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PHD CHAMBER OF COMMERCE AND INDUSTRY

GREEN BUILDINGS

THE PATH TO A SUSTAINABLE FUTURE

MESSAGE FROM PHD CHAMBER OF COMMERCE AND INDUSTRY

Shri Sanjeev Agrawal

President
PHDCCI

PHDCCI is organising the Conference on Futuristic Buildings- Promoting Green Tech for Sustainable Development to understand the futuristic building practices adopted in India, convey the policies that catalyze the green building movement, investment, funding and provide insights into the actionable measures to foster the growth of the green futuristic buildings.

The built environment has a deep impact on our natural environment, economy, health and productivity. Buildings leave a significant carbon footprint and account for one third of global energy consumption.

The green futuristic buildings are now being adopted worldwide to facilitate sustainable development. These buildings help in substantial reduction of pollution, energy and water consumption. These buildings are based on the concept of utilization of natural resources in sustainable and effective manner. Green buildings have tremendous benefits like substantial reduction in operating energy, water cost, increasing productivity, better health and healthy environment to the occupants. Several Corporates and developers are now seeing Green Building Rating as a tool to enhance marketability.

As part of its focus on green growth, government is now addressing this aspect and implementing measures to promote circular economy.

MESSAGE FROM PHD CHAMBER OF COMMERCE AND INDUSTRY

Dr Ranjeet Mehta
Executive Director
PHDCCI

Green Futuristic Buildings also referred to as 'Green Construction' or 'Sustainable Buildings' which reduces the negative impact on the environment. There is an immense potential in the green buildings in India as there is rising demand of new homes every year to keep pace with Indian housing demand and creates significant opportunities exist with regard to establishing new techniques in climate-responsive construction. India stands third after the USA in green technology adoption and the number of green projects. It is growing slowly steadily with the support of the government.

It is crucial for the Government to promote green futuristic buildings by providing incentives, setting standards, and enforcing regulations. The use of generative AI should be promoted and adoption of architecture to design sustainable buildings that are better suited to specific climates, and locations. Offering financial incentives to developers and builders who choose to construct sustainable buildings will also promote the Green Buildings construction. These incentives can include tax credits, grants, and low-interest loans. The government can also promote green building by setting standards and regulations for building construction and operation.

On this account, PHDCCI is organising the Conference on Futuristic Buildings- Promoting Green Tech for Sustainable Development which will help in understanding the policies and initiatives that encourages sustainable construction, ensures environmentally responsible building practices, and creates healthier, more productive environments for people to live and work in.

MESSAGE FROM RESURGENT INDIA

Shri Jyoti Prakash Gadia

Managing Director
Resurgent India Ltd

India's relentless urban expansion and mounting climate threats necessitate a decisive and tough-minded approach, transforming these challenges into drivers for innovative long-term and consistent urban development. Futuristic buildings are no longer flights of fancy but necessary adaptations for sustaining burgeoning urban populations within environmentally sustainable frameworks. These structures are at the forefront, incorporating advanced technology and design to mitigate the environmental impact and elevate urban living.

The nation's strategy employs a pragmatic approach by integrating digital technologies and sustainable practices, critical in managing the complexities of rapid urbanization. The India Urban Observatory exemplifies this strategic application by using data-driven insights to guide urban development effectively. This is not just progressive thinking, it is essential for survival, ensuring that urban growth is both manageable and sustainable.

This determined push to align sustainable development with urban planning reflects a broader well thought out commitment to overcoming environmental and urban challenges through innovation. India's urban policy aims not merely to adapt but to pioneer, setting a benchmark for global sustainable urban development. The emphasis on smart, sustainable infrastructure in India's futuristic buildings showcases a resolve to transform urban challenges into opportunities for resilience and advancement for the overall well-being of the growing urban populace.

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FUTURISTIC BUILDINGS: THE FUTURE IS HERE

India has set an ambitious target to achieve net zero emissions by 2070, a crucial step in mitigating climate change and promoting sustainable development. Green buildings are essential in this journey, as they significantly reduce energy consumption, lower greenhouse gas emissions, and conserve resources. Green buildings can cut energy use by 3040% compared to traditional buildings, leveraging sustainable materials and advanced technologies to minimize their environmental impact.

In 2023, India ranked third in the US Green Building Council's (USGBC) list of top countries for LEED (Leadership in Energy and Environmental Design) certification, maintaining its position from previous years. China and Canada held the first and second spots, respectively. India certified 248 projects, covering 7.23 million gross square meters (GSM) of space. China led the rankings with over 24 million GSM certified, followed by Canada with 7.9 million GSM.

Rank	Country/Region	Project Count	Square Feet	Square Meters
1	Mainland China	1,563	264,287,540.13	24,553,139.67
2	Canada	280	85,421,062.41	7,935,884.06
3	India	248	77,891,785.74	7,236,390.69
4	Turkey	36	31,335,904.56	2,911,203.61
5	Brazil	119	28,042,859.15	2,605,269.39

Blueprints for Tomorrow: How Smart Cities Are Crafting the Future of Urban Living

Smart cities represent the nexus of information and communication technology meticulously woven into the urban tapestry to orchestrate a city's vital assets: from the intricacies of local departments' information systems to the broad reach of schools, libraries, transport networks and hospitals. ake, for instance, Songdo International Business District in South Korea, which exemplifies this philosophy. Here, technology is harnessed to manage traffic, energy and other urban infrastructures through the meticulous collection and analysis of realtime data showcasing how technology can breathe intelligence into the concrete skeleton of city life.

Key Highlights of India's Smart City Mission (SCM)

Investment and Project Completion:

Total investments: Approximately Rs. 1.70 lakh crore.
Completed projects: Rs. 1.25 lakh crore.

Urban Mobility:

Enhanced transportation infrastructure and smart mobility solutions.

Waste Management:

Implementation of smart waste management technologies in over 50 cities.
Improved urban sanitation and cleanliness.

Energy Efficiency:

Installation of over 0.5 million solar/LED streetlights.
Extensive underground electricity cabling projects.

Green Energy Solutions:

Development of projects like the 'Mudasarlova Reservoir Floating Solar Plant' in Visakhapatnam, leading to significant electricity generation, cost savings, and reduced carbon emissions.

Water Management:

Sensor-based surveillance systems for monitoring and optimizing water usage. Improved daily water supply and reduced water waste.

Innovations in Future Architecture

The architectural innovations that define the future are an intricate fusion of aesthetics, sustainability and functionality, transforming our built environment into dynamic and interactive spaces. Hypnotic bridges and rotating skyscrapers exemplify this synthesis, blending cutting-edge design with practicality. Rotating skyscrapers, such as the proposed Dynamic Tower in Dubai, epitomize this evolution by allowing floors to move independently, continually altering the building's silhouette while optimizing solar exposure and views. This concept not only redefines our visual landscape but also enhances the building's environmental interaction.

Similarly, hypnotic bridges meld visually striking designs with high functionality, integrating sensors and adaptive mechanisms that adjust to varying traffic flows and environmental conditions.

Indoor parks further illustrate this progressive blend by reintegrating nature into urban developments. The ACROS Fukuoka Prefectural International Hall in Japan, with its expansive terraced roof garden, serves as both a critical feature of the building and a vibrant public space. This design demonstrates how modern structures can harmoniously coexist with natural elements, providing green sanctuaries amidst urban sprawl and enhancing the quality of urban life. These innovations are not just architectural feats; they are transformative strategies that enrich urban environments and foster sustainable, liveable cities for the future.

India is witnessing a transformative era in architecture, where innovative designs blend seamlessly with sustainability and technology. This evolution is evident in a range of projects that not only respond to environmental challenges but also enhance urban liveability, with the requisite 'ease of living' inputs.

For instance, the 'In the Mountains' residence in Mukteshwar by Ant Studio is an example of integrating the building with its natural surroundings. The design uses local materials and technologies to harmonize with the rugged terrain of the Himalayas, showcasing a profound respect for nature and locale-specific architecture.

In urban contexts, the Wallmakers firm in Kerala has been pioneering sustainable designs using materials like mud and waste. Their projects, such as the Kurien Phillip residence are noted for their ecofriendly yet aesthetically pleasing constructions underscoring the potential of sustainable materials in modern architecture.

Additionally, Studio Lotus's Imagine Studio at The Trees in Mumbai is a stellar example of adaptive reuse, transforming an industrial space into a vibrant community hub that balances heritage with contemporary design needs. This project reflects a growing trend in India where historical contexts are preserved and reimagined through innovative architectural practices.

In India, the integration of traditional architectural wisdom with modern sustainability practices is vividly demonstrated in various innovative projects. **One profound example is the sustainable project by Zero Energy Design Lab in New Delhi.** The firm focuses on net zero building design, striving for energy-efficient and sustainable buildings. Their commitment is reflected in projects like the Scoop House, which exemplifies sustainable living practices and architectural innovation. Similarly, firms like Wallmakers in Kerala are pioneering eco-friendly designs using sustainable materials like mud and waste, emphasizing the potential of sustainable materials in contemporary architecture.

Furthermore, the Smart Cities Mission in India showcases a strategic blend of technology and urban planning to enhance the quality of urban living while addressing environmental challenges. This mission includes initiatives such as the installation of solar/LED streetlights and the development of efficient waste management systems, illustrating a commitment to sustainable urban development.

As we venture into the future, the role of these buildings extends beyond their physical boundaries, influencing social, economic, and environmental realms. They are not only about creating spaces that are liveable but also about fostering communities that are vibrant, resilient, and in harmony with their environment.

FUTURE GREEN TECHNOLOGIES

Existing Green Technology

The technologies discussed below are not exhaustive, and some of them may be in their early stages, with potential constraints in supply.

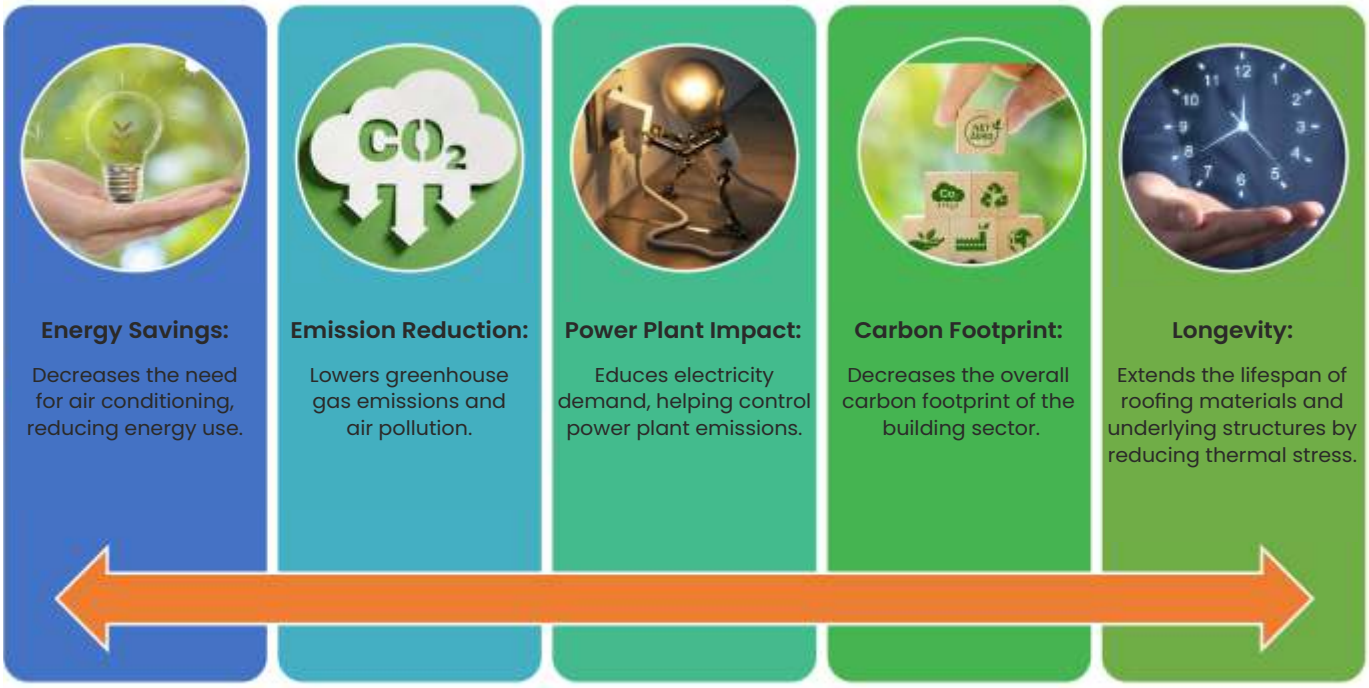
India's commitment to renewable energy is strongly reflected in its expanding solar and wind energy capacities, driven by substantial government initiatives and policy frameworks.

KEY STATISTICS:

- **Solar Power:**
  As of early 2024, over 55% of total installed renewable capacity.
- **RPO Targets:**
  29.91% renewable energy by 2024-25.
  43.33% renewable energy by 2029-30.
- **Ground-mounted Solar: Installed capacity exceeds 59 GW.**
- **Rooftop Solar: Installed capacity at 11 GW.**
- **Total Solar Capacity: Combined ground-mounted and rooftop solar exceeds 70 GW.**

Furthermore, the broader adoption and integration of renewable energy are facilitated by innovative government schemes like PMKUSUM, which supports the installation of solar power sources in agricultural settings, thereby enhancing energy security for farmers and contributing to the nation's green growth strategy, besides reducing cost.

Cool roofs are yet another significant technology gaining traction. Cool roofs are an integral part of green building technologies designed to reflect more sunlight and absorb less heat than traditional roofing materials, using reflective paints or special tiles. The benefits of cool roofs are:



Despite these advantages, there are some challenges in adopting cool roofs, particularly in terms of initial costs and the perception of their aesthetic. However, many states and municipalities offer incentives, rebates, and support programs to encourage the adoption of cool roofs, making them a cost-effective option over the long term.

Electrochromic smart glass is an innovative technology that significantly enhances energy efficiency and occupant comfort in buildings. This glass can change its tint when an electrical voltage is applied allowing it to control the amount of sunlight entering a space. During hot days, it can tint to reduce heat gain thus reducing the need for air conditioning. In colder conditions, it can become transparent, allowing for passive solar heating and natural light, which can decrease heating costs.

The advantages of electrochromic glass include enhanced energy efficiency, improved control over natural light, privacy on demand, a long lifespan with low maintenance, and a modern aesthetic appeal to buildings. These features not only provide cost savings on energy bills but also contribute to the environmental sustainability of building projects by reducing energy consumption and enhancing indoor environmental quality.

However, there are challenges associated with the adoption of electrochromic glass. The initial installation cost is higher than that of traditional windows. There are also limitations in the speed of transition between tints and a limited range of color options, which may not suit all architectural designs. Additionally, the installation process is more complex, requiring electrical connections and control systems, which can complicate retrofit projects.

Despite these challenges, the long-term benefits such as significant reductions in energy consumption and improved comfort and privacy make electrochromic smart glass a compelling option for sustainable building designs. As technology advances and costs decrease, more buildings will likely adopt this smart glass, leading to broader environmental and economic benefits.

INDIA'S ADOPTION OF ADVANCED SUSTAINABLE BUILDING PRACTICES

India is at the forefront of incorporating eco-friendly and carbon-absorbing designs into its urban development strategies. Innovations such as the integration of carbon-capturing technologies in concrete production are showing significant promise.

Advancements in Sustainable Building Materials

Carbon Sink Concrete: New additives enable concrete to incorporate CO2 during setting, reducing carbon footprint and enhancing mechanical performance without extending construction time.

Advanced Technologies: Focus on eco-friendly and effective materials in urban settings.

Sea Stone: Developed from waste seashells, used for non-structural applications due to its environmentally friendly properties.

3D-Printed Formwork: Reduces concrete usage, making buildings lighter and decreasing overall material demand.

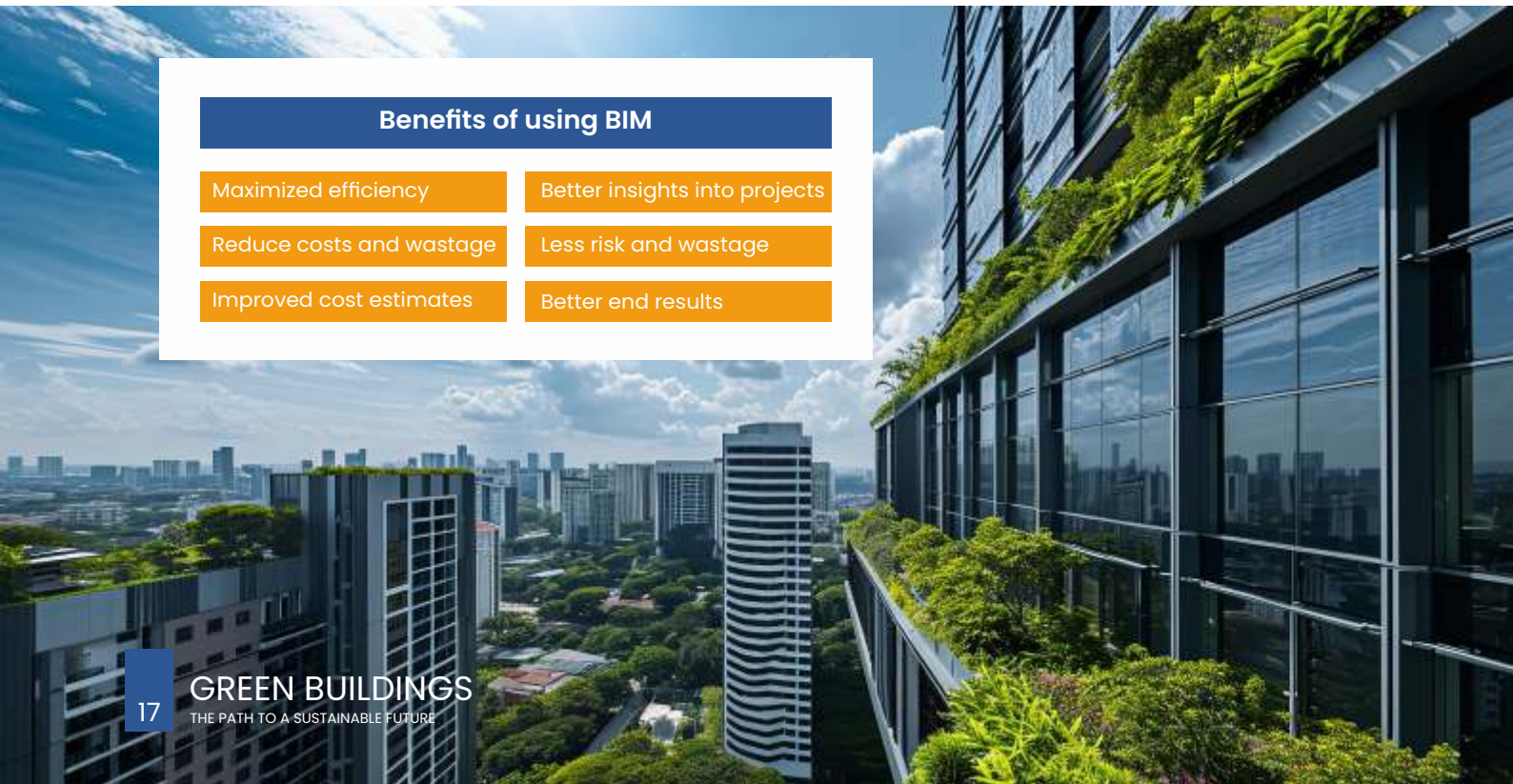
In India, builders using sustainable materials have found considerable benefits, particularly in terms of environmental impact and market appeal. Utilizing eco-friendly materials like bamboo and recycled concrete not only reduces the carbon footprint but also meets the growing consumer demand for sustainable properties. Builders are increasingly seeing the advantages of such materials in enhancing energy efficiency and water conservation leading to lower long-term costs and improved building performance. The Indian government supports these initiatives with incentives like tax benefits and faster project approvals making sustainable building practices more attractive and feasible. This commitment is driving a significant shift towards green construction promising substantial growth in the sector.

Furthermore, the architectural landscape in India is being reshaped by a focus on integrating advanced technologies and sustainable practices. This includes the implementation of digital tools and innovative approaches to urban planning and design which are crucial for addressing the complex challenges posed by rapid urbanization and environmental sustainability.

Building Information Modelling (BIM) is revolutionizing India's real estate sector by streamlining construction processes and improving project management. BIM's 3D modeling capability enhances visualization, facilitates better collaboration among various stakeholders and provides precise cost management thereby reducing errors, rework and budget overruns. The technology also promotes sustainable building practices by enabling simulation of energy performance and facilitating the achievement of green certifications which is crucial in the context of environmental conservation.

Moreover, the integration of BIM with other advanced technologies like augmented reality (AR) and smart city solutions further optimizes construction workflows and infrastructure management. This synergy is essential in the development of Smart Cities, improving planning and implementation processes for urban projects. As BIM continues to gain traction in India, driven by government initiatives toward smart urban development, it is set to transform the real estate landscape by making construction activities more efficient, sustainable and aligned with global best practices.

Therefore, the investment in sustainable infrastructure not only supports economic growth but also aims to meet environmental and sustainability goals. For instance, the Indian government has pledged to reduce the emissions intensity of its GDP by 45% by 2030 compared to 2005 levels and achieve net zero emissions by 2070. Such commitments underscore the importance of integrating sustainability in all future infrastructural planning and developments.



GOVERNMENT POLICIES AND SUPPORT

Energy efficiency in the construction of commercial buildings in India has seen significant advancement, driven by initiatives like the Energy Conservation Building Code (ECBC) and supportive measures from the Bureau of Energy Efficiency (BEE). The ECBC sets minimum energy standards for new commercial buildings, which are instrumental in reducing the overall energy consumption and carbon footprint of the sector. As of recent updates, the code has been adopted by several states, pushing for wider compliance across the country.

Moreover, BEE has been active in promoting energy assessments and retrofitting processes for existing buildings. Their targets aim for a substantial percentage of new commercial buildings to comply with ECBC standards by the end of the current plan period, and for a significant portion of existing buildings to reduce their energy use through effective retrofitting measures. These efforts collectively contribute to the ongoing push towards sustainability in India's urban landscape, fostering the development of energy-efficient buildings that align with global environmental goals.

The Bureau of Energy Efficiency (BEE) is enhancing the energy efficiency of buildings through collaborations with state-designated agencies and international partners. Drawing from global best practices, BEE has engaged in significant initiatives such as the IndoUS Partnership to Advance Clean Energy Deployment program, the IndoSwiss Building Energy Efficiency Project, GIZ, and the United Nations Development Programme.

Additionally, BEE has expanded its labelling program to include net zero energy buildings (NZEBs) and net positive energy buildings (NPEBs). The program introduces two labels: the Shunya label for NZEBs, awarded to buildings achieving an Energy Performance Index (EPI) between 0 and 10 kWh per square meter per year, and the Shunya+ label for buildings with an EPI below 0 kWh per m² per year. This initiative aims to motivate owners and developers to construct buildings that not only meet energy efficiency standards but also strive for net zero or net positive energy status.

To foster the adoption of green building practices, there are several certification programs that evaluate a building's compliance with environmental standards across various dimensions. These certifications, by verifying the ecofriendly attributes of a building, add credibility to the projects and affirm their sustainability claims. This is particularly valuable for buyers and investors who prioritize environmental impact, as these certifications provide a reliable measure of a building's sustainability performance.

The LEED (Leadership in Energy and Environmental Design) certification system is a globally recognized framework for assessing the environmental performance of buildings. It evaluates projects based on key criteria like water efficiency, energy use, and choice of sustainable materials. Buildings are scored and classified into one of four levels: Certified (4049 points), Silver (5059 points), Gold (6079 points), or Platinum (80 or more points), with Platinum being the highest achievable status.

LEED CREDIT CATEGORIES

Water efficiency

Sustainable sites

Innovation in operations and regional priority

Indoor environmental quality

Energy and atmosphere

Materials & resources

In India, more than 1,600 buildings have earned LEED certification, including prominent structures such as Terminal 3 at Indira Gandhi International Airport in Delhi the Anna Centenary Library in Chennai and the American Embassy School in Delhi.

Smart Cities Mission 2015

India's Smart Cities Mission (SCM) has made substantial strides, investing approximately ₹1.70 lakh crore in a wide array of projects aimed at improving urban mobility, waste management, and energy efficiency, enhancing urban living quality and promoting sustainable practices with ₹1.25 lakh crore of these projects already completed. Despite these achievements, the mission faces several obstacles that hinder its full potential. Notably, development has been uneven across different regions, with cities in the Northeast experiencing particular challenges due to limited local planning and investment capacities. The mission also faces difficulties in securing sufficient funding through public private partnerships (PPPs), essential for sustaining infrastructure projects financially. Administrative issues, such as frequent changes in leadership within Special Purpose Vehicles (SPVs) and inconsistent advisory forum meetings, complicate effective project management and stakeholder involvement.

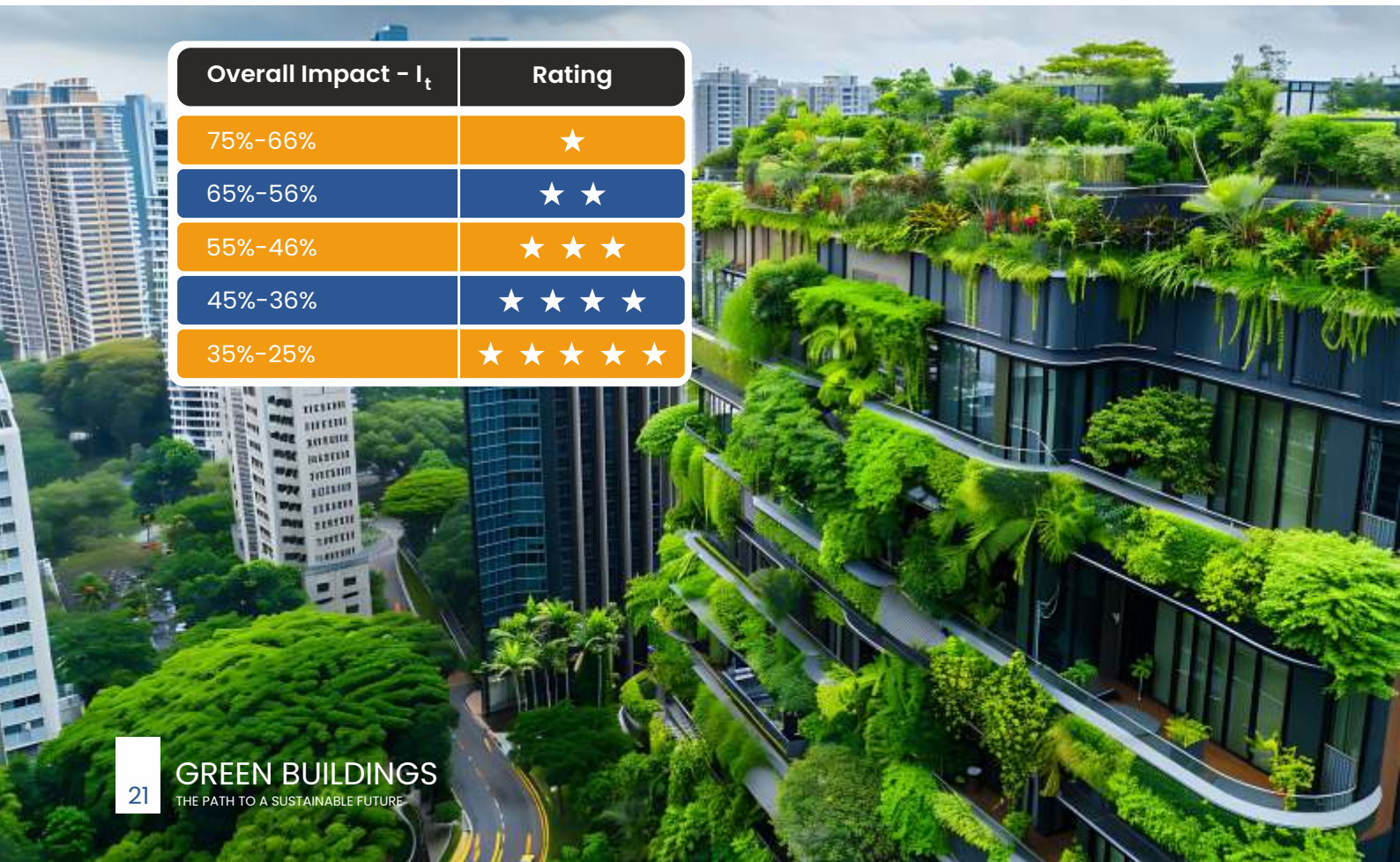
As digital infrastructure becomes increasingly integral to SCM projects, cyber security concerns have also arisen emphasizing the need to protect sensitive data and ensure privacy. To address these issues, recommendations include enhancing the capabilities of urban local bodies, stabilizing SPV leadership, focusing more on PPPs, and prioritizing pan-city projects that tackle common urban challenges comprehensively. The further extension of the SCM underscores its ambitious scope and the complex challenges it continues to face, highlighting the ongoing need to refine and expand urban development strategies across India.

GRIHA (Green Rating for Integrated Habitat Assessment) Rating

The GRIHA LD (Green Rating for Integrated Habitat Assessment Large Developments) initiative, a collaborative effort by the GRIHA Council, The Energy and Resources Institute (TERI) and the Ministry of New and Renewable Energy (MNRE), embodies this shift. It offers a comprehensive framework for evaluating the environmental impacts of large-scale developments, aiming to mitigate negative effects and promote sustainability through meticulous planning in energy use, water management, waste handling, transportation and social infrastructure.

The GRIHA LD rating system is a strategic tool designed to guide developers towards achieving minimal environmental disruption and maximal self-sufficiency in resource usage. The system evaluates projects across various domains such as site planning, energy efficiency and waste management using both quantitative and qualitative measures. For instance, the assessment of energy involves looking at the efficiency and sustainability of energy sources utilized within the development while social aspects consider the quality of life and community benefits the project delivers. This dual approach ensures a balanced evaluation encouraging developments not only to coexist harmoniously with their environments but also to contribute positively to the broader context of urban sustainability.

The GRIHA LD (Large Developments) rating system assesses the environmental impact of large-scale construction projects, assigning one to five stars based on the project's effectiveness in minimizing environmental harm. The ratings range from one star for projects with an Overall Impact of 75%66%, increasing in sustainability up to five stars for those achieving between 35%25%. This progressive rating motivates builders to pursue higher environmental standards and promotes sustainability by providing a clear benchmark of each project's ecological performance.



Overall Impact - I_t	Rating
75%-66%	★
65%-56%	★ ★
55%-46%	★ ★ ★
45%-36%	★ ★ ★ ★
35%-25%	★ ★ ★ ★ ★

EDGE Program in India

The EDGE **(Excellence in Design for Greater Efficiencies)** certification program is promoted in India through a partnership between the IFC (a member of the World Bank Group) and the Confederation of Real Estate Developers' Associations of India (CREDAI), the apex body of private real estate developers. This collaboration aims to foster the development of green buildings across the country. A Memorandum of Understanding (MoU) was signed on November 25, 2014, in the presence of the former Minister for Environment and Forests, Prakash Javadekar.

Challenges to Green Buildings:

Green buildings face several notable challenges that hinder their widespread adoption. One significant obstacle is the high initial costs, with green buildings typically costing 15% to 35% more than traditional structures. This increased investment stems from the use of eco-friendly materials and advanced technologies necessary to meet green building standards. These higher upfront costs can deter potential buyers and developers, reducing the overall demand for sustainable housing.

Developers often face tight construction deadlines, leading to the neglect of crucial aspects of green housing design. Essential elements such as climate responsiveness and the efficient integration of green technologies may be compromised to meet these timelines. Depending on the project's complexity and size, the total timeline from planning to commissioning typically ranges from 18 to 36 months. For instance, a small residential project might take 18-24 months, while a large commercial building could take 24-36 months or more.

The increase in the number of skyscrapers contributes to higher energy consumption, particularly due to the constant use of elevators. High-rise buildings require significant energy to maintain comfort levels and operate lifts, which can offset some of the environmental benefits intended by green building practices. Elevator energy consumption can rise to 40% during peak usage times, particularly in high-rise commercial buildings.

Additionally, construction technology in major cities often demands more concrete, resulting in walls with higher carbon footprints and weaker insulation. This not only increases the environmental impact during construction but also affects the building's energy efficiency over time. Poor insulation can lead to higher energy usage for heating and cooling. Concrete production is responsible for approximately 8% of global carbon dioxide emissions, which is more than double the emissions from the aviation industry.

Land shortages pose significant barriers to the development of green buildings in India. The scarcity of affordable land in urban areas, combined with the elevated costs of sustainable construction practices, limits the feasibility of green projects for many developers. This challenge is particularly pronounced in densely populated cities where land is at a premium.

These challenges highlight the complexities and obstacles in the path toward more sustainable building practices. Overcoming these barriers requires concerted efforts from policymakers, developers, and the broader community to make green building more accessible and economically viable.

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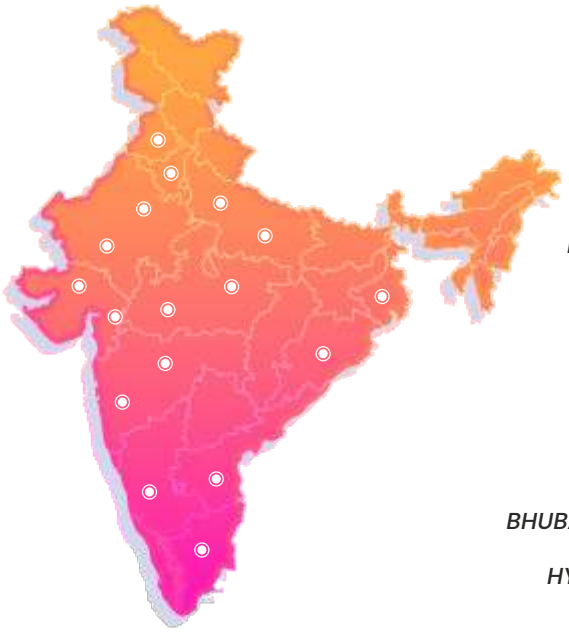

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