said that a holistically designed low-carbon building would have better

health and quality of life outcomes for the occupants, there is a need to study and effectively communicate this aspect to building end-users.

Mr. Rajkiran Bilolikar shared learnings of his experience of assisting the governments of Andhra Pradesh & Telangana with the implementation of Energy Conservation Building Code (ECBC). He suggested DELTA strategy for successful implementation of ECBC in states. DELTA stands for Demonstration, Ease of enforcement, Leadership, Trained manpower & local Availability of building materials. He emphasized that each one of these is necessary. Elaborating on the Leadership aspect, he said that finding an effective political lever is important for getting support of the political leadership in a state. He gave example of AP and Telangana where due to power shortage, energy conservation became an important political priority which translated into political support for ECBC (commercial buildings). In case of ENS (residential buildings) linking it with the large affordable housing programme was the key in the state of AP. He said that the regulatory framework for buildings differ from state to state e.g. states of AP and Telangana have unified building bye-laws, and an amendment like ECBC done in the unified building bye-law becomes applicable to all ULBs of the state. In states not having unified building byelaws, amendment in building byelaws has to be done at each ULB.

Mr. Stefan Kessler shared the Swiss experience to stress the need for having mandatory building energy codes. In Switzerland, during 1974-1992 the building energy codes were voluntary. In 1992 they were made mandatory, and since then the EPI of new buildings has seen sharp reduction of around 75%. He also presented three pillars for the successful implementation of building energy codes a) NorMs., legislation and enforcement b) information, education and capacity building c) incentive, leadership and motivation. He cited EU directive on existing buildings which provide a clear roadmap for retrofitting of existing buildings which is beneficial for the building industry and make their investments more secure. He also pointed out that both the Swiss and the EU building regulations till now do not have mandatory provisions for embodied energy/carbon.

Ms. Meenal Anand shared the experience of BEE in mandating ECBC. She said that the implementation of ECBC takes place at the state & ULB level. The first milestone is the notification of ECBC at the state level, which requires buy-in for important departments like Housing, PWD, Energy/electricity, etc. as well as an approval from the state cabinet. This then leads to the amendments in the building bylaws. In her view, developing adequate capacities in the ULBs to check compliance and dispelling the myth that ECBC compliance increases the cost of construction are also important barriers that need to be overcome. She wondered whether a “customer driven/focused” approach which creates demand for energy efficient building will be more effective.

In response to a query from the moderator, Mr. Gaurav Jain suggested making disclosure of carbon footprint of a building mandatory under RERA. After disclosure requirement, the mandatory regime can kick-on later. He stressed on the need that adopting energy efficiency measures should not result in increased cost of the building. In his opinion, BEE providing technical support to line ministries such as Ministry of Housing or Ministry of Steel for implementation may be a better approach compared to BEE having its own voluntary building energy code initiative.

There was a discussion on having “star rating” for buildings and having provision of incentives for higher star rated buildings. Mr. Biliolikar informed that such a system is being tried out in AP & Telangana. There was also discussion on the use of new technologies like “digitalization” and “block chain” in furthering the implementation.

Ms. Aarti Khosla summed up her three key takeaways from the session:

- Making disclosure of carbon footprint of building materials and buildings mandatory
- Mandatory building energy codes
- Need to focus on consumer awareness.

Thematic Session 3

Thermal comfort and climate resilience in residential buildings

15th September 2022; 15h45 – 17h15

Moderator:

Mr. Ashok B. Lall, Principal, Ashok B Lall Architects

Speakers:

- Dr. Rajan Rawal, Senior Advisor, Centre for Advanced Research in Building Science and Energy, CEPT University
- Dr. Jyotirmay Mathur, Professor, Centre for Energy and Environment, MNIT Jaipur
- Dr. Vishal Garg, Professor, Plaksha University
- Dr. Richard de Dear, Professor, The University of Sydney
- Mr. Abdullah Nisar Siddiqui, Advisor,
- Indo-German Energy Programme–- Climate Smart Buildings (IGEN-CSB)

Session Objective:

The session was organised in partnership with GIZ.

Indoor thermal comfort, essential for physiological and psychological well-being, can be typically provided by active heating or cooling or a combination of both – this is contingent mainly on the local weather and the seasonal variations therein.

The overarching goal of India Cooling Action Plan is to provide sustainable cooling and thermal comfort for all while securing environmental and socio-economic benefits for the society. According to ICAP, Government support for the vulnerable communities should include strategies such as: enforcing efficient building envelope and comfort systems through Eco-Niwas Samhita (ECBC-R) in the design and construction of housing for EWS and LIG to enable thermal comfort for all; funding and support for initiatives led by local municipalities and NGOs, such as cool-roof programs, off- grid micro-systems for cooling, and localized heat-action plans.

This session provided a platform for various agencies to come together and discuss the challenges, probable solutions and approach for mainstreaming thermal comfort and climate resilience in residential buildings

Presentations:

Mr. Ashok B Lall introduced the session and started by inviting the first speaker.

Dr. Richard de Dear put forward a strong case to move towards “personalized comfort systems (PCS)”. He said that the HVAC industry and standards have been pushing for temperature uniformity throughout a building, however, field thermal comfort studies show that one-size-fits-all approach doesn’t work quite as well and a major reason for thermal dissatisfaction is identified as not having control over the thermostat. The future of HVAC is personalization, this is also driven with the availability of very low-watt and affordable PCS, low-cost sensor technology (IoT) coupled with artificial intelligence (AI) methods. Thermal PCS devices are based on simple rule of “cool the head and warm the feet” and examples include fans for air movement aimed at head/face/upper body, regulable conditioned air-outlets in floor or furniture, misting fans, etc. Studies show that with the use of PCS it is possible to achieve thermal comfort over wider set point temperature range. Mr. Ashok B Lall raised the issue of adaptive thermal comfort strategies in residential setting where a person is involved in various activities in different spaces.

Dr. Rajan Rawal’s presentation was focussed on the Indian Model for Adaptive Thermal Comfort in Residential Buildings (IMAC-R). He stated that the

initial models of thermal comfort were based on heat balance model of the human body. Around 25 years ago, the models started taking into account other factors, such as, the effect of outdoor weather conditions and voluntary or involuntary adjustments made by humans to adapt. In India, research on adaptive thermal comfort at CBRI in 1980's resulted in a document SP41, and another major milestone was India Model for Adaptive Thermal Comfort, (IMAC) by CEPT University (2014-16), which got adopted by NBC and ECBC. In 2019, with support from GIZ and BEE, CEPT university started work on IMAC-R. The data collection for IMAC-R covered 8 cities and a variety of building typologies and socio-economic strata of population. He presented the IMAC-R equation and curve and showed the temperature band for Ahmedabad. The final curve for IMAC-R has a steeper slope compared to ASHRAE-55 and IMAC-C (mixed mode). He stated that "addiction of air-conditioning" reduces the ability to adapt. Mr. Ashok B Lall raised the issue that only limited number of building designers have access to simulation tools to estimate the indoor temperatures while designing a building and thus using adaptive thermal comfort models.

Dr. Jyotirmay Mathur made a presentation on "Adaptive Thermal Comfort Actions". Both personal factors e.g. metabolic rate and clothing and environmental factors e.g. air temperature, humidity, etc, have an influence on thermal comfort. Thermal adaptation is possible through psychological adaptation, physiological adaptation and behavioural adaptation. In his presentation, Dr. Mathur focussed on behavioural adaptation. In the unconditioned residential environment, the common adaptive measures are adjustment in fan speed, adjustment of window opening, adjustment in clothing, adjustment in blinds/curtains, etc. He presented the findings of research work which shows that people take multiple actions together to achieve thermal comfort and their actions are influenced by various other factors apart from the desire to achieve thermal comfort. Use of fan is influenced both by air temperature and relative humidity and hence a good adaptive comfort model should directly include relative humidity. Thermal adaptation is not a univariate problem and univariate adaptive equations need to be read with their qualifiers/applicability limits. He concluded his presentation giving interim results of a research study in which loss in productivity in homes is studied by stating that the temperature at which a person is thermally comfortable may not be the temperature at which that person is most productive.

Dr. Vishal Garg made a presentation on Smart Home Energy Management System (SHEMS). He gave an example of a SHEMS for opening and closing of windows, which uses EnergyPlus simulation, hourly local weather forecast data through AERIS Weather Data, prediction of loads and occupancy profiles using Seasonal Autoregressive Integrated Moving Average (SARIMA) Models and generates signal for opening/ closing of windows. In his view, advances in information technology, rising disposable incomes and availability of affordable smart building products are the driving factors for SHEMS. He informed that under an ongoing research project named RESIDE, the project team plans to deploy SHEMS in 200 homes in Hyderabad over 12 months. The system will provide a detailed understanding of the usage pattern to generate an online repository of residential energy and thermal comfort.

Mr. Abdullah Nisar Siddiqui introduced the Climate Smart Building project. The objective of the project is to enhance Thermal Comfort and Energy Efficiency in affordable houses constructed under Pradhan Mantri Awas Yojana (Urban). He stated that thermal comfort is one of the primary function of buildings. The project consists of regulatory actions such as development of Thermal Comfort Standard, capacity building through training programmes for a variety of stakeholders, providing technical assistance for thermally comfortable affordable housing and develop a catalogue of replicable designs for affordable housing typologies for developers, architects, homeowners. The project has established cluster cells in 6 locations in India (locations of the MoHUA Light House Projects).

Q&A:

Q. How does the air supplied through a PCS interacts with the room air?

Dr. Richard de Dear: There are a wide variety of PCS, in some complex PCS e.g., Personal Environmental Module by Johnson Controls the air is directly supplied to the person, on the other hand there are PCS in which the supplied air mixes with the room air.

Q. Are Radiant heating/cooling part of PCS?

Dr. Richard de Dear: There are examples where radiant systems e.g. radiant heating for foot are part of PCS.

Q. The example shown shows SHEMS controlled by air temperature instead of mean radiant temperature. Why?

Dr. Vishal Garg: Ideally measurement and control through mean radiant temperature would be better, but due to ease of measurement air temperature has been used.

Q. *Discussion on* the centrality of city planning (pollution, green areas, building heights, etc) to achieve thermal comfort in buildings and broadly move towards sustainable buildings.

Mr. Ashok Lall: It is imperative that the academic community should research this aspect and bring this to the notice of the policy makers. If there is no change in city planning, the issue of thermal comfort at building level remains a peripheral issue.

Thematic Session 4

Climate Strategies for Cities

15th September 2022; 15h45 – 17h15

Chairperson:

Saurabh Diddi, Director, BEE

Speakers:

- Ms. Sakshi Chadha Dasgupta, Senior Thematic Advisor, SDC
- Ms. Anumita Roy Chowdhury, Executive Director, Centre for Science and Environment
- Dr. Umamaheshwaran Rajasekar, Chair, Urban Resilience, National Institute of Urban Affairs
- Mr. Mehul Patwari, Director Sustainable Finance, South Pole

Session objective:

Cities are reported to be responsible for more than 70% of GHG emissions, and they share a big responsibility for the decarbonization of the global economy. They are a crucial link in developing and successfully implementing resilient, equitable and inclusive climate solutions, especially in key sectors like energy, building, mobility, water and waste management. City climate action plans have been developed for several cities in India. However, there are the challenges of clear definition of the climate action and its quantification, as well as the challenge of including the climate action in the statutory mechanism.

This discussion focussed on:

- City level climate action plans
- Integrating climate priorities with urban planning, especially with respect to energy and thermal comfort in buildings sector
- How cities set their climate action goals and how do they quantify them
- Realistic steps to realise the climate goals for the built environment

Presentations:

Mr. Diddi stated that cities are large contributors of CO2 emissions, driven by the transportation, buildings and other sectors. Reduction of city level CO2 emissions and energy consumption is a crucial step in ensuring the international climate commitments.

Dr. Rajasekar talked about ClimateSmart Cities Assessment Framework, a joint initiative between the Ministry of Housing and Urban Affairs (MoHUA) and the National Institute of Urban Affairs (NIUA). This started as a response to the need for incorporating climate action in the smart city initiative. The ClimateSmart Cities Assessment Framework is a stage-wise assessment framework that provides strategies for cities to initiate climate action across various areas that the cities work on a day-to-day basis. The assessment comprises of five thematic areas, one of which is energy and green buildings. The first two assessments showed that none of the participating Indian cities are in the 5-star level which is the highest level. However, between 1st and 2nd assessment, a shift was seen from many cities moving from lower levels to higher levels, specially from level 1 to level 2, showing cities have started planning climate action projects. Specific inferences in the area of energy showed that there seems to be 5 times more consumption in cities that are not taking progressive action. Renewable energy generation is also seen to be low. Cities with good mobility plan show a per capita fuel consumption 5-times less than cities without it. Efficient street lighting has been a successful in most cities through innovative PPP. While adoption of green buildings in the private sector is seen, promotion of green buildings is not yet a priority in most cities. However, there are several good case studies. Initiatives on climate action are more in Tier II and Tier III cities, which is an opportunity to implement climate action before they move to the next level of population growth.

Dr. Roy Chowdhury looked at urban planning and transit-oriented development in India and its contribution in reducing the carbon intensity of urban growth. India has a much better baseline for urban mobility, with walking, cycling and public transport usage being higher than personal transit. But bigger transit systems like BRT and metro, after initial rapid expansion, have plateaued and remain very small in scale. We are moving toward automobile dependence which has been aided by urban sprawl and hidden subsidies for car owners. The way we plan our urban expansion, with affordable housing, kept outside municipal limits, has also affected liveability, access to services, gender equity, defeating the purpose of inclusive planning.

Policy instruments to address these issues exist. Dr. Roy Chowdhury gave various examples of targets from the Delhi masterplan 2021 and 2041 which encourage people to opt for public transportation like the metro. The National mandate for Transit Oriented Development (TOD) also has all the right ingredients. It mandates high density, mixed land use development in TOD zones, compact walkable communities, availability of basic services within the zone, small block size with finer street network, mixed income development, inclusion of EWS and affordable housing, open areas, active frontage, managed parking etc. This needs to localised and implemented at scale. But currently many states are yet to come up with their TOD policy.

She also reflected on how these policy instruments are misinterpreted or ignored in reality. The real estate industry looks at TOD as an opportunity to increase built area and higher FSI for densification. The approval process, in most cases, does not consider the requirements stated in policy. She gave the examples of new developments in Delhi that ought to be permeable as they are in the TOD zone, but are being designed as gated development. This increases the distance from the public transport station to an unwalkable distance. Such design disruptions come in the way of low- carbon urban planning.

She concluded by summarising what needs to be done by the cities. This includes mandating and implementing urban form based code to have compact, connected, and accessible cities; mandating adoption of all TOD measures; demand management measures to reduce automobility; shifting budgets from road-building to public transport, active transport and zero-emissions mobility; adaptation plan to make transport infrastructure climate resilient; fiscal reform to mobilise resources to build sustainable and resilient transport infrastructure; implementing just urban transition; and adopting measurable and verifiable impact monitoring systems

Ms Sakshi Chadha Dasgupta presented the learnings from the SDC funded project CapaCITIES that has been operational since 2016. Phase 1 of the project (2016-19) started with 4 cities (Rajkot, Udaipur, Siliguri and Coimbatore), with the objective to help them lower greenhouse gas emissions and find areas, sectors and implement projects that are climate smart. These cities also developed their climate resilient city action plans (CRCAPs). These are approved by the municipal council which meant that the city has the mandate to allocate municipal budget to the plan. With this budget being allocated, implementation starts to happen. These CRCAPs also enabled these cities to be recognised in the ClimateSmart Cities Assessment Framework by MoHUA and NIUA, that Dr. Rajasekar talked about earlier in the session.

The time taken to develop these CRCAPs was 2 years. A learning from this phase was that the cities do not have the resources and time to spend 2 years for an action plan. Hence in Phase 2, instead of starting with a comprehensive plan, a simplified plan was developed in a 6-month timeframe. This simplified plan would kick-start activities which is then built upon to make a comprehensive plan over time. In the second phase, the project also got state governments in Tamil Nadu and Gujarat involved, in addition to the city government. It is vital for the continuation of the work that the state government is onboard, understands the methodology and understands how to implement and monitor. Another aspect that got more impetus in the second phase is financing.

She summarised the many learnings from the project. There remains a mismatch between translation of the national and state climate action policies to local actions and a lack of understanding on how to climate proof existing project proposals, public works etc. While understanding on mitigation and adaption growing is growing and several climate action plan methodologies are available, it requires a systemic change with sustained focus and resource allocation. There remain gaps in capacity & limited manpower at the city level (municipal corporations) to respond to climate mainstreaming. Cross department coordination and cross-cutting tasks is required. District level involvement could be a critical tier to bring in the regional focus which is critical because of

increasing disaster, water (flooding-droughts), mobility, urban sprawl.

Mr. Patwari started by emphasising that climate action plans need to be converted into investment plans to see real action on the ground. Cities need to provide respite from immediate climate disasters while ensuring that the new infrastructure being developed in climate resilient as well as climate neutral. In India more than USD 1 trillion investment is required. However, with the comparatively miniscule income generated by the Indian municipalities, it would be impossible to financially engineer and leverage the huge investments that the city requires to implement the action plan and ensure that it gets implemented with good level of services. There is also a lack of a pipeline of bankable climate resilient infrastructure projects, limited knowledge and access to sources of urban climate finance and the additional perceived costs and unquantified benefits of “sustainable” projects.

In CapaCITIES, along with the CRCAPs, city investment plans were also developed, and a shelf of bankable projects were identified based on the crucial GHG emitting sectors and the city’s priorities. Some of these were developed into pilot projects under CapaCITIES and the detailed project reports were prepared for other projects for the cities to be implemented on their own. Today, many urban climate finance sources are available, both public and private. There are innovative private sources of finance available which can be tapped by the city. He also mentioned the various climate finance instruments like green bonds, green loans, blended finance structures and impact funds. One needs to be aware of the financing sources available and then develop projects to tap these sources.

Mr. Patwari gave a few examples of projects under CapaCITIES. This included a captive solar plant in Rajkot to offset the Rajkot Municipal Corporation’s (RMC) own electricity consumption, financed through green bonds; a waste-to-bio CNG project in Coimbatore that will leverage private capital; and, the Green Mobility Zone Program in Udaipur that will also mobilise private investment.

Q&A:

Q. How can decarbonisation in buildings be done at city level?

Mr. Mehul Patwari: The primary requirement is the city climate action plan approved by the municipality and the building sector must have priority in the action plan.

Q. What are the challenge of the robustness of the data that the city uses for the inventory used for the assessment frameworks?

Dr. Umamaheshwaran Rajasekar: MoEFCC has provided the mandate of reporting to the states and not the cities. Rather than going for the inventory numbers, the more important challenge is what we do with the number. We need to set drastic reduction targets and design ways to achieve them.

Dr. Anumita Roy Chowdhury: States and cities are required to report on a large number of indicators as part of the mandated their climate action plan, clean air action plan and a district environmental plan. The challenge is that data generation, data recording and data keeping as an institutional process is very weak. Also, India is digitalising rapidly, and hence there is opportunity to generate large amounts of data. But there is no standardised protocol to keep it properly and use it for reporting and monitoring. This requires a big intervention, otherwise it won’t translate into on-ground action.

Q. In the CapaCITIES programme, was the social impact of the city-level projects considered?

Ms. Sakshi Chadha Dasgupta: The projects were identified and developed over time, during which social impact is also assessed. Also, some things become more evident after the project is operational. The idea would be stay on with the project over some time and share these learnings with the government to avoid such mistakes in the future.

Q. What is the panel’s opinion on gentrification that usually occurs around the transit corridors and how to make sure that the urban poor is incorporated in the transit-oriented development?

Dr. Anumita Roy Chowdhury: It is true that gentrification occurs and new development is not as inclusive as it needs to be. One challenge is that the redevelopment that addresses housing requirement of the poor gets adversely affected because of land price and tenural issues. Also, while new policies are talking about in-situ development, the challenge is that we have not been able to address both residential and livelihood requirement for the poor in the building typologies being designed. But in the PMAY, it is now mandated that the masterplan must provide for land inside the city, and the new vertical under PMAY for affordable rental housing is also a step in the right direction. However, a lot more needs to be done.

Plenary Session 5

International initiatives for sustainable habitat: The way forward

16th September 2022; 10h00 – 11h15

Chairperson:

Dr. Ajay Mathur, Director General, International Solar Alliance

Speakers:

- Ms. Elizabeth Wangeci Chege, Energy Efficiency & Cooling Specialist- Africa, Sustainable Energy for All (SEforALL) (Virtual)
- Mr. Jonathan Duwyn, Head of Cities Unit and Head GlobalABC Secretariat
- Ms. Melanie Slade, Senior Programme Manager, IEA (Virtual)
- Mr. Andre Mueller, Programme Manager- SDC Bern
- Dr. Winfried Damm, Head- Indo-German Energy Programme, GIZ

Session objective:

A climate-neutral and net-zero future depends on synchronized concerted effort across our planet. There is a lot to learn, debate, discuss, contextualise and help among different countries and regions if we are to achieve our climate goals.

This session brought together such initiatives from different developing economies to continue this learning in the domain of decarbonizing buildings.

Discussion:

Dr. Ajay Mathur started the session by emphasizing that building decarbonization is essential to meet net zero goals. He invited the panelists to make initial remarks.

Ms. Elizabeth Wangeci Chege introduced SEforALL as an international organization focused on driving faster action towards meeting SDG 7 goals i.e. to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. Energy efficiency is one of the focus areas of SDG 7. SEforALL promotes passive design as priority before energy efficient cooling appliances. It also believes that the building

design should respond to the climatic and cultural context.

Mr. Jonathan Duwyn said that building sector is fragmented and to bring about a change coordinated action is required by all the actors in the building value chain. Global Alliance for Buildings & Construction was formed to bring together different actors in the value chain and governments. Currently GABC has 258 members including 37 governments. It is an organization that provides platform to discuss decarbonization of buildings as well as is involved in policy advocacy at the higher political level. Together with IEA, GABC brings an annual global status report on the building sector as well as is involved in developing roadmaps. He noted that unfortunately the building sector is lagging; while 80 countries of building energy codes, in most of the countries the building energy codes are voluntary. The alliance has identified a few areas that needs more attention. These are a) shortage of 'data' on buildings b) looking at buildings from "adaptation" lens c) closer look at "building materials". He invited various organizations, particularly from the Global South, to join the GABC.

Ms. Melanie Slade presented IEA study results that identifies energy efficiency measures and electrification which are expected to account for nearly 70% of building related emissions. She then presented some of the key recommendations of the decarbonization roadmaps prepared by IEA in collaboration with GABC. These include

- Improving energy efficiency of building envelope and appliances through a policy package approach. The policy package consists of regulations (e.g. building energy codes, minimum energy performance benchmarks for appliances, etc.), information and incentives (e.g. financial incentives, expedited administrative procedure) and award & recognition programme.
- State of the art building energy management systems
- Ensure use of onsite renewable and electric vehicle charging
- Use of digital technologies to increase electricity demand flexibility

Mr. Andre Mueller explained the two-fold approach adopted by the Swiss Agency for Development and Cooperation (SDC). On one hand SDC provides support to the global initiatives such as GABC, which are important for policy advocacy as well as for the sharing of knowledge and experiences. On the other hand, SDC also supports country focused projects on decarbonization of the buildings sector e.g., BEEP in India, net zero energy project in China and a project in Latin America. In the country level projects, the focus is on Policy & Regulations, building capacities of the practitioners and applied research. The country focused projects have resulted in several learnings such as a) the energy efficiency measures in a new building should be integrated early during the design phase by conducting design charrettes, b) through design measures at the level of building and neighbourhood, it is possible to bring in significant reductions in indoor temperature thus ensuring thermal comfort over longer period of time and reducing the requirement for air-conditioning c) more focus on building materials is important and both new as well as traditional materials (e.g timber) can play their part in decarbonization. He also identified certain areas where the efforts can be focused much more in future, such as, a) increasing awareness and sharing knowledge b) circularity (e.g. extending the lifetime of building, recycling of materials etc) c) greater involvement of the banking sector.

Dr. Winfried Damm started by referring to the pledge made by India to achieve net zero carbon emissions by 2070. As any new building has a life of 50+ years, it means that all new buildings constructed should be net zero. He then briefly described the main outputs of the GIZ-BEE building energy efficiency project, which had contributed to the development of Eco-Niwas Samhita, demonstration projects, etc. Some of the key learnings of the project are that the building energy codes should be “simple, user friendly and flexible” and “energy labelling of buildings” is a key strategy for market transformation. He also mentioned the importance of urban planning in addition to implementing energy efficiency measures at the building level. He also briefly spoke about the Climate Smart Building project being implemented by GIZ with MoHUA. In this programme the focus is on thermal comfort in affordable housing and one of the flagship activities is RACHNA under which 75 training programmes, across 25 states, covering around 3500 participants have been carried out. He concluded by saying that policy, implementation, market development and R&D are three critical actions in decarbonization roadmap.

Q&A:

In the question-and-answer session, some of the key issues that got discussed includes the direct link between urban/spatial planning on decarbonization of buildings, importance of having a comprehensive approach for the implementation of building regulations, importance of local materials and circularity at a local level, importance of global information exchange and sharing of successful case studies.

Thematic Session 5

Reengineering traditional & indigenous design, materials, and construction practices

16th September 2022; 11h45 – 13h00

Chairperson:

Dr. Sameer Maithel, Director, Greentech Knowledge Solutions Pvt Ltd

Speakers:

- Ms. Chitra Vishwanath, Principal architect, Founder & Managing Director, Biome Environmental Solutions
- Ms. Rita Panicker, Founder Director, Butterflies India & Mr. Ashok Lall, Ashok B Lall Architects
- Ms. Suhasini Ayer, Principal Architect, Auroville Design Consultants
- Mr. Prashant Bhanware, Indo-Swiss Building Energy Efficiency Project

Session Objective:

Traditional design, building materials and construction practices are generally accepted to be low-carbon, climate and context responsive and climate resilient. However, with the pressures of scale, speed and modern building standards, they've come to be looked as niche solutions that cannot be translated at scale. To be mainstreamed again requires re-engineering and innovation in design, manufacturing and application, capacity building and possibly also an image-change. This session discussed examples and approaches for mainstreaming traditional design, materials and construction practices

Presentations:

Ms. Chitra Vishwanath started her presentation with "resource efficiency in foundations" for load bearing construction. She said that as per 2011 census, almost 70% of the building construction in India is low-rise (Ground +1). Foundations account for almost 25% of the masonry cost in load bearing low-rise construction. Various measures to reduce the consumption of material and cost of foundation can be taken. The foundation design depends on the type of soil strata. For different type of soil strata, she presented case studies of various resource-efficient

foundations e.g. use of wooden piles, use of lime piles, unreinforced pile foundations, stub foundation, arched foundation and rammed earth foundation. Coming to walling material, she said that in her practice they prefer the use of earth which is an excellent material for construction in and around Bangalore. Earth obtained from digging basement is a very good source of earth for the manufacturing of Cement Stabilised Earth Blocks. She showed examples of reuse of materials from existing buildings e.g wood, walling materials to reduce the demand for new building material. She also covered the use of Construction and Demolition (C&D) waste in construction and commented how C&D waste is now being used for the production of aggregates. She also gave examples of use of plastics and electronic waste in building construction.

Ms. Rita Panicker and Mr. Ashok B Lall presented a case study of construction of a resource efficient building of NGO "Butterflies" located in the urban village Jaunapur in Delhi. Jaunapur, is an urban village located at the outskirts of Delhi where the old buildings are being replaced by new four storey tall buildings and the urban fabric is becoming dense, with narrow streets and lanes. The building is a mixed-use building covering residence, work and recreation functions. The building design incorporates traditional courtyard typology and focused on recycle and reuse of local material, use of earth from the basement and reducing the steel intensity. The resource efficient construction involves

the use of bubble deck using recycled plastic balls, use of rubble aggregate concrete, use of CSEB blocks obtained from the earth dug for the basement construction, use of recycled timber. The roof of the building has been used for harnessing solar energy for electricity production, water heating and urban farming. The courtyard construction helps in providing daylight. Evaporative cooling and aided ventilation are used for the cooling of the building.

Ms. Suhasini Ayer explained that she and her team work as an integrator and try to integrate innovations across settlement planning, urban and architectural design and construction materials and technology. In building design, the first area to focus is to build less which is possible through efficient functional layout and efficient building envelope design for maximum volume for minimum surface area. For choice of building materials cultural continuity is important for dissemination. In terms of walling material construction, they have progressively moved from Cement Stabilised Earth Blocks (CSEB) to rammed earth construction and then to poured earth concrete. Construction and demolition waste along with earth is used for poured earth concrete. Apart from being lower embodied energy, it also has advantage of faster construction speed, lower cost compared to plastered brick walls. The success of alternative building materials and technologies can be gauged if they are getting replicated in owner-driven housing, and they see rapid uptake of poured earth concrete in area around their buildings. She also gave example of use of industrial waste from stone cutting for the construction of walls, use of country fired bricks for the construction of roof (segmental arch vault), use of waste thermocole as a filler material in roofs and floors and Indian Patented Stone (IPS) flooring to reduce embodied energy in construction. She said that most of the projects are public buildings like government offices, educational buildings etc which have high footfalls and which can be used to influence the perception of the general public and disseminate alternate building materials and construction technologies.

Mr. Prashant Bhanware explained the importance of shading of windows and use of natural ventilation in the Indian context and showed examples of how they were incorporated in traditional buildings. However, with the building construction in urban areas fast shifting towards dense vertical construction and increased use of glass there is a need to find new solutions to incorporate and use shading and natural ventilation in modern buildings. He introduced “Vayu Pravah” which is a freely available Computational Fluid Dynamics (CFD) tool developed by the Indo-Swiss Building Energy Efficiency Project (BEEP) which helps architects to design buildings with better natural ventilation. The tool can simulate wind driven air flow around and inside the buildings. As it is simple to use and can give results quickly it can be used during the design process. He then spoke about the “External Movable Shading Systems (EMSyS)”, or the dynamic shading systems which could be extremely useful in shading glazing in modern buildings. He showed results of a measurement study carried out in the bedroom of an apartment in Gurugram, which resulted in up to 3.5°C lower peak inside operative temperature and 32% lower cumulative cooling demand (thermal) with EMSyS. Highlighted inhis presentation advocating a push-and-pull approach by integrating requirements in policy/ bye-laws (e.g. shading provision, showing minimum ventilation etc) and creating the demand among end-users (demonstrating and disseminating).

Q&A:

Q. How to influence the clients to make sustainable choices during buildings/interior design?

Ms. Suhasini Ayer: People in general want to be “good” and as a designer we try to influence their “value system” to help them in making sustainable choices.

Sensitization around environmental issues and alternate choices available help the clients in taking decisions

Ms. Chitra Vishwanath: It is important to convey to the clients that we are not compromising “structurally” while choosing an environmentally sustainable building materials/system. Thus, in communication to influence the client decision, science and numbers also have an important role.

Q. Financing agencies having focus on “affordable housing” equate “indigenous technologies building materials and technologies” with “kutcha” construction and does not fund them. How to influence their thinking?

Mr. Ashok Lall: To address this issue, we have attempted to work with the “developers” and with the “financial institutions” on affordable housing projects. The “developer/financial institutions” require technologies which are institutionally approved by a national agency e.g. BMTPC and are also included in the CPWD schedule of rates. One example is of CSEB construction which is approved by BMTPC.

This process can move faster if there are more number of “innovative developers” open to considering alternate options.

Ms. Chitra Vishwanath: It is important not to categorise “earth blocks as vernacular or traditional material”. Rather it should be categorised as “futuristic” and “better” material.

She gave example of Bangalore where after initial setback in the promotion of CSEB in 1980’s there are now around 10,000 CSEB buildings available and CSEB is now available in the market.

Ms. Suhasini Ayer: Our team has used the approach to get government funding for the construction of public buildings using alternate technologies. It takes time but getting government commitment is important. During the process of construction, certification of the material/technology is required for which they work closely with the local academic institutions having required laboratory facilities. Thus, in her view, an active involvement of practitioners partnering with the government, supported by the academia is needed for getting recognition for the alternate technologies.

Q. How to scale-up the alternate technologies and use them in large building projects? For example, it is difficult to imagine the use of external shading in tall buildings of 30-50 stories.

Mr. Ashok Lall: There are several examples of alternate technologies being used in housing projects having several hundred houses, similarly there are examples of their use in large public buildings. Globally, there is more acceptability now about having climate responsive external envelope with responsible use of glass. In case of external movable shading, the weakness is on the supply side, with not having enough products and service providers.

Ms. Suhasini Ayer: It is wrong to assume that the new building construction necessarily must be “high rise”. We should rethink what is meant by “development”. In Indian urban context Ground+4 construction typology seeMs. highly suitable and desirable.

Ms. Chitra Vishwanath: Building by-laws require a relook, the building height gets influenced by the road width, without taking into account other environmental factors.

The use of glass in commercial buildings is also driven by the business motivation to maximise the saleable carpet area.

Thematic Session 6

Emerging Low-Carbon Cooling Practices and Technologies

16th September 2022; 11h45 – 13h00

Chairperson:

Mr. Akash Rakheja, Vice President, ASHRAE

Speakers:

- Dr. Yash Shukla, Executive Director, CARBSE, CEPT University
- Mr. Pierre Jaboyedoff, Indo-Swiss Building Energy Efficiency Project
- Mr. Rahul Pathak, Manager Product Marketing & Key Accounts, Emerson
- Shri. Arijit Sengupta, Director BEE
- Mr. Anubhav Acharya, Daikin
- Ms. Akshima Ghate, MD, Rocky Mountain Institute India

Session objective:

As the world warms, cooling through air-conditioning becomes increasingly important in our climate adaptation measures. It is vital to get cooling right-meeting the cooling demand without the devastating climate impacts. In recent years, much effort has gone toward this, including the Global Cooling Prize, which saw technology prototypes with 5 times less climate impact than conventional air-conditioning. Work is going on personal cooling devices and technologies as well as on a host of low-carbon cooling technologies including mechanical ventilation, evaporative cooling, radiant cooling, etc.

This session looked at some of the sustainable cooling technologies and what is required to make them market ready.

Presentations:

Mr. Rakheja set the context by emphasising the importance of decarbonisation and that it is also an important area of work for ASHRAE. ASHRAE has set up a task force for building decarbonisation and has a committee with 100 volunteers working on setting standards on the subject. A white paper on decarbonisation was released by ASHRAE on the same in June 2022. Efficient and low-carbon cooling is a key part of decarbonising buildings and a lot of transitions have occurred. He reminded the audience that in order for cooling to be decarbonised, one should look at nature for the solutions, before applying technology.

Mr. Jaboyedoff, in his presentation, talked about three things that can optimise cooling in buildings. The first thing to do is design a building envelope that reduces heat gain. He noted that Switzerland has some of the most stringent standards for energy efficiency in buildings. For e.g., if you have fully glazed buildings, equivalent SHGC must be be 8% or less, which means one will need external movable shading system. This can significantly reduce the cooling load.

Second, he talked about high performance cooling towers and chillers. He opined that in multi-storey residential buildings, one could very well have one cooling tower cooling the condenser of the AC units. In a more centralised cooling system, one can have a high-performance cooling tower that maintains storage and can get go directly to slab cooling, with chillers only used to supplement during very hot period and separate dehumidification used only when needed.

The third point is to introduce more and more radiant cooling. With good building envelope and well-designed system, room temperatures can be kept from going beyond 26°C with supply water temperature of 22°C. This can mean that water from cooling tower may be used directly in the radiant cooling system.

He also touched upon simulation tools and parametric analysis which can help making effective design decisions early in the design of buildings that can optimise energy use in the building. He gave the example of the new tool, Vayu Pravah, developed under the Indo-Swiss BEEP project that helps users visualise wind flow and wind access in and around their buildings. He also emphasised the importance of collecting actual post-occupancy measurements to validate simulation results, which in turn results in better confidence in and validates the use of simulation models.

Dr. Yash Shukla presented about current low-energy cooling systems, challenges in their deployment and some emerging low-energy colling systems. He started with an overview of the term “low-energy cooling”. Currently no scientific definition of low-energy cooling system, and it loosely means systems with no vapor compression cycle, those that use water as a refrigerant, consumes less energy, uses refrigerants with no or low Global Warming Potential. Night cooling with mechanical ventilation and ground or aqua coupled cooling are also counted among low-energy cooling systems. Conventional systems achieve high level of comfort, with high energy consumption. Over the years, we have seen systems move toward high comfort-medium energy systems and medium comfort-low energy systems. The goal is for systems that are high comfort and low energy.

Dr. Shukla described the various low-energy cooling systems currently available, their benefits and limitations. These systems included cooling by ventilation, evaporative cooling, radiant and chilled beam systems, ground and aquifer cooling and desiccant cooling. While these systems are promising, the challenge in overall deployment is that each of them works in specific applications. Hence, more versatility needs to be built into them. Second, controllability is an important variable where traditional system win over low-energy system. And third, we need to evolve system protocols and standards that can recognise the benefit the low energy system. Right now, the standards are technology focussed and not technology agnostic, which is the direction we need to move toward.

He also touched upon some of the promising emerging cooling systems. Among the ones available in the market are radiative sky cooling, multiple-stage evaporative coolers and vapor absorption and adsorption. There are others in the research phase including barocaloric cooling, membrane-based by dehumidification, automatic water generators and carbon dioxide adsorption.

Mr. Arijit Sengupta spoke about district cooling which is one the not-in-kind technologies recommended by the India Cooling Action Plan (ICAP). District Cooling is an efficient way to air-condition clusters of buildings where chilled water is supplied to multiple buildings through an insulated underground piping network. District cooling can be potentially used in commercial, residential, and industrial buildings or even the entire city. There are multiple benefits like freeing up of valuable space in buildings, the economies of scale arising from aggregating the cooling needs of multiple buildings, reduction in installed cooling capacity, reduction in peak load and energy demand, lower lifetime cooling costs, effective refrigerant management and operation, as well as better acoustic management.

However, currently there are multiple risks and challenges for its implementation in India including design and technical risk, lack of skilled resources, limited knowledge on M&V, no scalable business models and regulatory risk such as interest rates, tariff and tax. The Bureau of Energy Efficiency (BEE) has started work on overcoming these challenges, through a recently commenced project with GIZ. GIFT City, which is the only government district cooling project in India is the knowledge partner. Under this, a first draft of District Cooling Guidelines has been prepared and submitted for inputs from a technical committee. These guidelines will be launched for public consultation in November-December 2022. In addition, district cooling has been included in Climate Smart Cities Assessment Framework (CSCAF) of MoHUA.

He concluded with state level actions that will be required to promote and implement district cooling. Much needs to be done for its effective implementation and Mr. Sengupta requested the audience to recommend new and existing projects where district cooling may be demonstrated.

Mr. Rahul Pathak, representing the HVAC industry, talked about the low carbon emission cooling & heating solutions that are required to support ICAP. Three key parameters which can support ICAP are seasonal energy efficiency, green refrigerants, and cleaner heating solutions.

Today, HVAC standards focus on part load efficiency. Any comfort chiller is evaluated at four load points-100%, 75%, 50% and 25%. The sum of the product of the coefficients of performance (CoP) at each of these points multiplied by the corresponding weightage coefficients gives the seasonal energy efficiency of the chiller. 84% of the weightage is given

to the performance at 75% and 50% of the load. This means we need technologies that gets maximum efficiency at these part loads. There are a few compressor technologies that can achieve maximum part load efficiency like variable speed scroll or inverter scroll, digital scroll, two-stage scroll and tandem or trio scroll.

In India we currently use refrigerants that have high global warming potential (GwP) value. The ultimate goal of the HVAC industry is to go to ultra-low GwP refrigerants. Current examples include R-290, Co2, ammonia but they come with specific disadvantages like high flammability, high pressure properties or toxicity. The industry is working towards exploring ultra-low GwP but low TEWI refrigerant options. TEWI stands for Total Equivalent Warming Index which evaluates both GwP value and the energy efficiency of the refrigerant at system level.

In cleaner heating technologies, Mr. Pathak spoke about heat pump technology. Heat pump for sanitary heating applications delivers up to 75% power consumption saving. Heat pump also works well with renewable energy water heaters like solar water heaters as back-up. Various case studies showed significant savings from heat pump or hybrid solar thermal plus heat pump technology and an RoI of 10-15 months.

Ms. Akshima Ghate gave an overview of the Global Cooling Prize that was conducted in 2018 and their learnings from it. The Rocky Mountain Institute (RMI), along with many partners, conceived the idea of the Global Cooling Prize with the aim to address the cooling dilemma by breakthrough technology improvements. Even with projecting trends in buildings codes, equipment efficiency and grid and grid emissions intensities – annual cooling emissions will almost triple by 2050. The efficiency opportunity in residential air conditioners (RAC) is significant. But the RAC segment is subject to a massive market failure as the focus is on lowest upfront cost and meeting near term market requirements — not transformational efficiency.

The specific objective of the Global Cooling Prize was to spur private sector innovation to identify residential cooling solution that have 5x less climate impact than standard ACs without compromising comfort and affordability. The two winners- Daikin with partner Nikken Sekkei Ltd. and Gree Electric Appliances, Inc. with partner Tsinghua University- were able to achieve the climate impact target and also life cycle cost of half that of the standard AC.

One of the learnings from the prize was that we need to update testing standards and protocols by simulating close to real-world conditions to reflect units operating at lower aggregate capacity levels with much higher latent loads (humidity). Second, performance rating systems need to keep up with technology and highest performing technologies should be the benchmark and used as reference to derive performance rating ladders that can truly differentiate performance. Third, manufacturers need clear market and policy signals, a more clear and complete target to design to and a level field on which they can then compete.

Mr. Anubhav Acharya from Daikin presented on the winning entry from Daikin for the Global Cooling Prize. Their proposed cooling system adopted two innovative methods to achieve higher efficiency and lower climate impact. First, a multi-split method is used to connect two indoor units with one outdoor unit. This method helps optimize refrigerant flow rate for each of the two indoor units depending on ever-changing cooling load and uses refrigerant control technology to closely modulate the capacity. Second, it used evaporative cooling to improve the system's efficiency by using the heat of vaporization to lower the temperature of the air that the outdoor unit takes in. The system uses control technology that measures the outdoor temperature with sensors and applies the control system to automatically spray water when under high ambient temperature conditions where cooling load seems particularly high. As part of Daikin's research and development initiative, the use of low-GWP (global warming potential) refrigerant HFO-1234zI) is proposed based on the criteria of the Global Cooling Prize. However, as per Daikin's current refrigerant policy, R-32 is considered to be the most balanced refrigerant, and Daikin will continue to proactively promote it.

Mr. Acharya also spoke of current efficiency and other unique features of Daikin air-conditioners. These included Daikin Patented Swing Compressor Technology which ensures high efficiency with less noise, less wear and tear, Super PCB design that ensures smooth inverter operation leading to energy savings, their patented R-32 Refrigerant, inner grooved copper pipe in condenser & evaporator and IDU & ODU DC Motor for improvement in motor efficiency. They have also introduced features to improve customer awareness. For e.g., the Triple Display Function in 3 star and above air-conditioners, in which customers can see the amount of power consumption in percentage.

Q&A:

Q) HVAC focus on indoor air quality and balancing it with comfort? How HVAC bodies manage the possibility of conflict of interest where the industry itself is setting the standards and regulations.?

Mr. Rakheja: Indoor air quality, health and well-being are gaining prominence and is taken into account in design. Mixed mode ventilation is also gaining importance from the perspective of both energy efficiency and indoor environmental quality. In response to his second question, Mr. Rakheja replied that while making standards there are guidelines on forming the committees where equal representation is given to all segments of the industry like manufacturers, consulting bodies, academic institutions etc. The standards also go for wide circulation for public comments before it is finalised and released.

Thematic Session 7

Emerging Construction Practices and Technologies

16th September 2022; 14h00 – 15h15

Chairperson:

Dr. Shailesh Agrawal, Executive Director BMTPC

Speakers:

- Mr. Anders Hall, President, European Sun Shading Organisation, Switzerland
- Mr. Tarun Jami, Founder & CEO at GreenJams.
- Mr. Rick Torgerson, CEO & Founder, Humengi
- Mr. Hal Hinkle, CEO & Director, Bamcore, USA (Virtual)
- Ms. Meenakshi, Project Engineer, BEE
- Dr. Dibakar Rakshit, Associate Professor, IIT Delhi

Session Objective:

In India, the construction sector is the largest sector with regard to material consumption, especially for cement and steel, both of which have a large share of GHG emissions. Buildings are also the second-largest consumer of electricity. Decarbonisation of buildings will not be possible without an overhaul of current materials and construction technologies to reduce their embodied energy and enable reduction of operational energy. At the same time, any construction technology will also have to deliver on scale and speed. This session gives the stage some of the new materials and technologies that are contributing to reducing emissions, both embodied and operational.

Presentations:

Dr. Shailesh Agrawal introduced the session and first invited Mr. Hal Hinkle who made the presentation virtually from USA.

Mr. Hal Hinkle put up the case for climate positive bio-based building material using timber bamboo. He informed that timber bamboo sequesters almost 5x to10x more CO_2 compared to wood. Timber bamboo grows faster than wood and uses far less space (1/5 the land). He introduced “Prime Wall” a bio-based building systems being developed by BamCore that has lower carbon, cost, time & labour. He presented results of a case-study of LCA of a typical low-rise (4 storey) urban housing construction in India and

showed that using Prime Wall (made from bamboo) results in huge savings in embodied carbon and operational energy (due to better insulating properties) compared to conventional building construction technology and materials. He pointed out the importance of biogenic carbon dioxide storage in buildings using BamCore technology and how the mass timber wood buildings are getting acceptance in USA and Europe. He informed about the better physical characteristics of the Indian bamboo (density and stiffness) and great potential to use it as a construction material. He also informed about research being carried out to optimizing fibre strength to commercial applications and maximize fibre yield recovery.

Mr. Tarun Jami introduced Agrocrete blocks which are made by mixing crop residues (rice straw/ bagasse/ cotton stalks/ soybean stalks, etc.) with industrial by-products (ashes & slags from power and steel industries). Agrocrete hollow blocks can be used for both load bearing and non-load bearing construction. He informed that the cost of construction using Agrocrete is lower compared to the conventional construction and the product having been derived from bio materials has a negative embodied carbon. He showed examples of use of Agrocrete for boundary wall and industrial building construction. He also presented an operational model to scale-up production of Agrocrete blocks in which the GreenJams plans to partner with local manufacturers.

Mr. Rick Torgerson introduced “Humengi”, a mortar less interlocking technology using hollow blocks that results in faster, stronger and lower cost construction. The technology economises on the use of cement and steel thus reducing the embodied carbon content significantly.

Mr. Andres Hall spoke about solar shading. He said that “the best kWh is always the one we do not need” and how solar shading can help in reducing the cooling loads and keeping indoors thermally comfortable in a warming climate. He gave the example of the 2018 heatwave in Netherlands which resulted in more than 700 deaths and sale of 1,44,000 air conditioners – more than normal. He shared results of a recent study commissioned by the European Solar Shading Organisation. Currently around 28% of the buildings in EU require air-conditioning, which is slated to increase to 45% of the buildings by 2050 in a BAU scenario. However, with the preferential use of shading this percentage could be kept at 28% and after incorporating improvement in the efficiency of ACs, results in 62% decrease in cooling electricity requirement. He showed results of a measurement study carried out with TERI on dynamic solar shading which showed almost 50% reduction in peak cooling load and around 30% reduction in cooling electricity. He made a strong case for making the use of solar shading mandatory before installing air-conditioners and for made in India dynamic solar shading solutions.

Dr. Dibakar Rakshit talked about the performance evaluation study based on thermal modelling of Phase Change Material (PCM) embedded walls/ roof. He said that new product development (PCM incorporated brick/block conforming to Indian Standards) will offer a feasible solution to reduce cooling energy demand of buildings and can be implemented in housing schemes of the government such as Pradhan Mantri Awas Yojna. Giving results of the study, for buildings in composite climatic conditions, OM35 and Eicosane (99% pure, Alfa Aesar) were found to be suitable PCM materials for utilization, using which, a reduction (up to 10℃) in temperature fluctuations with PCM incorporated bricks can be obtained, while heat gain reduction by 8% to 12% for experiments carried out in summers, as compared to the conventional bricks was observed.

Ms. Meenakshi shared information on the Building Materials Directory for India (BMDI) initiative of the Bureau of Energy Efficiency. She said BMDI is key for the successful adoption of the ECBC & ENS. The key objective of this initiative is to provide the consumer an informed choice about the energy-saving and thereby cost-saving potential of the relevant marketed product. BMDI covers various products such as bricks and blocks, insulation, glass, cement, paints, tiles, etc.

Q&A:

Q. How many floors can we build using the bamboo products of Bamcore?

Mr. Hal Hinkle: “Prime Wall” product is for low-rise construction; in USA it is code compliant for construction up to 5 stories. “Mass Timber Bamboo” can be sued for construction up to 18 to 22 stories. In USA, there are over 500 timber buildings of 5 to 18 stories, in Europe there are around 1100 timber buildings of 5 to 22 stories.

Q. Is Eucalyptus given its high-water requirement a good material for construction?

Mr. Hal Hinkle: Yes, high water requirement for Eucalyptus is an issue which is hotly debated in India. While discussing this issue, we should remember the high-water requirement for concrete. Also, currently Eucalyptus is mostly used for paper production which means that the carbon comes back to the atmosphere very quickly. On the other hand, if the wood is used for building construction, it would help in storing of carbon over longer periods of time.

Q. Is there an issue of using engineered bamboo products in humid climates?

Mr. Hal Hinkle: If the condensation of water vapour takes place in the cavities it can give rise to persistent mould. The product is code compliant all over USA which also include very humid climates found in parts of USA. To be on safer side, the designer should take care that in the humid climates, the structure is able to breathe.

Q. What are the environmental impact of “glue” used in the manufacturing of engineered bamboo products?

Mr. Hal Hinkle: There are two environmental concerns related with the glue. One is the VOC (Volatile Organic Compounds) release and the other is the carbon footprint of glue. Bamcore would be initiating work on a US Department of Energy supported project, which will also look at alternate glue options.

Q. What are the barriers in mainstreaming alternate building materials?

Mr. Tarun Jami: The Construction industry is conservative in nature, that is also understandable because people are putting their lifetime savings in owning/constructing a house so for they do not want to experiment. They also do not have the means to check the claims of the alternate technologies. The role of industry bodies and government bodies becomes important if they can evaluate and create awareness about the alternate building materials.

Dr. Shailesh Agrawal: BMTPC acts as an enabler of new building materials and technologies. It is a government agency with a mandate to evaluate and certify new building materials and technologies. BMTPC certification also opens the door for including of these technologies in the CPWD Schedule of Rates. The Ministry of Housing & Urban Affairs is also providing support for the demonstration of new construction technologies.

Thematic Session 8

Entrepreneurship and Innovative Technologies & Business Models

16th September 2022; 14h00 – 15h15

Chairperson:

Mr. Saurabh Diddi, Director, BEE

Speakers:

- Mr. Rahul Bhalla, CEO, Zenatix
- Mr. Samit Jain, Managing Director, Pluss Advanced Technologies
- Mr. Arjun Gupta, Founder & CEO, Smart Joules
- Mr. Gaurav Burman, Managing Director, Asia Pacific, 75F
- Mr. Siddharth Arora, Co-Founding Director & Co-promotor, Revayu Energy

Session objective:

The challenge of low-carbon development has seen an entrepreneurial response with many products, technologies and tools being developed, including ones that are for buildings and the built environment. Low-carbon and energy efficient building start-ups range from ones on efficient and low-carbon envelopes (low-carbon cement, insulating blocks, blocks from waste, smart windows, insulating plasters etc.), efficient space conditioning technologies, efficient lighting technologies, energy storage technologies, efficient energy services, and many energy analytics and optimization tools / platforms.

This session looked at some of the products and services, their business models and discusses what innovation gaps still need a response in the Indian context.

Presentations:

Mr. Diddi stated that entrepreneurship and innovation are two of the key components to achieve decarbonisation in buildings. More and more smart technologies and devices are being used for many things, including to optimise energy usage. The Bureau of Energy Efficiency has also conducted a study, with the support of the EU, on the feasibility of a Smart Readiness Indicator (SRI) in Indian buildings. He said that smart technologies must not only be restricted for building energy optimisation but also be integrated for city level optimisation.

Mr. Bhalla, was among two speakers in the session who spoke about IoT solutions for energy efficiency. He showed that there is a lot of low hanging fruit available through simple data analytics using IoT. In small-to-mid-sized buildings, which is Zenatix's key market, the IoT connected systems bring centralised visibility, the collected data can be used to drive intelligent controls and can enable condition-based monitoring and predictive maintenance. This results in 10-20% energy savings, 20-25% improvement in comfort compliance, 25-30% reduction in breakdowns, and RoI of 12-18 months which is required for someone to adopt a new technology. Additionally, it is an open extensible technology architecture that can work across the variability in the infrastructure within the different buildings.

He enumerated the reasons why IoT is a better option over BMS. The connected systems through IoT provide visibility across sites. It enables correlating energy with business metrics for board room discussions. It's 40-60% more cost effective as it is hardware light and software rich, and it's easy to deploy because it is battery powered and uses wireless technology. IoT also takes an agnostic approach in its deployment in buildings- it can connect with existing BMS, fill the gaps where there's

partial BMS, thus leveraging what already exists in the building.

He concluded with three things learnings from his entrepreneurship experience. First, that product market fit is vital. Second is that there are no shortcuts. In the IoT space, delivering operational energy necessitates dealing with not only the software side of things but also the hardware. And third, is that perseverance pays. He signed off stating that while there is positive outlook toward IoT but a lot more support from the industry is needed.

Mr. Samit Jain, from Pluss Advanced Technologies, spoke about their phase change materials (PCM) which they started working on in the last decade. They are working on developing products which is creating products and devices that provide heating and cooling in a less energy-intensive way. He explained the basic working of PCM, which are materials change phase from solid to liquid and liquid to solid. When they change phase, they can store a lot of energy around the temperature that they melt.

He further described the working of PCM in buildings through a few case studies. PCM essentially provides thermal storage. In office buildings in Europe, PCM used in the ceiling tiles is recharged using free cooling in summer nights when outside temperatures are low. During the day the absorbed energy reduces load on the active system. This is a perfect case of free cooling and would work wherever there's a wide diurnal temperature difference. Another example was from Leh where evacuated tube collectors, usually seen in solar water heaters, heats the PCM. At night, this stored heat is used to heat the cold night air and improve comfort inside the room. It can maintain 10-15°C at -20°C ambient temperature. This avoids using batteries improving efficiency, reduces back-up fossil fuel consumption and it is cheaper as it is a passive system with few moving parts. PCM is also being used in heat compact battery in Europe, where captured low-grade process heat is stored and used for water and space heating.

As with any new product, it has taken time for customers to accept this technology, with scepticism over its design life, warranties, cost, durability etc. Over the last years, they've had several case studies, including in India, to demonstrate that it can work successfully.

Mr. Arjun Gupta's said that achieving the targets in the India Cooling Action Plan and emission reduction commitments requires the creation of a new industry centred around efficiency with new policies supporting it.

He enumerated the various entrepreneurial challenges Smart Joules faced as a smart energy utility business, and how he thinks they could be converted into opportunities. If energy efficiency through private ESCOs has not been successfully done before- use that to motivate young people. Sell energy efficiency as solutions to specific existing problems. Use the "sexy" solutions like IoT to grab attention and attract the best talent. Build an environment of learning, growth and enjoyment to build and retain teams with interdisciplinary excellence. Shift personal attitudes to accept that a lot of leadership goes into "not building stuff" and pick your battles.

He introduced their new business model JouleCOOL for new builds and JoulePAYS for retrofits which is turning cooling into a complete utility business model. These leverage all ways to save energy: intelligent design, selecting most energy efficiency equipment and data-based automated operations. It has resulted in an average 35% savings in over 45 facilities in India. He added that the opportunity to create a utility business to heating and compressed air end-uses in buildings and factories. The collective impact has been more than 94,000 tons of avoided carbon and savings of more than INR 113 crores of energy cost, which is a tiny fraction of their vision- 29 million tons of avoided carbon emissions and INR 34,000 crores of reduced costs by 2027. He concluded with an invitation to everyone to support and put the focus on energy efficiency and make it the default choice.

Mr. Gaurav Burman, from 75F, likened building controls to Lego blocks which require a Lego master to make them into something useful. Most facility managers do not use BMS to its true intended potential. 75F saw an opportunity to disrupt, not just innovate. Their target was buildings with area between 10,000 to a million sq.ft.- this group usually don't have the budget to deploy the solutions nor the ability to neglect the cost of inefficiencies in the building.

With their native IoT BMS they aim for the two OEs- operational efficiency and occupant experience. They set out to solve specific problems of energy wastage, occupant preferences, errors due to manual control for building O&M, the inability to integrate equipment across multiple protocols, difficulty in retrofitting the latest technologies in older buildings and lack of trends and insights on key building parameters. Native IoT BMS uses an ecosystem of integrated sensors that measure all the required parameters, smart equipment controllers for building automation,

central control unit for building optimisation, and the user experience laid out on top of it via cloud-based machine learning to make sense of all the data that's being collected. Through this 75F saves up to 50% on energy while improving occupant experience by up to 10%.

In almost all of the deployments done by 75F, they replaced the traditional BMS. In 2019, their system resulted in more than 4.5 million kWh of energy saved, 3.8 million kgs of CO2 emissions avoided, occupant comfort improved by 7.5% across 16 facilities in the Asia Pacific, with an ROI ranging from 1.5- 3 years. Different revenue models like capex, subscription, OPEX are being used by them.

Mr. Sidhharth Arora, from Revayu, listed their different clean energy offerings, finally focusing on their solar & wind hybrid solutions. He explained that the small wind power is positioned as complimentary to solar PV and not its substitute and provides more consistent and reliable clean power throughout the year. They've also worked on addressing the technical and O & M problems of small winds.

He then addressed the financial challenges that are still there in the renewable energy solutions area. Financial institutions and banks still don't consider solar or any RE plant as an mortgageable asset. Technology and R&D driven start-ups usually hit losses in initial years and gets disqualified for even profitable projects. All financial institutions aim for highest credit rating of client & developer – as a result MSME sector & mid-size institutions are deprived. The current financial model is also not suited to emerging RE technology like captive storage or small wind turbine.

Revayu's recent innovative step to address these challenges is the deferred capex model where they can get the consumer directly financed with 75% loan against mortgage of upcoming solar plant. The technology provider provides minimum generation guarantee to the consumer to ensure that the plant becomes virtually EMI free. After the completion of virtual loan term, the consumer becomes the owner of the plant. He recommended that to unleash the potential of clean energy and accelerate its adoption in the MSME sector, banking should think of treating RE plants as mortgageable asset and the value of the asset can be ascertained based on the estimated value of the clean power it can generate over its lifetime. This way, even the non-profitable registered start-ups with some experience criteria shall be eligible for such financing

Q&A:

Q. What can we do in India to get the ESCO business off the ground?

Mr. Saurabh Diddi: ESCOs were a main agenda item in the Finance Minister speech this year. Ministry of Power is developing guidelines for ESCOs.

Q. The advancement of efficient technology adaptation for chillers and window air-conditioners has been slow in the past. What are the areas left to achieve the decarbonisation targets?

Mr. Arjun Gupta: The areas of cooling, heating, and compressed air. The key to doing it is to use business and economics as the fundamental drive- they must be turned into utilities.

Mr. Rahul Bhalla: We must work as an ecosystem around energy efficiency, retrofits and renewables. He added that the hardest step is to promote the adoption of new technologies and some support has to be there to initiate things. He gave the example of the IFC's Sustainable Cooling Initiative, where they ran a national challenge, selected start-ups, where they invested in the first phase of just having a customer try out a new technology.

Mr. Gaurav Burman: The major issue of access to easy finance. It requires government intervention, reaching out to national and international funds, figuring out enablers that are required. He insisted that the need for energy efficiency is there and is very apparent.

Mr. Saurabh Diddi: If any technology is effective and is being accepted by people, things move automatically and access to finance will accelerate that.

Special Session

Conversations with students & next-gen building professionals

16th September 2022; 15h15 – 16h15

Moderator:

- Mr. Ram Bhat

Speaker:

- Ms. Saswati Chetia

Panellists

- Ms. Abinaya Kandasamy
- Mr. Harsh Nag
- Ms. Lahari Vishwanath
- Mr. Mohit Jain
- Ms. Ritika Goswami

Discussion:

Mr. Ram Bhat spoke about the significance of people working toward energy efficiency and how the education and experience of young professionals affect their commitment to sustainability. Then he throws the panelists a question.

Q) To what extent have your education and recent work experience provided you with the opportunity to align your work with sectoral goals on energy efficiency in buildings, or are there any gaps? If so, what are they and how can they be bridged?

Ms. Ritika Goswami said that as an engineer, she has learned HVAC design and renewable energy concepts, but she finds it difficult to align these subjects with other domains when factors such as passive design and daylighting are taken into account. She also pointed out that, despite the fact that the current educational system has begun to incorporate the building design integrated approach, soft skills, technical tools, and industry expertise are still lacking. interacting with industrial experts and staying up to date on industry trends helps to broaden knowledge and bridge the gap.

According to Mr. Harsh Nag, our educational system emphasises qualitative rather than quantitative approaches, making it difficult for architects to achieve energy goals similar to building physicists. He suggests that, while we can train ourselves

through sources such as workshops and short online programs, a specific system that is easily accessible and legible is required to strive for sustainability beginning with education and should continue in our practice supported by governance. The educational system should include introductory courses like BEEP Camp, and standards like green building codes and the Eco Niwas Samhita should be implemented. He concluded, "Collaboration is therefore not a choice but an effective way to bring our goals into action."

As an architectural student, Ms. Abinaya Kandasamy said that she has seen a curriculum that focuses on design aspects of various typologies but lacks an approach to conscious design with the respective site, necessity, and resources. She suggests that practicality be brought into academics to bridge the gap. She recommended that undergraduate courses cover water efficiency, waste management, and energy conservation concepts. She also emphasised the importance of being aware of environmental policies and bylaws. She concluded by stating that understanding and implementing integrated design processes can help to overcome real-world challenges.

Mr. Mohit Jain said that as a mechanical engineer, he learned subjects such as heat transfer, fluid mechanics, and material strength, all of which can be broken down into bits and pieces and combined to

form a domain. He suggested that such courses can help bridge the gap and students should be aware of policy trends and market assessments. He said that interacting with stakeholders as a professional and having practical experience helped him bridge the gap. He recommended that energy efficiency concepts be integrated into core subjects and that students be encouraged to participate in competitions such as the Solar Decathlon and BEEP Camp, which provide students with great exposure.

Ms. Lahari Vishwanath agreed with the other panelists and added that the educational sector is not as holistic as it should be. She said that students gain theoretical knowledge and work on projects with like-minded people while only considering a few factors, which creates a comfort zone, but when it comes to professional careers, practical knowledge is essential, and we should be able to work with various professionals such as engineers, architects, and stakeholders considering multiple factors. She concludes, "I hope that somewhere we are taught what is practiced and we practice what we are taught."

Mr. Bhat asked the audience what can be done in education or at the start of a career to prepare students for work in the energy efficiency arena. He also asked how integrated design courses can be implemented.

Answers came in the form of Solar Decathlon India, an opportunity where architects, engineers, and other experts are brought together, and students engage in projects with industries.

The USGBC-facilitated LEED lab provides access to existing buildings and new developments that are registered under LEED certification. These labs can be set up in institutions by contacting the USGBC.

Ms. Saswati Chetia discussed the BEEP student camp, which was developed under the Indo-Swiss Building Energy Efficiency Project. She described the Camp as an immersive in-person workshop focusing primarily on the Integrated Design process, which is critical from the design stage. She believes that architects, as the primary communicators with builders and owners, must be well-versed in explaining energy efficiency in qualitative and quantitative terms. Engineers should be able to translate the calculations into a tangible physical design at the same time. The goals of the camp are to introduce an embedded Integrated Design process, to cover the basics of each other's (Architects and Engineers) knowledge and skills relating to buildings, to improve competencies in own field, and to develop effective communication.

She informed that the camp is for students and young professionals who will benefit from group exercises and learning sessions led by Indian and international practitioners and educators. The in-person camp was held in 2018 and 2019 at CEPT University in Ahmedabad, and due to the pandemic, it was held online in 2020 and 2021. The camp was also awarded CIBSE Award 2021 in the learning and development category.

Mr. Bhat then asked the panel about their experiences at BEEP Camp and suggestions for future camps of this type.

Ms. Lahari Vishwanath, who has a degree in Sustainable Architecture wanted a reality check. She says it was interesting to interact with professionals from other construction industry domains and that the camp was like a practice for the Integrated design approach, working with various professionals and being challenging due to time constraints. this encourages one to get out of their comfort zone and work, which provides real-life professional experience. The mentors were always supportive and that interpersonal and communication skills sessions helped in her professional development.

Mr. Mohit Jain described it as a wonderful opportunity for engineers and architects to collaborate on projects in a limited time frame that is both challenging and exciting. He believed that the camp's approach was holistic, the learning course was very systematic, and the interpersonal and communication skills sessions were extremely beneficial in a professional career. He recommended students take advantage of the camp and said the camp could grow exponentially, with alumni forming a community of building physicists, architects, and engineers similar to ASHRAE.

According to Ms. Abinaya Kandasamy, the camp has provided an idea of reality in the sector as it provides a platform to collaborate with a multidisciplinary group, and it is also a great opportunity for students and interns to work with professionals. She claimed that the camp gave her the confidence to learn the fundamentals of building science and to compete in the Solar Decathlon as one of the finalists. Overall,

she said it was a fantastic opportunity to interact with experts and expand her network in the industry.

Mr. Harsh Nag described BEEP Camp as a "milestone" in his career as a young graduate about to enter the sector. the camp has kept a healthy balance between the integrated design approach, lectures, soft skills sessions, and a focus on learning. He suggested that local chapters can collaborate to form a larger group of professionals and students who can contribute to a sustainable future.

Mr. Bhat concluded by stating that the BEEP camp is one of the efforts aimed at bridging the gap and preparing students and working professionals for careers in the energy efficiency sector, and that other opportunities exist, such as Solar Decathlon India and LEED labs. He also mentioned the need to implement these at the college level and look for ways to make energy efficiency a priority.

Valedictory Session

16th September 2022; 16h15 – 16h30

Speakers:

- Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development and Cooperation
- Mr. Saurabh Diddi, Director, BEE

Remarks:

Dr. Demenge, in his remarks, stated that decarbonisation is not only a technical problem but a civilisational problem, and that business-as-usual is not an option. The human species, though called *Homo sapiens*, which means "wise man", has been more of "*Homo economicus*"- being very good at simplifying complex realities into the single metric of price. He stated the importance of looking at nature for the means to survive climate crisis and how often it's not the species that's the strongest but the one which uses resources most efficiently that survives. The question before us is how we also become "*Homo energeticus*". This is not incompatible with "*Homo economicus*". Energy is precious; hence the price of energy must be right. The cost of pollution and emissions must also be right and must be integrated.

He noted that following the rapid and untoward use of ACs all over the world, we've created a cooling dilemma- an energy problem, a CO2 problem, and also equity and access problem. He warned about three dangers in how we, as a society, decide to change. First, is to do nothing. Second, to change the discourse but not the action. And the third one is doing incremental changes, whereas we need to work massively and quickly. He proposed recoining the conference name ANGAN as All Need to Go for Adaptation and Neutrality Now.

Dr. Demenge enlisted six important takeaways from the conference. First, we need to make carbon neutrality and energy efficiency a priority. Second, we need solutions, both high-tech and low-tech ones, many of which were seen in the conference. Third, we need to work together. Fourth, we need commitment at all levels- globally, nationally, across sectors, businesses, financiers, and regulators. We need voluntary codes and actions, and we need to build capacities to adopt and implement the codes. Fifth, we need to work at different scales, from individual housing to planning. Sixth, we need to

create demand and more awareness. He concluded by calling upon everyone to transform the knowledge and technology that we already have into action.

Mr. Diddi reiterated Dr. Demenge's call for action. He urged the audience to take forward the discussions in ANGAN 2022 on various platforms and to different stakeholders, including with BEE, and to convert them to actionable items. He expressed the hope that the next ANGAN, likely in 2024, would show real action and real reduction in energy and emissions. The conference name, ANGAN, harks back to traditional building principles and connects it to future carbon neutrality and he hoped that everyone will work their part in the net-zero movement.

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SPEAKERS

Keynote and Inaugural Speakers

Shri. Alok Kumar

Secretary, Ministry of Power

Shri. Alok Kumar is Secretary Ministry of Power, Government of India. Prior to taking over as Secretary, Ministry of Power, he was serving as Principal Secretary (Power) of the state government of Uttar Pradesh. He was also Chairman of UP Power Transmission Corporation Limited. During his career of 30 years as an IAS Officer, he has held various administrative positions in revenue, transport, power, housing, urban planning and handicrafts sectors.

Shri. Kumar has also worked in the areas of skill development, handicraft based micro enterprises, apprenticeship programmes and National Career Services. He has also authored the book “Electricity Sector in India – Policy & Regulation” which was published by Oxford University Press in 2012.

Shri. Ajay Tewari

Addl. Secretary, Ministry of Power

Shri. Ajay Tewari is an Indian Administrative Service Officer of 1993 Batch of Assam Meghalaya Cadre. He is presently Additional Secretary, Ministry of Power looking after Energy Conservation, Energy Transition, International Cooperation, Training & Research and Perspective Planning of the Ministry of Power. Mr. Ajay Tewari is B. Tech (Electrical Engineer) from Indian Institute of Technology, Kanpur and holds PG Diploma in Financial Management from Indira Gandhi National Open University (IGNOU), New Delhi. Before joining Central deputation in the Ministry of Labour & Employment as Joint Secretary & Director General of Labour Welfare in the year 2018, he had worked in different capacities in the State of Assam and Meghalaya. Shri. Ajay Tewari has wide range of experience of working in Finance, Education, Housing & Urban Affairs, Sports, Youth Welfare, General Administration, Revenue Administration, Disaster Management & Labour Welfare sectors.

Shri. Abhay Bakre

Director General, Bureau of Energy Efficiency (BEE)

Shri. Bakre is the Director General of BEE. He belongs to 1988 Batch of Indian Railways Electrical Engineering Services, Ministry of Railways. Before joining BEE, he worked as Executive Director in the newly created Environment Directorate of the 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

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 a

nation-wide mass media campaign through PCRA and other oil companies to generate awareness among consumers on adoption of simple fuel saving measures in day today life.

Shri. Kuldip Narayan

Joint Secretary & Mission Director PMAY (U), Ministry of Housing and Urban Affairs (MoHUA)

Shri. Kuldip Narayan, Joint Secretary, Ministry of Housing and Urban Affairs, Government of India is looking after its flagship programme of Housing for All/ Pradhan Mantri Awas Yojna (Urban). He assumed charge as Joint Secretary & Mission Director (JS&MD), Housing for All on October 14, 2021. In the Government of India, Shri. Narayan has served as Private Secretary to the Hon'ble Minister of State, Environment, Forest & Climate Change and Hon'ble Minister of State Health and Family Welfare. Earlier, he served as the District Magistrate of Gopalganj, Chhapra, Munger, and Madhubani districts in Bihar. Shri. Narayan also held the charge of Director, Panchayati Raj Department, Patna Municipal Commissioner, and MD of Bihar Rajya Jal Parshad (BRJP) in Bihar.

Dr. Olivier Fink

Chargé d'Affaires, Embassy of Switzerland

Olivier Fink is currently Chargé d'Affaires at the Embassy of Switzerland, New Delhi. He has been at Minister, Deputy Head of the Protocol Division at Berne from 2017 to 2021. He was Councilor, Deputy Head, Political Section at Washington from 2014 to 2017, and Transatlantic Diplomatic Fellow, Russian Affairs Bureau, Department of State at Washington in 2015. He has PhD in Arts (Japanese Literature) from Lausanne University, Tokyo University and Geneva University.

Dr. Brian Motherway

Head of Energy Efficiency, International Energy Agency (IEA)

Dr. Brian Motherway is Head of the Energy Efficiency Division at the International Energy Agency, overseeing a range of analytical and outreach programmes supporting energy efficiency globally. He also leads IEA's work with the Global Commission on People-Centred Clean Energy Transitions. Prior to joining the IEA Brian was Chief Executive of the Sustainable Energy Authority of Ireland. Brian holds Bachelors and Master's degrees in engineering and a PhD in sociology.

Dr. Richard de Dear

Professor, The University of Sydney

Over the last 35 years, Professor Richard de Dear has focused his research career on defining what occupants want and need from their built environments and assessing the performance of buildings in terms of meeting those requirements. He is currently the most highly cited living researcher in the domain of thermal comfort, with over 250 peer-reviewed papers plus several monographs on the subject. Within that body of research, it is his adaptive model of thermal comfort that's had the greatest impact, not just on the research community but also on the design and operation of actual buildings. De Dear's adaptive model underpins the American Society of Heating and the Refrigerating and Air Conditioning Engineers' thermal comfort standard, ASHRAE 55-2004, 2010, 2013, which in turn, informs several national thermal comfort standards around the world.

Dr. Jonathan Demenge

Head of Cooperation, Swiss Agency for Development and Cooperation (SDC)

Jonathan Demenge is the Head of Cooperation for the Swiss Agency for Development and Cooperation (SDC), New Delhi. The Agency undertakes direct actions, supports programmes of multilateral organizations, and helps to finance programmes run by Swiss and international aid organizations in the area of Regional Cooperation and Global Cooperation, Humanitarian aid, Cooperation with Eastern Europe. Dr. Demenge has led and managed the programme on Climate Change, DRR, Roads and Water management. He has been the programme manager, for Desk Niger and rural development, Desk Mali and regional education as well as for global programmes on climate change and food security at SDC. He has also been the Country representative at Tajikistan for GERES, a French NGO with a mission to fight against poverty and climate change. He has also done extensive research on the politics and consequences of road construction in Ladakh for local populations and migrant workers in Ladakh, North India.

Shri. Saurabh Diddi

Director, Bureau of Energy Efficiency (BEE)

Shri. Saurabh Diddi is working as Director in the Bureau of Energy Efficiency. He has 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 has 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.

Speakers and Panellists

Ms. Aarti Khosla

Founder, Climate Trends

Ms. Aarti is the Founder of Climate Trends, and she has over 20 years of experience working on various communication efforts across the environment sector, and FMCGs. She has dedicated the last 12 years to advance the discourse on climate change in India. She holds an MBA in marketing from the Institute of Management Studies and an undergraduate degree in Zoology from Delhi University.

Mr. Abdullah Nisar Siddiqui

Technical Expert, GIZ

Mr. Abdullah Nisar Siddiqui is currently associated with Climate Smart Buildings Programme of Indo German Energy Programme (IGEN-CSB) at GIZ India. He has a keen interest in exploring the use of computational techniques and performance analysis in the development of building sector policies. From his past positions at United Nations Development Programme (UNDP) and Bureau of Energy Efficiency (BEE), he has garnered a range of operational knowledge in the development and enforcement of building energy codes and standards. He spearheaded and implemented numerous schemes and initiatives through the UNDP project on “Energy Efficiency in Commercial Buildings”, these included: (a) Capacity development of building sector professionals through education in building physics and energy simulation, (b) Developing State specific Roadmaps for implementation of ECBC, (c) Demonstration projects to showcase ECBC compliance, (d) Establishing ECBC cells in the states/UTs to assist in the notification and operationalization ECBC, and (e) Market Assessment of Energy Efficient building materials.

His specialties include Policy Advocacy & Code Development, Building Energy Modeling, Built Environment Simulation (CFD), Green Building Certification, Fire, Smoke & Evacuation analysis, Daylight analysis, Renewable Energy, Capacity Development, Training and Support.

Dr. Ajay Mathur

Director General, International Solar Alliance

Dr. Ajay Mathur is Director General of the International Solar Alliance (ISA). Prior to joining ISA, Dr. Mathur was Director General of the Energy and Resources Institute (TERI). He was co-chair of the global Energy Transitions Commission; and of the Clean Cooling Initiatives of the One Planet Summit. He earlier headed the Bureau of Energy Efficiency, and was responsible for its foundational programmes which mainstreamed energy efficiency through initiatives such as the Star Labeling programme for appliances, the Energy Conservation Building Code, and the Perform, Achieve & Trade programme for energy-intensive industries. He was a leading climate change negotiator, and was the Indian spokesperson at the Paris climate negotiations. He served as the interim Director of the Green Climate Fund during its foundational period.

Ms. Akshima Ghate

Managing Director, RMI India

Ms. Akshima Ghate is the Managing Director of Rocky Mountain Institute India where she leads research, analysis, and partner engagement. She provides leadership to RMI India's on-going initiatives with the government agencies at national and sub-national level, which aim to transform mobility trajectory of Indian cities to a shared, clean and people-centric path.

In the past, Akshima has also been associated with TERI University as an Associate Faculty and has been taking guest lectures at the School of Planning and Architecture, New Delhi, Institute of Urban Transport (India), and the International Center for Environment Audit and Sustainable Development (iCED), Jaipur.

Dr. Anand Shukla

Senior Thematic Advisor Energy, SDC

Dr. Anand Shukla is working as the Senior Thematic Advisor at the Swiss Agency for Development and Cooperation (SDC), New Delhi. Having about 27 years of working experience, he is responsible for Climate Change mitigation portfolio in the field of energy efficiency, renewable energy and clean air. He has written many research papers and articles in various journals and edited three books covering various dimensions of renewable energy in developing countries.

Mr. Anders Hall

President, European Solar Shading Organisation (ES-SO) Academy

Mr. Anders Hall started with solar shading back in 1995 as a Sales rep for Hunter Douglas. Later, he joined Somfy Nordic AB as Project Sales Manager and then in Somfy SA (International) as Int Business Developer. In parallel, he became active in ES-SO (the European Solar Shading Organization) in 2006 and since 2012 he is the Board member and Chairman of the Marketing Committee. Shade Academy is a private initiative to, over time, develop a platform online for useful sharing of knowledge and experience.

Mr. André Mueller

Swiss Agency for Development and Cooperation (SDC) Bern

Mr. Andre Mueller is the Programme Manager in the Climate Change, Disaster Risk Reduction and Environment Section of the Thematic Cooperation Division at the headquarters of the Swiss Agency for Development and Cooperation in Bern, Switzerland. He is responsible for programmes in the field of energy efficiency and cooling in the built environment. He has Master degree in environmental engineering with experiences in working in the private sector, non-governmental organization and with the Swiss Agency for Development and Cooperation.

Dr. Anshu Bharadwaj

CEO, Shakti Sustainable Energy Foundation

Dr. Anshu Bharadwaj was a member of the Indian Administrative Services (IAS, 1992 batch, Karnataka cadre). He worked in the state government in various capacities. In 2007, he joined as Executive Director of Centre of Study of Science, Technology and Policy (CSTEP) and helped establish CSTEP as a leading technology policy Think Tank. He functioned as ED of CSTEP till 2020. He has expertise in technology and policy aspects of energy and environmental sectors. He is a member of several government committees in these areas. He holds a PhD from the Departments of Engineering and Public Policy and Mechanical Engineering, Carnegie Mellon University, Piittsburgh, USA. He also has a B.Tech. in Mechanical Engineering from Indian Institute of Technology, Kanpur and PGDM from Indian Institute of Management, Kolkata.

Dr. Anumita Roy Chaudhury

Executive Director, CSE

Dr. Anumita Roy Chowdhury is the Executive Director, Research and Advocacy, Centre for Science and Environment, India. She is in charge of research and advocacy on Sustainable Urbanisation that encompasses clean air, sustainable mobility and sustainable habitat. Over the last two decades she has worked extensively to shape policy advocacy on these issues and has catalysed the Right to Clean Air campaign at the Centre. She has helped to guide and build some of the key policy campaigns on air pollution especially vehicular pollution and multi-sector clean air action planning in cities. She is working with other Indian and African cities to help shape the roadmap for clean air action plans. She has participated and played active role in several national policy forums as well global environmental platforms. She has been participating either as a member or an advisor in various committees and forums. She has widely written and published articles, policy research papers and books. She has been awarded the prestigious Haagen-Smit Clean Air Award by the California Air Resources Board, California, USA.

Mr. Arijit Sengupta

Director, Bureau of Energy Efficiency

Mr. Arijit Sengupta is a Director with the Bureau of Energy Efficiency, Ministry of Power, Government of India. In this role, he is responsible for International Cooperation, New Initiatives, and Planning & Statistics. Apart from this, he is also responsible for coordinating with other Ministries on technical matters. Arijit Sengupta is an MBA from Delhi University, Certified Energy Auditor, and Chemical Engineer having around fifteen years of overall experience, of which he has worked on various Energy Efficiency projects.

Mr. Arjun Gupta

Founder & CEO, Smart Joules

Mr. Arjun started Smart Joules in 2014 to drive substantial energy efficiency improvements across India's businesses and factories, based on the belief that efficiency is the quickest, cheapest and most scalable way to tackle energy inequity and climate change. Under Arjun's leadership, Smart Joules has executed multiple energy efficiency retrofit projects in Hospitals, and has won national and international recognition and financial support for its work. Arjun was recognized in 2014 as one of India's top Young Leaders by the Economic Times newspaper, in 2015 as an Echoing Green Climate Fellow, in 2016 as Young Entrepreneur of the Year by Business Standard and Climate Strategies Accelerator Fellow by the David & Lucile Packard Foundation, and in 2017 as a Champion of Change by the Hon'ble Prime Minister of India and Niti Aayog. Arjun also contributes to nurturing the efficiency industry as an Executive Council member of the Alliance for an Energy Efficient Economy (AEEE). Arjun has a Master's degree in Engineering Systems from MI' and Bachelor's degrees in Environmental Engineering and Economics from UC Berkeley.

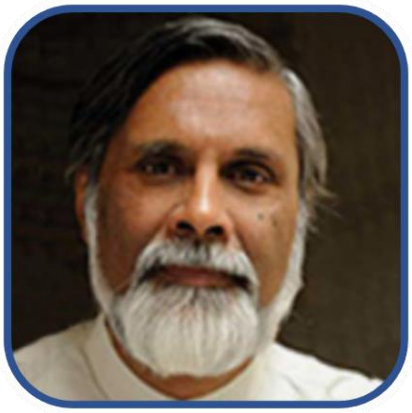
Mr. Ashish Rakheja

Vice President, ASHRAE

Mr. Ashish Rakheja is a Vice President at ASHRAE and is the Managing Partner at AEON. He has a postgraduate degree in Thermal Engineering with twenty-eight years of work experience.

A seasoned Consulting Engineer, he has designed over 2000 projects including Hotels, Airports, Hospitals, Retail, Residential, Commercial, High rises and Industrial projects. He specializes in high-performance buildings and has been actively involved in leading design activities of electro-mechanical services for ten Net Zero Energy Buildings and over forty Platinum rated green projects in India. He is spearheading the green building movement in India as Chairman, Technical Committee of Indian Green Building Council (IGBC) and certified Trainer.

A seasoned speaker, he has delivered over 500 talks on various facets of building design across the world and is the recipient of many awards. An active member of over 20 Technical societies, he regularly contributes his time on writing standards, codes & position papers for government bodies & technical societies. He is involved in imparting training to budding architects in the field of Building Services and is part of the visiting faculty at leading schools in India.



Mr. Ashok B. Lall

Principal, Ashok B. Lall Architects

Mr. Lall is the principal architect of Ashok B. Lall Architects in New Delhi, India. He studied architecture and fine arts at the University of Cambridge, UK and then undertook further study at the Architectural Association, London, including the Department of Tropical Studies.

Among India's most respected architects, Ashok B. Lall has been a pioneer in formally integrating sustainability into his architectural works – decades before the term attained significance. The firm Ashok B Lall Architects was established in 1981. The practice specialises in low-energy sustainable architecture. He has also been a devoted academician and served as Dean of Studies at the TVB School of Habitat Studies. Among several notable accolades, Mr. Lall has been nominated for the prestigious Aga Khan Award for Architecture twice, served on the international Holcim Foundation Jury thrice.

Ms. Chitra Vishwanath

Principal Architect, Founder & Managing Director, Biome Environmental Solutions

Ms. Chitra Vishwanath is a household name in ecological and sustainable architecture. Ms. Vishwanath is the Principal Architect and Managing Director of Biome Environmental Solutions, a multi-disciplinary firm based in Bangalore. She holds a diploma in civil engineering from Nigeria and a Bachelor's degree in architecture from CEPT University, Ahmedabad. She started her practice in 1990 under the name Chitra Vishwanath Architects, which later in 2008 merged with Rainwater club to form Biome Environmental Solutions. Ms. Vishwanath and the entire team at biome has been involved in more than 700 projects to date. Social responsibility, energy efficiency, water management and overall impact on the land are essential components of any project at Biome.

Mr. Christian Richter

International Knowledge Exchange, Energiesprong

Mr. Christian works in the Energiesprong German team supporting the construction side and covering the industrial supply chain and innovation team. He also leads on transatlantic market knowledge exchange, supporting Retrofit NY and Rocky Mountain Institute to use the Energiesprong approach.

Mr. Christoph Ospelt

Founder and Managing Director, Lenum AG

Mr. Christoph Ospelt is the founder and managing director of Lenum AG in Liechtenstein. He is also co-owner and chairman of the board of directors of the sister company EK Energiekonzepte in Zurich. The focus of the activities of Lenum and EK is on the sustainability of buildings, energy efficiency and the use of renewable energies. Both companies have assisted in designing many advanced prize-winning sustainable buildings, including Positive-energy Buildings, Minergie, Passive and Eco-Buildings.

Christoph Ospelt began as a research assistant at the 'Solar Energy and Building Physics Laboratory' of the Federal Institute of Technology of Lausanne (EPFL). Later, his research at MIT focused on Life Cycle Assessment in the context of buildings and on the sustainability of buildings.

Mr. Daniel Magallon

Managing Director, Basel Agency for Sustainable Energy

Mr. Daniel Magallón is a sustainable energy financial specialist with over 23 years of experience working with international public and private organizations, experience in developing financing mechanisms and risk mitigation instruments 'or the 'Green' sector, including debt and equity finance of projects, as well as a deep understanding of the engineering, construction and operating issues of green energy technologies. He has worked on various projects related to market-driven solutions to accelerate investments and financing in climate change mitigation and adaptation projects.

Since 2007, he directs BASE's work, a Swiss-based organization focused on developing innovative business models and financing instruments to mobilize investment and financing to sustainable energy and climate change solutions. He has conducted assignments for UNEP, World Bank, GEF, REEEP, IDB, German Government (BMU) among others, mobilizing investments, developing business models, financial mechanisms, risk mitigation instruments, and accessing market opportunities for RE and EE projects in Mexico, Haiti, the Dominican Republic, Chile, Egypt, Morocco, Tunisia, China, and India.

Mr. Deo Shankar Tripathi

MD / CEO, Aadhar Housing Finance Ltd

Mr. Deo Shankar Tripathi is the Managing Director and Chief Executive Officer of Aadhar Housing Finance Ltd. He holds a bachelor's and master's degree in Science from Lucknow University and has cleared the examination for a diploma in Public Administration from Awadh University. He has also passed the associate examination of the Indian Institute of Bankers and has completed various certificate courses including International Study Tour on "Energy Efficiency in Residential Buildings" from KFW Entwicklungsbank, Germany, and Strategy and Management in Banking Programme from International Development Ireland Limited. He has worked as a general manager at Union Bank, and president and chief operating officer at DHFL. Prior to this, he was the chief executive officer of Erstwhile Aadhar. Presently, he is serving as a director on the boards of ASSPL and Fort Finance Limited.

Dr. Dibakar Rakshit

Associate Professor, IIT Delhi

Dr. Dibakar Rakshit is currently an Associate Professor at Department of Energy Science and Engineering, Indian Institute of Technology Delhi (IIT Delhi). He has nineteen years' experience in thermofluid sciences pertaining to design and optimization of energy systems. His Ph.D. at The University of Western Australia involved studies of multiphase mass transfer phenomenon related to thermal diffusion of Liquefied Natural Gas (cryogenic fluids). After joining IIT Delhi as an Assistant Professor, Dr. Rakshit continued his study of thermal energy storage capacity of materials that can be utilized for building energy conservation. He then started pursuing his further research in characterization of Nano-Enhanced Phase Change Materials (NEPCM) for thermal energy storage in building envelope. Along with this, he also carried forward his research on designing of energy efficient buildings, sustainable building infrastructures and development of sustainable technologies for catering to the energy needs of the society. His research works in the above areas along with his team of students have resulted in around 81 journal publications, 53 refereed conference papers and 17 book chapters.

Mr. Edwin Koekkoek

Counsellor on Energy and Climate Action in the European Union Delegation to India

Mr. Edwin Koekkoek is First Counsellor on Energy and Climate Action in the European Union (EU) Delegation to India, responsible for EU-India cooperation on Energy and Climate Action, including the implementation of the 2016 Clean Energy and Climate Partnership.

Prior to joining the EU Delegation, he worked for 7 years in t'e Netherlands' Ministry of Environment, 5 years as part of the Dutch delegation to the climate negotiations and 2 years as senior policy advisor on air quality. He then worked for 11 years for the European Parliament, including 5 years in the Environment Committee, inter alia on climate change and renewable energy. He specialized in the EU legislative procedures and negotiations between the Parliament and Council. He also worked in the Cabinet of the President, advising him inter alia on energy and climate issues.

Ms. Elizabeth Wangeci Chege

Energy Efficiency & Cooling Specialist- Africa, SEforALL

Ms. Elizabeth Wangeci Chege is the energy efficiency and cooling specialist in SEforAll (Sustainable Energy for All) Africa. She is also the Chair of the Africa Regional Network of WorldGBC. She was the winner of World Green Building'Council Chair's Award 2019-2020. This Award is given to individuals who have made an outstanding contribution to the global green building movement. She is also the Technical lead for ESG assessment for the 1st developer in East Africa to launch Green Bonds of USD 40 million for Student housing. Previously, she was the Vice Chair of the World Green Building Council in the field of building & construction industry.

Mr. Franco Alexander Piza Rondon

Head of Corporate Sustainability, Bancolombia Group

Mr. Franco Alexander Piza Rondon is a public accountant from the Universidad Central of Bogota and is a specialist in financial management and organizational development. He has worked in sectors such as international commerce, credit analysis and credit risks. He has been the manager of subsidiary risks since 2005. In 2008, he designed and took on the management of Environmental Management and from 2011 to 2015 he worked as the director of sustainability for the strategy of environmental and social impact of Bancolombia. Since 2015 he has served as Corporate Director of Sustainability.

Mr. Gaurav Burman

Managing Director, Asia Pacific, 75F

Mr. Gaurav Burman is the APAC President of 75F Smart Innovations Ltd. His previous assignment was with Schneider Electric, as Director – Marketing where he was also a part of the Management Team, South Asia. Gaurav has handled diverse portfolios in his career including product management, alliances, channel sales, and enterprise sales.

Prior to Marketing, Gaurav spent 20 years of his life in Sales and worked with companies like PCL, IBM, L&T, APC, and Schneider Electric. He was recently recognised as one of the 50 Most Talented CMOs in India in 2013, and one of the 100 Most Talented CMOs in the World by the US-based CMO Council. Gaurav obtained his Civil Engineering Degree from The Thapar Institute, Patiala. He pursued his MBA in Marketing from XLRI, Jamshedpur.

Mr. Gaurav Jain

Joint Vice President – North, National Real Estate Development Council (NAREDCO)

Mr. Gaurav Jain has more than 30 years of experience in real estate projects across all function with last 10 years as business head/CEO responsible for P&L and guiding projects from start to finish. He has a keen business insight as well as spots the trends well ahead of their becoming reality. Well versed with Government and policy formulation, he is well connected in the professional and business circles. He specialised in business turnaround and giving a forceful direction as demonstrated in his stints as CEO- Bombay Realty as well as MD & CEO of Jindal Realty. Prior to this, he has held key management positions in key real estate companies as Emaar MGF, M3M, ITC, DLF and Jaypee Group. He holds an MBA from MDI, Gurgaon, a Master's degree in Planning from SPA, New Delhi and Bachelor of Civil Engineering with Honors from Nagpur University. Mr. Jain is a MRICS and a visiting faculty in SPA, New Delhi.

With a keen insight of the emerging trends and market, he has successfully given shape and directions to many companies and projects across India. He is a team player and believes that every team member plays a pivotal role in success of every venture. He is also VP of NAREDCO at the national level, a real estate body under aegis of Government of India, Housing and Urban development ministry

Specialties: Real Estate Development, Profit centre head, Business strategy and business development Land and Town Planning, Project Management, Development and Construction.

Mr. Girish Sethi

Senior Director, The Energy and Resources Institute (TERI)

Mr. Girish Sethi leads and manages the programme on promoting efficiency in the industrial sector, encompassing both large industries and Small and Medium Enterprises (SMEs). He has more than 23 years of experience in the field of energy conservation and environment improvement in the industrial sector and has been with TERI for the past 15 years.

Apart from providing strategic direction and coordinating the activities related to industrial energy efficiency, he has led multidisciplinary research teams in action research projects involving development/adaptation of energy efficient and environmentally benign technologies. Mr. Sethi is presently managing a large program funded by a bilateral organization that focuses on holistic development of some energy intensive small-scale industry sectors in India. He is also involved in matters related to inventorisation of corporate level GHG emissions and aspects related to transfer and promotion of low-carbon energy technologies in the context of climate change.

Mr. Guruprakash Sastry

Regional Head, Infrastructure, Infosys Limited

Mr. Guruprakash Sastry is a green building professional with over 18 years of experience. As Sustainability Leader, he is responsible for driving environmental sustainability initiatives across Infosys campuses. In the last 14 years at Infosys, he has been instrumental in implementing several innovative technologies in buildings in the areas of building design, energy, water and waste management. Infosys has set new benchmarks for resource efficiency in the buildings sector and is considered a global leader in environmental sustainability. Infosys is among a few corporates in the world to have achieved carbon neutrality across all emissions.

Mr. Guruprakash has a Master's Degree in Sustainable Energy Engineering from Stockholm.

Dr. Hal Hinkle

CEO & Director, Bamcore, USA

Dr. Hal is the CEO of BamCore and its parent Global Bamboo Technologies, Inc. His focus on climate change began after his second retirement (22 years at Goldman Sachs, then 5 years running and selling a global online bond exchange). His initial climate focus began in 2004 when he started a non-profit foundation to focus on climate change education. Following a Ph.D. in Neuroscience and a Graduate Research Fellowship from the National Science Foundation, he returned to his native California to build an organic and climate-conscious vineyard and winery in Sonoma County (SeiQuerce.com), where he was introduced to BamCore for his building projects. Intrigued, he spent nearly a year researching timber bamboo and its ability to quickly capture carbon from the atmosphere, which could then be stored long term in buildings. Today, his wine label is managed by others but continues as the first dually certified organic and climate-adapted winery in the world. Now, his full commercial focus is on bringing structural fibers from bamboo and select fast-growing trees into the construction and industrial markets. Hal holds a BS degree (Cum Laude) in biochemistry from UC Irvine, an MBA (Beta Gama Sigma) from Columbia Business School, and MS, MPhil, and Ph.D. degrees from Columbia Medical School. He is also a certified University of California Climate Steward.

Mr. Hemant Chaudhary

Executive Director, Circular Economy Alliance Australia (CEAA)

Mr. Hemant Chaudhary is the founder of Circular Economy Alliance Australia, and is an acclaimed expert in the area of sustainability and the Circular Economy and works extensively on global initiatives with the UN, World Bank and international agencies. In a career spanning 28 years Hemant has worked for large corporations, governments, peak industry bodies, non-government organizations, municipal corporations, community groups, and venture capital investors. Hemant has covered diverse sectors and specialties that include water, waste, renewable energy, mining, oil & gas, manufacturing, food, major infrastructure and education delivering innovative environmental programs and projects of significant scale, sensitivity and impact.

Mr. Jonathan Duwyn

Head of Cities Unit and Head GlobalABC Secretariat

Mr. Jonathan Duwyn is Head of Cities Unit and Head of the GlobalABC Secretariat at UNEP. He joined the United Nations in 2005 and has worked at country level, regional level and headquarter level. His international project experience ranges from mainstreaming environment into national policies, supporting climate technology transfer, encouraging energy efficiency and the use of renewable energy technologies, and fostering access to climate finance. Prior to joining the United Nations. Jonathan worked with the private sector in France and Morocco, designing, installing and doing maintenance of standalone energy systems (solar PV, wind generators, diesel generators and hybrid systems) as well as conducting on-site wind assessments for wind farm project developers.

Dr. Jyotirmay Mathur

Professor, Centre for Energy and Environment, MNIT Jaipur

Dr. Mathur works in the field of energy and modeling, building energy simulation, energy conservation in buildings, and life cycle assessment of renewable energy systems. He has in his credit 55 journal papers and more than 120 talks, several research projects including 3 international collaborative projects. His current activities include studies on adaptive thermal comfort, modeling of passive and low energy cooling systems, long term energy system modeling penetration of renewable energy.

Besides teaching and research, he is presently also working as the Head of the Incubation Centre. He was founder Head of the Centre for Energy and Environment at MNIT Jaipur. He is a mechanical engineer, having done post-graduation in energy studies from the Indian Institute of Technology, New Delhi (India) and doctorate in energy systems from University of Essen (Germany).

Ms. Meenakshi

Project Engineer, Bureau of Energy Efficiency (BEE)

Ms. Meenakshi is a Project Engineer in the Bureau of Energy Efficiency. She has more than eleven year of extensive and multidisciplinary professional experience in the field of Energy Efficiency and Information Technologies. She is currently working in Building Energy Efficiency Program and looking after Energy Efficiency in Residential Building, Net Zero Buildings, Building Materials and Enforcement of Energy Efficiency schemes in the States. She is also working in development of regulatory framework for Energy Efficiency Schemes and amendment of Energy Conservation Act.

Ms. Meenal Anand

Sector Expert (Building), Bureau of Energy Efficiency (BEE)

Ms. Meenal Anand is an Electrical Engineer with Masters in Energy Management. Presently, she handles implementation of Building Energy efficiency schemes in States/UTs, providing technical assistance and guidance to implementation team, capacity building of stakeholders. She has experience in working with different stakeholders: Govt. departments, States/ UTs, bilateral, developers, organisations for development of new schemes and for the enforcement of the existing schemes under building energy efficiency program and NetZero Building.

Ms Meenal has 16+ years of professional experience in the field of designing, testing, Energy efficiency. She has experience of working in United Nation Development program (UNDP), Karnataka Renewable Energy Development Limited.

Mr. Mehul Patwari

Director Sustainable Finance, South Pole

Mr. Mehul Patwari has more than 20 years of corporate experience covering skills of project appraisal/finance, due diligence and infrastructure project development in sectors like New City Development (Infrastructure & Real Estate), Urban infrastructure, Transport (roads, bridges), Real estate, Tourism, ICT, Oil & Gas. He has a rich experience in Project Conceptualization, Development and Structuring on PPP basis, Fund Raising, Joint Venture / Deal Structuring, Conceptualization of Economic Development Programs at GIFT, Policy Formulation for Private Sector Investment in Infrastructure Development, Project Management. He is an expert of Infrastructure and Real Estate Projects: Techno-Commercial Due Diligence, Deal Making, Investment and Structuring, Financial and Risk Analysis, Documentation

Ms. Melanie Slade

Senior Programme Manager, IEA

Ms. Melanie Slade has spent thirty years in energy efficiency policy development and implementation in many parts of the world. She started out working in the UK Government on industrial and appliance energy efficiency and has worked with many other governments to establish similar programmes, perhaps most notably, the Government of China since the 1990s. In 2007 Mel became the Chair of Australia and New Zealand's Equipment Energy Efficiency programme and where she led the phase-out of inefficient lighting. Mel moved to the international Energy Agency in February 2014 to manage the Energy Efficiency in Emerging Economies Programme. Mel and her team work with policy makers in Brazil, China, India, Indonesia, Mexico, South Africa and Thailand to develop more effective energy efficiency policy, track its progress and assess its potential.

Mr. Mridul Upreti

Senior Investment Officer, IFC

Mr. Mridul has worked extensively in Finance, Real Estate and Private Equity Industry. He worked with JLL for 16 years, where he was the CEO of JLL Funds and before that Joint MD of Capital Markets. He is currently senior advisor to International Finance Corporation, an start-up investor and visiting faculty at Delhi University and SPA Delhi. He is one of the early adopters and investors into futuristic Tech enabled Solutions. He has made over 18 early-stage tech investments in Indian Start-ups. He founded YSTART to combine his passion of teaching and mentoring young entrepreneurs innovate and navigate the era of digital innovation. He has done B. Planning from SPA, Delhi and MFC (DFS) from Delhi University

Ms. Neetu Jain

Founder & MD, Panache Greentech Solutions

Ms. Neetu Jain is the managing director at Panache Greentech Solutions. She has experience in business development, management, and business planning. She has worked with Cool Roof Rating Council and Federation of Gujarat Industries (FGI).

Her expertise in Energy efficient & protective building enveloping products & solutions comprising of cool surfaces (cool roofing & cool wall coatings), thermal comfort, insulation, and waterproofing, as well as other UHI mitigation technologies is exceptional. As a Founder and MD of Panache Greentech Solutions Pvt Ltd her core intention is to provide the best up to the mark, genuine environment friendly innovative products & solutions with sustainable performance which also comply with global standards.

Mr. Nicolas Schenk

Chief Development Officer, Delhi-Noida International Airport

Mr. Nicolas Schenk has been working for Zurich Airport in various positions since 2006. First he joined the master planning department in Zurich. In 2008 he was transferred to the Bangalore International Airport project. After his time in India, he worked on various projects abroad in Brazil, Kazakhstan and Colombia. From 2017 onwards he was employed exclusively for the international business development division of Zurich Airport, participating in various airport privatisation projects. Since February 2020 he has been the designated chief development officer for Noida International Airport in Jewar, Uttar Pradesh, India.

Mr. Oliver Rapf

Executive Director, Buildings Performance Institute Europe (BPIE)

As Executive Director of BPIE, Mr. Oliver has spearheaded strategic planning, administration, program development, fundraising and outreach since joining BPIE during its infancy in 2011. Through his leadership, Oliver has grown BPIE into a financially independent non-profit organization and trusted thought leader on energy performance of buildings in Europe and globally.

Before joining BPIE, Oliver worked for the global conservation organization WWF in various roles, including as Head of the Climate Business Engagement unit of WWF International, managing strategy and partnership development with the private sector. Leading an international team, he advised multinational companies on climate change and energy issues.

Oliver's experience in buildings efficiency goes back to the late 90s when he was a project leader for several deep renovation projects on behalf of WWF in cooperation with housing companies across Germany. Oliver participated in UNFCCC negotiation processes, and was the leader of the German NGO coalition at international conferences. Oliver has been active as a jury member of environmental and sustainability awards and serves on various advisory boards. In his early career, he worked on regional sustainability strategies and spatial planning.

Mr. Pankaj Sharma

Project Engineer, Bureau of Energy Efficiency (BEE)

Mr. Pankaj Sharma is working as a Project Engineer in Bureau of Energy Efficiency. He is an Electrical Engineer and BEE certified Energy Manager. In Bureau of Energy Efficiency, he is looking after the Energy Efficiency achieved and aimed in Energy Efficiency in Transport Sector programme, Commercial Buildings under PAT scheme and Star Rating of Buildings programme. Prior to joining BEE, he has worked in a Power Distribution Company. He successfully conceptualized the 11kV Feeders segregation and rearrangement of the to minimize outage & commercial losses.

In BEE, he has worked in target setting & Monitoring of the Energy consumption for Commercial Buildings/Hotels notified as Designated Consumer under Perform, Achieve & Trade scheme, worked on the

development of Fuel Efficiency programme for Passenger Cars, Heavy Duty, and Light & Medium commercial vehicles. Additionally, he is looking after the revision of the Labelling programme for commercial buildings and addition of new typologies including Net-zero buildings under the regime of building labelling.

Mr. Pierre Jaboyedoff

Indo-Swiss Building Energy Efficiency Project (BEEP)

Mr. Jaboyedoff heads the Swiss PMTU of the Indo-Swiss BEEP and is a senior engineer specialising in energy-efficient buildings and solar energy applications, with over thirty years of experience in the field. He is a pa'tner in Effin'Art Sarl, a Swiss consulting firm founded in 2014, which focuses on the design of low-energy buildings and optimisation of existing buildings. His expertise in the development and application of high-performance, innovative, and climate-responsive solutions ranges from industry to data centres, including university campuses and large office buildings.

Mr. Jaboyedoff also has vast experience in India, where he has been implementing projects related to energy efficiency and renewable energy in various economic sectors (industry, power generation, buildings, etc.) since the early 1980s.

Mr. Prashant Bhanware

Principal Consultant, Indo-Swiss BEEP

Mr. Bhanware is an energy engineer with core expertise in building energy simulation, energy efficiency, and renewable energy. He is a BEE certified Energy Auditor & ECBC Master Trainer. He has a Master's degree in Energy Systems Engineering from the IIT, Bombay. He has more than twelve years of experience in the energy sector in research and consultancy. He is part of Indo-Swiss BEEP PMTU since its inception.

Mr. Rahul Bhalla

CEO, Zenatix

Mr. Rahul Bhalla is the CEO of Zenatix, which is a provider of IoT based automation solutions to commercial buildings, retail chains and B2B OEMs. Previously, he's been in the Intellectual Property outsourcing space, helping businesses build and grow their Intellectual Property functions. His specialities are business development, strategic account management, new product/solutions development, operations and delivery. Rahul is responsible for overall strategic direction as well as sales & customer relationships at Zenatix. He holds a B.Tech from IIT Delhi.

Mr. Rahul Pathak

Manager Product Marketing & Key Accounts, Emerson

As a Product Manager in Emerson, Mr. Rahul Pathak leads Air Conditioning & Heating Marketing initiatives in India. He is responsible for Product Marketing & Business Development that includes building product strategies, new product introduction, product positioning and developing value proposition, market analysis, new business opportunities. He also looks after key account management of few AC customers. Rahul Pathak is a Mechanical Engineer from Government Engineering College Aurangabad and MBA in Marketing from Pune University. He has a total work experience of 15 years in Marketing & Business Development. He began his career with Emerson in 2008 from Pune Head office. Rahul also worked in Honeywell for a small stint as Customer Marketing Manager for Air & Water Product line.

Dr. Rajan Rawal

Senior Advisor, CARBSE, CEPT University

Prof. Rawal is a faculty member at CEPT University, Ahmedabad, and Executive Director of Centre for Advanced Research in Building Science and Energy (CARBSE). He teaches energy efficient built habitat, energy modelling, energy policy at post graduate level. His work emphasis is on 'energy performance of human habitat' and 'architectural science education'.

He leads the Indo-US Joint Clean Energy–R & D Centre - Building Energy Efficiency Sector and is a member of various committees. In 2014, he was appointed as a senior expert at the Global Building Performance Network. He spearheaded inclusion of adaptive thermal comfort standard as part of National Building Code of India in 2015. He has served as a member of the Board of Studies at various educational institutes.

Mr. Rajkiran Bilolikar

Director, Centre for Energy Studies (CES), ASCI

Prof. Rajkiran V Bilolikar is Director, Centre for Energy Studies at Administrative Staff College of India (ASCI). Here he leads the Energy Efficiency, e- Mobility, Renewable Energy and Power Sector Projects. He has worked in Maharashtra State Electricity Distribution Company, one of the largest electricity utilities in India prior to joining ASCI.

Prof. Bilolikar played an instrumental role in operationalizing mandatory compliance of Energy Conservation Building Code (ECBC) in the state of Telangana and Andhra Pradesh. Currently he is working on strengthening the implementation of Energy Efficiency Code Compliance in Telangana, Andhra Pradesh and Maharashtra along with clean mobility promotion in India. He has 20 years of experience in Electricity Distribution Management, Energy Efficiency Policy, Renewable Energy, Strategic management of Power Utilities, Climate change and Sustainability and e – Mobility.

Mr. Ram Bhat

Facilitator & Organisation Development Expert

Mr. Ram is a change facilitator primarily in the Social Development sector, focusing on capacity building and change processes in organisations. As the founder of Options & Solutions, over the last 23 years he has worked with numerous clients across sectors like UNDP, WHO, ILO, International Organization for Migration (IOM), NABARD, GiZ (German Government Agency for Technical / International Co-operation), Aga Khan Foundation, International Trade Centre Geneva, DWHH / German Agro Action, Christian Children's Fund Canada, Misereor Germany, etc., as also a large number of Indian and Asian NGOs. He has been involved as a facilitator and trainer for organizations in India, Bangladesh, Nepal, Sri Lanka, Indonesia, and the Philippines. In recent years, Ram has worked with a number of organisations in the Garment Sector, including the Centre for Responsible Business (CRB), Marks & Spencers, H&M, Shahi Exports Ltd., and with the World Fair Trade Organisation (WFTO).

Mr. Rick Torgerson

CEO & Founder, Humengi

Mr. Rick Torgerson is Founder and CEO of Humengi, the world's most highly engineered masonry building system. Mr. Torgerson spent more than 25 years in marketing, advertising, media and publishing in the San Francisco Bay Area, California, USA, and more than 10 years in the California real estate industry. He holds a Bachelor of Arts degree from the University of the Pacific, Stockton, California, and is passionate about helping with solutions for affordable housing on a global scale. One of his favourite quotes is one by Margaret Mead: "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed it's the only thing that ever has."

Ms. Rita Panicker

Founder Director, Butterflies India

Ms. Rita Panicker Pinto is the Founder Director of Butterflies, a non-governmental organization in New Delhi, India working to protect & empower street & working children since 1989. In 2019, the Butterflies' Resilience Centre was completed.

Ms. Panicker has been a faculty member in the Women's Studies Unit, at Tata Institute of Social Sciences, Mumbai and was also the Founder Member of MASHAL – Maharashtra Association for Social Housing. In 1990, Rita was appointed Consultant to UNICEF New York and Nigeria to assist UNICEF Nigeria office to formulate a national policy and programme for Children Especially in Difficult Circumstances (CEDC). Today this whole area is known as Child Protection. From 1988-1992, Rita also served as the Director of the Board of ChildHope International, an international organization working on issues of street and working children. Rita was elected to the Ashoka Fellowship in 1993 and has authored several books on children's issues. She was also the Vice Chair of the Board of Family for Every Child, a global alliance of local civil society organisations working together to improve the lives of vulnerable children around the world.

Ms. Sakshi Chadha Dasgupta

Senior Thematic Advisor, SDC

Ms. Sakshi C. Dasgupta, is the Senior Thematic Advisor with the Swiss Agency for Development and Cooperation (SDC). She is managing projects like CapaCITIES, Clean Energy Policy etc. and is responsible for SDC's Urban and Environment portfolio. She has more than 15 years of professional experience in the urban development/environment sector. She was earlier associated with the German Development Cooperation (GIZ) on projects related to Sustainable Development of Smart Cities and Support to National Urban Sanitation Policy in various states and cities. She has worked with organizations like TERI, Centre for Science and environment (CSE) on aspects related to water resource management, green buildings amongst others. She has extensive experience working with reputed bilateral organizations for development cooperation, research/ advocacy institutes, and state and city governments. Sakshi holds a master degree in urban and regional planning from the Centre for Environment Planning and Technology (CEPT), Ahmedabad. She completed her masters and bachelor's degree from the Delhi School of Economics and Miranda House, Delhi University respectively.

Dr. Sameer Maithel

Director, Greentech Knowledge Solutions Pvt. Ltd.

Dr. Sameer Maithel is the Founder Director at Greentech Knowledge Solutions. He is an engineer having primary interest in the development and dissemination of energy-efficient, low-carbon, renewable energy solutions in the building sector, small industries, and rural communities. His work experience covers design & technology development; field measurements and testing; conceptualization, development and implementation of policies, programmes and projects; trainings & capacity building.

Over a career spanning 30 years, he has worked on facilitating adoption of energy-efficient/less polluting brick firing technologies in several thousand brick kilns in South Asia, development of Eco-Niwas Samhita, development of sectoral roadmaps and national and regional projects deal with energy efficiency and resource efficient building materials. He has also designed and conducted training programmes for professionals and practioners in the area of resource-efficient brick production, energy-efficient building design, and decentralized renewable energy applications.

Mr. Samit Jain

Managing Director, Pluss Advanced Technologies Pvt. Ltd.

Mr. Samit has an M.Sc. in Physics and Bachelor in Electrical and Electronics Engineering, from the Birla Institute of Technology & Science, Pilani, India (1994). He also holds an M.S.in Electrical Engineering. from the Univerlity of Hawai'i, USA (1997). As MD at Pluss, Samit heads the overall strategy, marketing and finance portfolios.

With a belief that Energy access is going to be the key for a sustainable world, he has led the growth of energy storage materials and their applications at Pluss. He led his team to develop and create products – some of which were the first in the world – MiraCradle™, worlds first neonatal cooler can keep a baby cool for 3 days. Pluss went on to receive the CII's – Most innovative

MSME award twice – In 2015 and 2017. Samit also led PLUSS to develop several energy efficient and innovative solutions in the field of temperature control of buildings, HVAC equipment, refrigeration and agricultural solutions.

Extremely passionate about Environment, he engages in Environment conservation through Advit Foundation, a Gurgaon, India based NGO. An avid marathoner, Samit has successfully completed the Los Angeles Marathon, the Delhi Half Marathon and the Mumbai Marathon.

Mr. Sanjay Dube

CEO, International Institute for Energy Conservation (IIEC)

Mr. Sanjay Dube is the Chief Executive Officer of IIEC. He has over 32 years of experience and has worked on clean energy and climate change related programs supported by international agencies like USAID, ADB, World Bank, UNIDO, UNEP, UNDP, GIZ, and DFID. Prior to joining IIEC, he has worked as Chief of Party for Partnership to Advance Clean Energy – Deployment (PACE-D) Technical Assistance Project of USAID in India, Vice President for Emergent Ventures India Pvt. Ltd. (2010-2012), Senior Program Manager with ICF International (2006-2010) and Senior Project Manager for IIEC (2001-2006).

He has worked extensively in providing energy efficiency, renewable energy, clean energy finance, sustainability and climate change related services to various national and international agencies. Mr. Dube has worked on the design of waste heat recovery program for industries, development of the roadmap for implementation of net zero energy buildings, and provided technical assistance to the Ministry of Power in implementing audit programs for industries and buildings as well as updating the Energy Conservation Building Code (ECBC) for India.

Mr. Sanjay Joshi

Additional Sr General Manager, HDFC Ltd

Mr. Sanjay Joshi serves as Additional Senior General Manager & Regional–Business Head - Rajasthan of the Company. He holds a Bachelor's Degree in Civil Engineering from Institution of Engineers (India). He has been associated with the Corporation since 1985 & has over 30 years work experience in the Housing & real estate industry.

Mr. Sanjay Seth

Senior Director, Sustainable Habitat Division, TERI

Mr. Sanjay Seth is Senior Director of the Sustainable Habitat Division 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 joined BEE in 2007, with the introduction of the “Energy Conservation Building Code (ECBC)”, and was given the responsibility of developing an enabling framework for facilitating its implementation in a consistent manner. Prior to joining the Bureau, he has worked in various capacities in a Central Public Sector Generating company, under the Ministry of Power and was associated with planning, monitoring, co-ordination and construction management of Hydro and Thermal power projects.

Mr. Sarada Kumar Hota

MD, National Housing Bank

Shri. Sarada Kumar Hota, a Post-Graduate in Agricultural Science, is a senior banker with 29 years of commercial banking experience having served across the country. Before joining NHB, Shri. Hota was the Managing Director & CEO of Can Fin Homes Ltd, a premier housing finance institution and also the first Bank sponsored Housing Finance Company having been in business for over three decades. He has steered the company successfully during the period FY 17 – FY 19, when the sector witnessed major reforms and challenging times. He was the Chairman of the Management Committee and a member of Stakeholders Relationship Committee of the Board at Can Fin Homes Ltd. He was also the Circle head of Nagpur and Jaipur Circles of Canara Bank for 3 years followed by a brief stint in the Recovery Wing of the Bank at Head Office. Apart from his expertise in retail operations, he also carries with him the experience of working in the areas of Human Resources, Strategic Business Planning and Profit Planning at the Head Office of the Bank.

Ms. Saswati Chetia

Associate Director, GKSPL & Senior Programme Officer, Indo-Swiss BEEP

Ms. Saswati is Associate Director at Greentech Knowledge Solutions Pvt. Ltd., a research and advisory firm working on energy efficiency in buildings, resource efficiency in the production of building materials and deployment of decentralized renewable energy systems. She's an architect and environmental planner by training. She has 15 years of experience working as an architect, green building consultant and building energy efficiency expert. She’s been involved with the Indo-Swiss Building Energy Efficiency Project since 2012.

Dr. Satish Kumar

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

Dr. Satish Kumar serves as the President and Executive Director of the Alliance for an Energy-Efficient Economy (AEEE). Prior to AEEE, he was the Energy Efficiency Ambassador and led the Energy Management business at Schneider Electric India, a Scientist at Lawrence Berkeley National Laboratory, and the Chief of Party for a USAID-supported bilateral energy efficiency technical assistance program (ECO-III) project. He has a Ph.D. from Carnegie Mellon and a B. Arch from IIT Roorkee), was nominated for the executive leadership program at

Harvard Business School and the University of North Carolina, is a member on the TEAP's Energy Efficiency Task Force under the Montreal Protocol, is a LEED Fellow (USGBC), Certified Energy Manager and Certified Measurement and Verification Professional (Association of Energy Engineers).

Dr. Shailesh Agrawal

Executive Director, Building Materials and Technology Promotion Council, MoHUA, Govt. of India

Dr. Shailesh Kr. Agrawal is heading BMTPC an Apex Inter Ministerial organization under the Ministry of Housing & Urban affairs, Government of India mandated to promote cost effective, environment friendly, energy efficient building materials and construction technologies from lab to land. One of the recent initiatives taken by Dr. Agrawal is to identify, evaluate and certify emerging construction systems for mass housing for faster, quality, safe and sustainable construction. Prior to this, he has served Central Building Research Institute, Roorkee, a constituent establishment of CSIR and a premier research institute involved in R&D in the area of building science and technology as a scientist for 20 years.

Mr. Shounak Ray

Business Development Lead, IFC

Mr. Shounak is an Architect, Project Manager and Business Strategist by training. After over two decades of work in the APAC region across Healthcare Groups, Consulting and Real Estate Development, he thrives today in a role with the International Finance Corporation (IFC) of the World Bank Group, championing sustainability and decarbonization in buildings and cities, especially the IFC tools such as EDGE, BRI and APEX. He works towards a day, hopefully soon, when building projects and cities, and indeed financing them, are about green building and green financing, by default.

Mr. Siddharth Arora

Chief Financial Officer, Revayu Energy

Mr. Siddharth has done his masters in Business Strategy majoring in finance from Thames Valley University, London. Have over 10 years of experience in startups in diverse verticals. After having hands on experience in business for 5 years post his education and handling each aspect of business from operations to HR to sales and marketing, decided to start a completely new venture in the field of green air i.e. Indoor Air Quality. Business driven by values & ethics, cohesive teamwork, long term vision, gap identification are hallmark of his leadership skills.

Mr. Siraj Hirani

Senior Programme Management Specialist, Gujarat Mahila Housing SEWA Trust

Mr. Siraz Hirani is presently working as Senior Programme Management Specialist at Gujarat Mahila Housing Sewa Trust (MHT). He is a senior professional with 20 years of strategic & operational experience with international development organisations including 10 years at leadership positions at Global & National level. He holds M.Sc. in Disaster Mitigation, M.Sc. in Life Science & MBA with specialization in Finance. He is an Alumni of the prestigious Harvard Kennedy School with work experience in multi-cultural & challenging countries like India, Bangladesh, Afghanistan, Tajikistan & Myanmar.

His sectoral experience includes Habitat Development, Climate Change & Disaster Risk Management. He has proven capability in strategic planning, program management, policy development, resource mobilization, monitoring & evaluation.

Ms. Sonia Shukla

Senior Project Manager, International Institute for Energy Conservation (IIEC)

Ms. Sonia Shukla has more than a decade of experience in renewable energy, energy efficiency, electric vehicles, air quality management, and sustainable development. She is presently working with IIEC as a senior project manager handling projects on energy efficiency, air pollution, and renewable energy in buildings. She led the first study in India of assessing the technical and economic impact of electric vehicles on the electricity grid and local air quality for the Forum of Regulators. She was also involved in developing unique and innovative DSM programmes under the Standard Offer Program framework and has carried out load research for several distribution utilities. She was involved in developing innovative strategies for the promotion of rooftop solar in the residential consumer segment and worked with financial institutes & end consumers on capacity building and to identify and alleviate challenges in the solar rooftop sector. She also led the development of India's first Climate Finance Knowledge Portal hosted by NABARD and training of the officials.

Dr. Soumen Maity

Chief Technology Officer, Technology and Action for Rural Advancement (TARA)

Dr. Soumen Maity is the Chief Technical Officer, TARA & Vice President at Development Alternatives. He is a Material Scientist by profession and currently leads the Technology Management business at TARA. Dr. Maity is with TARA for over a decade anchoring the interface between innovation and business. On one hand he guides and mentors the Clean Technology systems at the Development Alternatives Group, on the other, he also leads the incubation of developed technologies at TARA. His expertise lies in the building material sector wherein he has been instrumental in exploring commercial approaches to utilization of industrial waste, improving energy efficiency and reducing environmental emissions.

Mr. Stefan Kessler

Associate Partner, INFRAS

Mr. Stefan Kessler is an Associate Partner in INFRAS, a private Swiss company doing research and consulting focused on sustainable development. He has a master's degree in Mechanical Engineering from ETH Zurich [Swiss Federal Institute of Technology], with a specialization in energy systems and development cooperation. He has a long standing and international experience in conceptualising and implementing energy and climate related policy instruments, impact analysis of voluntary and regulatory activities, energy concepts and programs, implementation, and compliance issues. Lately, an additional focus of his work was on developing concepts and action planning for net-zero-greenhouse gas emission readiness at the National, State and Municipality levels.

Dr. Stijn Verbeke

Senior Researcher, Energyville / VITO

Dr. Stijn Verbeke holds a Ph.D. degree in applied engineering and can build on 12 years research experience in the field of sustainable building. His work focusses on assessment methods to improve the performance of (near) zero energy buildings and districts. Stijn was the principal investigator developing the EU Smart Readiness Indicator (SRI). He is research line coordinator 'building' and districts' at VITO/EnergyVille and coordinates several research projects on sustainable and smart buildings and communities for national and international clients. He is part-time post-doctoral researcher and lecturer at University of Antwerp in the fields of building physics and energy performance of buildings.

Ms. Suhasini Ayer

Principal Architect, Auroville Design Consultants

Ms. Suhasini is a graduate of Delhi School of Planning and Architectures; living in Auroville since 1985 and one of the co-founders of the Auroville Centre for Scientific Research; an organisation dedicated to research and experimentation in the field of appropriate building materials and technologies, water management, renewable energy and solar passive/ climatic architecture and sustainable urban planning.

As head of the Auroville Design Consultants, the Planning and Design wing of this organization, she has designed and implemented over 50+ projects in India in the last 25+ years. She was co-recipient of the Hassan Fathy Award for 'Architecture for the Poor' in 1992, co-nominated for the Aga khan in 1992 and recipient of the Design Share Award for educational buildings in 2003 and 2005.

Dr. Sunita Purushottam

Head of Sustainability, Mahindra Lifespace Developers Ltd.

Dr. Purushottam has over 20 years of sustainability strategy and environmental consultancy experience in the areas of environmental impact assessment; air pollution modelling and meteorology; GHG emissions inventory and carbon offsets; carbon neutrality strategy; waste management strategy; and water risk, technology solutions for sustainability and CSR. She is a physics postgraduate with Phd in environmental science and engineering. A highly driven, enthusiastic, people and results-orientated, knowledge driven professional, with a demonstrable track record of experience gained in international and national projects in different sectors in response to the challenges of environment and sustainability.

Ms. Swati Puchalapalli

Director, Terra Viridis

Ms. Swati Puchalapalli is the founding partner and director of Terra Viridis, an environmental design consultancy that she started ten years ago. During the past decade, Terra Viridis has worked across several sectors ranging from policy research to environmental consultancy for corporates, institutions and government agencies. Swati is a strong proponent of passive design as the first step towards sustainable design, constantly applying learning from local vernacular to new buildings. She works extensively with computer based building analysis to help architects make design decisions.

Swati is a founder member of GRIHA Council (society formed by the Ministry of New and Renewable Energy, Govt of India and Teri to promote sustainable design across India).

Mr. Tarun Jami

Co-Founder, GreenJams

Mr. Tarun Jami is the founder of GreenJams, an award-winning cleantech enterprise creating carbon-negative building materials out of crop residues and industrial by-products to solve for the climate change caused by construction and crop residue burning. At GreenJams he primarily takes care of product development and technical operations. He is an INK Fellow, Forbes 30 Under 30 and Meaningful Business 100 listee. A scientific authority on vegetal concretes, he holds bachelor's and master's degrees in civil engineering and environmental sciences. He is also currently pursuing a PhD in civil engineering from CSIR-Central Building Research Institute, Roorkee and RMIT University, Melbourne.

Dr. Umamaheshwaran Rajasekar

Chair, Urban Resilience, NIUA

Dr. Umamaheshwaran Rajasekar is Chair, Urban Resilience Unit and Heading the Climate Centre for Cities (C-Cube) at National Institute of Urban Affairs, India. He has over 17 years of experience in developing risk reduction strategies, climate change analysis, institutional strengthening for governments, INGOs and multi-lateral agencies. His recent efforts have been towards bridging the technology and communication gap to enable informed decision making. He has been the team leader and project manager for some of the pioneering risk resilience efforts in India including implementation of early warning systems, urban disease surveillance and city resilience strategies. His recent work on development and implementation of Urban Health Services Monitoring System has been recognized as an intervention to watch, by the U.N Secretary General's global pulse initiative.

Dr. Veena Joshi

Independent Expert

Dr. Veena Joshi is an expert in rural energy, renewable energy and environment. She is currently an Expert Member in the Indian Council for Medical Research (ICMR) Taskforce for National LPG Program Assessment and Planning for Health, Member of the Board of Trustees of the Foundation for Medium, Small and Micro Enterprises Clusters, and a Director in the Board of the Small Scale Infrastructure Development Fund (S3IDF), India.

Veena spent more than 30 years of her career with the Swiss Agency for Development and Cooperation (SDC) and TERI, where she developed, managed and guided programmes in the energy sector, notable among them were an Indo-Canada project on Women as Managers of Household Energy Systems and Evaluation of National Programme on Improved Cook Stoves. She has been on the technical and research Advisory Groups for the UNDP, Shell Foundation, World Bank and Prayas Energy Group. She edited the Journal of Solar Energy Society of India for five years. Veena has a Ph.D. in Physics from Indian Institute of Technology, Kanpur.

Dr. Vishal Garg

Professor, Plaksha University

Dr. Vishal Garg is a Building Science professor and works on various aspects of energy efficiency in buildings, such as cool roofs for UHI mitigation, building energy simulation for designing energy-efficient buildings and automation and controls for efficient operations.

Prior to joining Plaksha University, he was Professor and Head of the Center for IT in Building Science at the International Institute of Information Technology, Hyderabad. He was the founding president and board member of the International Building Performance Simulation Association's (IBPSA) Indian affiliate and is a panellist for a chapter on sustainability in the National Building Code of India. He is also a project committee voting member in the ASHRAE's Standing Standard Project Committee 90.2: Energy Efficient Design of Low-Rise Residential Buildings.

Dr. Yash Shukla

Executive Director, CARBSE, CEPT University

Dr. Yashkumar Shukla is Center Head and Principal Researcher at the Centre for Advanced Research in Building Science and Energy (CARBSE). He has more than seventeen years of research and consulting experience in high-performance buildings. He has led several ground-breaking research projects including low energy cooling and ventilation system in Indian residences, evaluation of innovative cooling technologies, and benchmarking of Indian buildings. He is also associated with the Master of Technology in Building Energy Performance (MBEP) program at the Faculty of Technology, CEPT University where he offers several courses and guides capstone proje'ts.

Dr. Shukla's current research includes calibration of simulation models, smart grids, low cooling energy systems, performance characterization of the novel envelope and air conditioning systems, and development of the next-generation control algorithms. He is presently the team lead on the technical assistance program by Asian Development Bank on building disease resilient, smart, energy-efficient air conditioning systems in developing member countries.

Dr. Winfried Damm

Programme Director- Indo-German Energy Programme, 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 IndoGerman Energy Programme.

EXHIBITION

About the Exhibition

Senior executives of several companies offering innovative technologies and solutions for energy-efficient and low-carbon buildings addressed the conference and around 20 companies showcased their products and services which included low-carbon building materials, external movable shading systems, energy-efficient space cooling technologies in the exhibition accompanying the conference.

List of Exhibitors

S.No	Name	Description of Exhibit
1	Smart Joules Pvt. Ltd.	Smart Joules is one of India's leading climate tech startups focussing exclusively on making energy efficiency simple, substantial and profitable for businesses through their innovative JoulePAYS (pay as you save) and JouleCOOL (cooling as a service) business models.
2	Indo-Swiss Building Energy Efficiency Project (BEEP)	BEEP is a joint project between the Government of India and the Government of Switzerland to promote energy efficiency in buildings. The stall will showcase various BEEP activities such as case studies of energy-efficient buildings, simulation tool to design natural ventilation, etc. A variety of BEEP publications would be available for display and distribution among building professionals.
3	ATE ENTERPRISES PVT LTD (Business Unit: HMX)	The stall will showcase DAMA - Indirect Evaporative cooling technology and Two Stage Indirect - Direct Evaporative Cooling Systems, Hybrid Air conditioning systems (incorporating Indirect evaporative cooling technology), Fresh Air Pre cooling Unit,etc.

List of Exhibitors

S.No	Name	Description of Exhibit
4	Technology & Action for Rural Advancement (TARA)	The stall will showcase technology for producing Lime Cement Calcined Clay (LC3). It will also display physical raw materials that goes into making LC3, various types of LC3, and building material products made out of LC3.
5	SERGE FERRARI	Serge Ferrari Soltis fabric range is a benchmark brand for solar protection. Soltis fabrics can be installed outside to block up to 97% of heat, offer greater comfort and reduce the need for air conditioning equipment. Précontraint technology makes them very resistant to repeated handling operations as well as to outside weather conditions (rain, UV, wind, etc.), deformation and tearing.
6	Advance Valves Pvt. Ltd.	The stall will showcase patented Made in India products i.e. Balancing Valves, Butterfly Valves, Pressure Independent Control Valves and Pre Insulated Valves which are used in green/energy-efficient buildings to save energy in the HVAC system.
7	DesignBuilder Software Australia	DesignBuilder is the foremost software to perform whole-building performance analysis in the world with an easy-to-use Graphical User Interface. DesignBuilder enables architects and engineers to design comfortable and energy-efficient buildings from concept to completion.
8	Phifer India Private Limited	The stall withh showcase sun control fabric which cuts down 80% of heat/light/uv radiations. It gives protection to the balconies and offers day time privacy.
9	Developer Group/AiREM	The stall will showcase AiREM - AiOT driven sustainable and comprehensive real estate asset management service with Network Operation Centre and the ESCO model for building energy efficiency.
10	Hisense India Pvt Ltd	The stall will showcase air to water Hi Thermal Heat Pump, HVAC range consisiting of VRF, chiller solutions, etc, along with sensors and controllers.
11	Renson SunProtection Screens NV	The stall will showcase, External Shading Motorized Fabric Blinds which reduces solar heat gain by 95%, thus reducing the air-conditioning load. The system can withstand wind tightness up to 130KMPH wind speeds.
12	AIR FLOW PRIVATE LIMITED	The company is one of the leading Manufacturers & Suppliers of HVAC&R (Heating, Ventilation, Air Conditioning and Refrigeration) products like Axial Flow Fans (for basement car park ventilation), Jet Fans, Plug Fans, Air Terminal Products, Air Distribution Products, Inline Fans, Grills, Flexible Connector, etc.
13	U.P. TWIGA FIBERGLASS LTD	Twiga Insul/Eco Insul glass wool thermal and acoustic insulation product is suitable for building envelope (roof and wall) and HVAC applications. Purpose of the insulation material is to achieve superior energy efficiency in the building, good acoustic comfort, environmental sustainability and fire safety.
14	Integrative Design Solutions Private Limited (IDSPL)	The stall will showcase, Integrated Station for Energy and Environment (I-SEE), which is a product service model based on IOT based energy & comfort monitoring & management system for the built environment; INNOSPIRE Building Energy Twin (I-BET) which is a novel product combining the power of Internet of Things (IoT), Data Analytics and Building Energy Simulation; and data analytics module “Vishleshan” which is powered by Artificial Intelligence and Machine Learning engine. I-SEE improves energy performance of the existing buildings by 15-20% and for new buildings by 30- 40%.
15	ShadeTec India (Falcon Contracts Pvt Ltd)	External Movable Shading Systems for sun protection, including window shutters and zip blinds.
16	FACE - a division of TDW Furniture Pvt.Ltd.	External movable shading systems that optimize daylight, reduce heat gain and conserve energy.
17	Department of Science & Technology (DST)	Research projects supported by the Department of Science & Technology in the field of building energy efficiency.

List of Exhibitors

S.No	Name	Description of Exhibit
18	GreenJams	Agrocrete® is a carbon-negative building material made from crop residues like rice straw, and by-products from steel and power industries. It is available in the form of blocks and replaces conventional bricks and blocks for up to 50% lower construction cost and 350% higher thermal insulation, while being stronger and more robust than conventional offerings.
19	Bureau of Energy Efficiency	The stall will showcase various BEE initiatives and schemes in the field of building energy efficiency.
20	Panitek Power Pvt Ltd	Panitek Power provides a portfolio of technologies to reduce the carbon footprint of a building/premise/campus/smart city. These include a) Smart Lighting (to reduce energy consumption, increase asset life and improve asset monitoring) b) Air Monitoring and Control (improves the air quality of a building and also reduces energy consumption by 5%)
21	ALP Aeroflex India Private Limited	The stall will showcase EPDM & NBR Thermal and Acoustic Insulation Solutions
22	Danfoss Industries Pvt. Ltd.	Danfoss Industries Private Limited, an industry leader focused on climate and energy-efficient solutions, is a 100-percent-owned subsidiary of Danfoss Group. Danfoss India serves a wide range of industries that rely on Danfoss products like VLT® and VACON® Drives, heating valves, controls & solutions for refrigeration, air conditioning, HVAC, district cooling and under floor heating applications.

Glimpses of the Conference


ANGAN 2022
Moving the ZERO Carbon Transition in Buildings
Augmenting Nature by Green Affordable New-Habitat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DELIVER THE HEALTH AND PRODUCTIVITY BENEFITS OF FRESH AIR WITHOUT BIG ENERGY BILLS?


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MR ANAND SHUKLA


SMART JOULES PVT. LTD.