

¹. Anshul JAIN, ¹. Ananda K. BABU

EXAMINING THE MARKET FEASIBILITY OF RESIDENTIAL GREEN BUILDINGS IN TIER-II CITIES WITHIN THE INDIAN CONTEXT: BHOPAL CASE STUDY

¹. Department of Civil Engineering, Shri Vaishnav Institute of Technology & Science, SVVV, Indore, INDIA

Abstract: The contemporary trend observed among corporate and residential apartments is the adoption of environmentally friendly practices. According to the Indian Green Building Council (IGBC), the demand for green building materials and equipment is projected to reach \$8 billion annually by 2025. In line with the global movement towards environmental conservation, this paper evaluate and enhance the level of knowledge pertaining to residential green buildings in Tier II cities in India among developers, customers, and local authorities. The focus of study is Bhopal, a burgeoning residential center located in the heart of India. A comprehensive three-tier survey involving Potential Buyers, Developers, and Government Bodies was conducted to gauge the awareness levels regarding green building concepts among the general public and local real estate developers in Bhopal. The public's willingness to invest in energy efficiency, analyze perspectives on green buildings from customers, developers, and government entities, assess the market potential of residential green buildings, identify challenges faced by developers in green construction, and provide insights into the current scenario of the residential green building market. The findings suggest that effective collaboration among all stakeholders involved in the development of residential green buildings can make them viable for Tier II cities in India.

Keywords: residential green buildings, Tier II cities in India, market feasibility

INTRODUCTION

Green building encompasses practices aimed at enhancing resource efficiency in buildings by minimizing their impact on human health and the environment through improved site selection, design, construction, operation, maintenance, and decommissioning processes. Various types of green buildings are emerging across India, including residential complexes, exhibition centers, hospitals, educational institutions, laboratories, IT parks, airports, government buildings, and corporate offices.

Given India's limited domestic oil reserves and high dependency on imported oil, the country has taken proactive measures to promote green buildings that utilize environmentally friendly designs and materials.

These structures offer a pollution-free environment and lower energy costs through the application of advanced energy management systems, solar technology, high-performance windows, and heat-resistant paints. Solar protection features in green buildings help in reducing heat absorption during the day, thereby decreasing the reliance on air-conditioning systems to maintain comfortable indoor temperatures. Additionally, these features maximize natural light utilization, leading to reduced electricity consumption for lighting purposes and providing thermal comfort for occupants by regulating sunlight exposure throughout the year.

Around the globe, the momentum of green construction is increasing as it is being recognized as a lucrative long-term business prospect. A study carried out by McGraw Hill Constructions across 62 countries, including India, revealed that 51% of professionals in the architecture, engineering, contracting, ownership, and consultancy sectors anticipate that over 60% of their projects will be green by 2015, a substantial rise from 28% in 2012. The expansion of green practices, as identified by McGraw Hill Constructions, is not confined to a specific region or economic condition but is permeating the worldwide construction industry. The Indian Green Building Council (IGBC) forecasts that the market for green building materials and equipment will hit \$8 billion annually by 2015. Embracing green practices has emerged as a prevailing trend among both corporate entities and residential complexes. Green construction, characterized by its emphasis on environmental preservation, water conservation, energy efficiency, utilization of recycled materials, and renewable energy sources, has witnessed a significant surge in India, with the number of green projects escalating from 164 in 2009 to over 2000 by 2012. The primary challenge lies in the lack of awareness regarding Residential Green building design in India. This issue is widespread, with a general lack of awareness among the public and developers leading to widespread

skepticism. Various experts echo the same sentiment about the necessity to address customer perceptions. While incorporating the concept of green building design in project brochures and pamphlets may be a modest beginning, the impact on a broad spectrum of customers is noteworthy. Tackling such issues categorized as myths poses a significant challenge that requires innovative solutions. The Indian real estate sector is largely unorganized, with a wide array of developers ranging from large groups to local entities affecting project quality and customer trust. Insufficient knowledge and reliance on traditional methods are key factors contributing to the misconception surrounding projects like green buildings. Developers must enhance their knowledge base as simply adding greenery in front of a multi-story residential complex does not suffice to classify the building as green. This challenge extends beyond developers, as local development authorities also demonstrate a lack of awareness regarding innovation and new techniques.

The crucial question pertains to achieving this transition in a Tier-II city with a population of around 24 lakh, as India progresses towards a global platform. Conducting surveys with customers aims to gauge their awareness levels and assess their receptiveness to new concepts and innovations. Similarly, engaging with various developers through surveys seeks to evaluate their technical expertise and knowledge in green building construction within the residential real estate sector. Insights gathered from interviews with government officials shed light on the policies and regulatory framework concerning green buildings in residential real estate. The overarching query revolves around the awareness levels among developers and local government bodies. Is it valid to assume that government bodies lack the vision for development? The forthcoming questionnaire will yield data to determine the commercial value and dispel associated myths, serving as a roadmap to evaluate the feasibility of introducing residential green buildings to the Bhopal market. The attitudes of local government bodies will play a pivotal role in shaping the acceptance of new ideas and technologies.

OBJECTIVE OF STUDY

The purpose of this study is to ascertain the necessity of Green Buildings in the current scenario, as advised by consultations from

Environmental Planning & Conservation Organisation (EPCO). The study aims to identify challenges linked with Green Buildings, including barriers to entry in Green Building construction, based on consultations from IGBC & Developers. Additionally, the study seeks to conduct a Market Analysis concerning green buildings in the Bhopal region, as per a survey conducted at three different levels.

SIGNIFICANCE OF THE STUDY

It is imperative to contribute to society, as this study stands to benefit customers and developers financially, while also enhancing their understanding of a new concept or innovation. The study primarily focuses on raising awareness among the populace and assessing the readiness of Bhopal citizens to embrace new innovations. Experts have debated the feasibility of green building design, suggesting that widespread acceptance may take up to a decade. The government must take proactive measures to promote such concepts and educate the public about these novel initiatives. Despite government hesitance, it is crucial to engage the public in promoting green buildings to facilitate national progress. This transition can be achieved by incorporating green building principles in the construction of new era buildings. The ultimate goal is to steer the public towards sustainable growth.

Market of developers is poorly organized, with major developers prioritizing brand image and customer satisfaction. There is a need to instill these values in local developers and establish a conducive platform for customer-developer transactions. The key objective is to enhance awareness among local developers to streamline the market. Developers must focus on unconventional concepts and adhere to the guidelines outlined in the Indian real estate act of 2013. Success in projects is contingent not only on market forces but also on developers' efforts to ensure customer satisfaction.

LITERATURE REVIEW

The Concept of Green building: Numerous definitions of sustainable or green buildings exist, with the USGBC (United States Green Building Council) being a prominent advocate of green buildings worldwide. According to USGBC, the term 'green building' is synonymous with 'high performance building,' 'sustainable design and construction,' and other terms that emphasize a comprehensive approach to design and construction. Green building design aims to harmonize environmental stewardship, efficient

resource utilization, occupant well-being, and community integration. According to the Indian Green Building Council (IGBC), a green building is characterized by its ability to operate with optimal energy usage, minimal water consumption, preservation of natural resources, reduced waste generation, and provision of spaces conducive to healthy and comfortable living, in comparison to traditional buildings. The Energy and Resources Institute (TERI), a non-profit organization dedicated to sustainable development, defines a green building as one that is meticulously planned, built, and maintained to decrease overall environmental impacts while simultaneously improving user comfort and productivity.

Some of the key characteristics of sustainable buildings encompass the integration of sustainability considerations in all phases of building design and planning, as well as during the construction and manufacturing of building materials. Sustainable buildings employ healthy and eco-friendly materials and products, along with efficient systems that are easy to maintain and service. These buildings prioritize high functionality, flexibility, adaptability, user health, and comfort, while also emphasizing aesthetic and urban design quality with high public acceptance. Furthermore, they are strategically located with convenient access to public transportation services and networks.

Conventional construction methods typically involve substantial quantities of non-renewable and toxic materials, with little regard for the environmental impact of the building. In contrast, green buildings mitigate these impacts, offer improved health benefits, and consume less energy, resulting in long-term cost savings. The design of green buildings is a pragmatic and environmentally conscious approach, considering factors such as geographical location, climatic conditions, use of locally available materials with low embodied energy, and specific design parameters based on building usage. By adopting such an approach, green buildings minimize harm to the environment throughout their lifecycle. When clustered together, green buildings form green zones that promote a healthier environment, reduce the heat-island effect, and ultimately contribute to significant energy savings and a lower global carbon footprint at the city and national levels. Sustainable buildings overall consume less energy and water, emit fewer greenhouse gases, use materials more efficiently,

and generate less waste than conventional buildings over their entire lifespan.

■ **Compulsions of going green:**

Research indicates that the global urban population is projected to increase from 47% in 2000 to 70% in 2050. Specifically, the urban populations of China and India are expected to grow substantially, exceeding one billion in each country by 2050. In India, rapid urbanization is primarily attributed to a combination of socio-political factors. In accordance with the expanding development and population, the building sector of India is anticipated to experience a five-fold growth by the year 2050, considering that two-thirds of the commercial and high-rise residential structures projected for 2030 are yet to be constructed (70%). The total energy demand of India is forecasted to increase by 6.5% annually until 2016–17 to support the country's expected growth rate. Consequently, India is on track to become the world's second largest emitter of greenhouse gases. It is widely acknowledged that green buildings play a crucial role in conserving resources throughout the entire lifecycle of a structure, with the process commencing from Green design.

Green design embodies environmental, economic, and social aspects that bring benefits to all stakeholders, such as owners and occupants. The rapid advancements in construction methodologies and principles indicate that numerous modern office buildings in metropolitan cities across India are already incorporating various Green features into their structures prior to occupation. Amidst such circumstances, it is imperative that residential developments also transition towards green development to tackle forthcoming challenges related to energy efficiency, heightened pollution, escalating carbon footprint, and emissions. Embracing green practices will ultimately lead to the sustainable advancement of society, the nation, and the global community as a whole.

■ **Benefits of Sustainable Building:**

The impact of buildings on the environment, human well-being, and the economy is substantial. The effective adoption of green building techniques can optimize both the economic and environmental performance of buildings. Ongoing research aims to identify and elucidate the myriad benefits and costs associated with green building, as well as how to attain maximum benefits at minimal costs.

According to the Indian Green Building Council (IGBC), green building offers a plethora of advantages including environmental benefits such as emissions reduction, water conservation, stormwater management, temperature moderation, and waste reduction. Moreover, green building presents economic benefits such as energy and water savings, increased property values, reduced infrastructure strain, enhanced employee attendance and productivity, sales enhancements, and the development of a local talent pool. Additionally, social benefits like improved health are also associated with green building practices.

■ Economic and Market Aspects of Green Building:

Recent studies suggest that enhancing energy efficiency in buildings and appliances could result in a reduction of 1.6 gigatons of CO₂ emissions by 2020 and up to 7 gigatons by 2050. An estimated \$158 billion annually between 2010 and 2050 is needed to disseminate energy efficiency technologies worldwide. Research by McGraw Hill Construction indicates that approximately half of new global commercial building projects are expected to adopt green building principles, while 45% of retrofit projects on existing buildings are geared towards enhancing energy performance. Asia emerges as the swiftest growing green building market region, with the number of firms primarily dedicated to green building projected to surge from 36% presently to 73% by 2013. More than half of the surveyed firms anticipate a significant focus on green building, with over 60% of their projects falling into this category, an increase from the current 30%. Furthermore, more than 85% of the firms foresee rapid or consistent growth in sales and profits associated with green building.

■ Challenges of Embracing Sustainable Practices:

Research indicates that the global urban population is anticipated to rise from 47% of the total population in 2000 to 70% by 2050. Notably, the urban populations of China and India are predicted to continue growing rapidly, surpassing one billion in both countries by 2050. In India, the substantial urbanization trends stem from a combination of socio-political motivations. The Green building movement in India has experienced significant growth over the past 3–4 years, ever since the CII–Godrej GBC initiated its pursuit of the prestigious LEED rating for its center in Hyderabad. The

achievement of a Platinum rating for this building has sparked considerable enthusiasm throughout the country, leading to a surge in various green building projects including residential complexes, exhibition centers, hospitals, educational institutions, laboratories, IT parks, airports, government buildings, and corporate offices.

Motivated by a desire to demonstrate environmental awareness, numerous commercial facilities have integrated "Green technologies" to obtain certifications for being "Green and Sustainable." The Green Buildings Ratings and Certification process, as outlined by USGBC, has gained significant traction in recent years, with a notable increase in projects certified by rating systems like Energy Star and LEED. In India, the Indian Green Building Council (IGBC) offers LEED ratings and aims to position the country as a leader in green buildings by 2015. The Green rating for Integrated Habitat Assessment (GRIHA), India's National Rating System, was developed by The Energy and Resources Institute (TERI) in collaboration with the Ministry of New and Renewable Energy. This system evaluates the design of green buildings across various climatic zones in India. Mumbai had the highest number of registered green building projects among Indian cities in 2008, reflecting a growing awareness and interest in eco-friendly constructions. The IGBC reported a total of 315 green buildings in India in 2008, with 250 of them being commercial properties.

The Kyoto Protocol is an international agreement associated with the United Nations Framework Convention on Climate Change, requiring Parties to adhere to globally binding emission reduction targets. Carbon credits and carbon markets play a crucial role in national and international efforts to mitigate the rise in greenhouse gas (GHG) concentrations. In certain markets, one carbon credit is equivalent to one metric tonne of carbon dioxide or its equivalent in other greenhouse gases.

Carbon trading involves the utilization of an emissions trading strategy whereby greenhouse gas emissions are restricted, and markets are employed to distribute these emissions among a group of regulated sources. The generation of carbon credits can serve as a viable source of revenue for rural areas and industrial sectors by reducing GHG emissions or implementing environmentally friendly practices such as tree planting, which is feasible for the Indian populace. The promotion and dissemination of

knowledge regarding such business opportunities should be facilitated through the educational system. In India, the concept of constructing energy-efficient 'green' buildings may seem appealing theoretically, but its practical implementation, particularly in developing nations, can be prohibitively costly. Unfortunately, there are no direct incentives in India for the construction of energy-efficient residential or commercial structures. The real estate services specialist Jones Lang LaSalle notes various challenges faced by the Indian housing industry in its efforts to adopt eco-friendly practices. A significant obstacle is the diminishing overall demand for space in Indian urban areas. By 2014, it is projected that India's major cities will encounter approximately 25 percent vacancy rates, posing a challenge for developers to find tenants or buyers willing to pay premium prices for environmentally sustainable spaces. Private homeowners lack immediate motivation to embrace energy-efficient measures due to the absence of mandatory standards for green buildings in India. Most municipalities do not possess uniform and practical energy codes, specifically for passive and solar designs. Furthermore, there is a lack of clear implementation guidelines for state and municipal bodies to establish and enforce building energy efficiency programs and policies. The absence of an effective local infrastructure for code administration and enforcement, including inspections, contributes to building owners' reluctance to invest in green technologies and energy efficiency during construction. Developers often refrain from investing in building energy efficiency since they do not directly benefit from these initial expenditures, ultimately passing on the inefficiency costs to tenants and the environment. The high current borrowing costs act as a significant barrier to securing incremental funds for efficiency improvements, despite the potential future energy cost savings. Bhopal, recognized as an emerging Tier-II residential hub, serves as the capital of the Indian state of Madhya Pradesh and the administrative center of Bhopal district and division. Renowned as the "City of Lakes" due to its natural and artificial water bodies, Bhopal stands out as one of India's greenest cities. Divided into old and new Bhopal, the city accommodates various national institutions and installations, including ISRO's Master Control Facility, AIIMS Bhopal, and NIFT. Bhopal gained

global attention following the tragic Bhopal disaster in 1984, caused by a gas leak at a Union Carbide India Limited plant. Since then, the city has been a focal point for protests and campaigns, drawing participation from worldwide supporters. Additionally, Bhopal is celebrated for its exquisite silver jewelry, intricate beadwork, and embellished velvet accessories. In recent times, Bhopal has emerged as a promising real estate destination subsequent to Indore in the state of Madhya Pradesh. It presents diverse investment prospects for both real estate developers and investors. The economic landscape of Bhopal predominantly consists of the prominent electrical entity BHEL, along with service and administrative sectors. The progression of real estate in Bhopal appears to be embracing a comprehensive approach as all sectors, whether residential, commercial, or retail, are experiencing rapid growth. The research methodology adopted encompasses the utilization of both Primary and Secondary data. The secondary data encompasses information sourced from publications such as journals, magazines, books, and the internet. On the other hand, the primary data is acquired through the administration of questionnaires across three distinct categories. Specifically, three separate questionnaires were formulated targeting Potential Buyers, Developers, and Officials affiliated with EPCO (Environmental Planning & Conservation Organization). All questionnaires were structured in a non-disguised format. The sample size for potential buyers was set at 200, while for Developers it was 10. The sample size for EPCO officials was determined as 2 based on governmental availability. It is noteworthy that the sample size was deliberately limited as the study is confined to the Bhopal region.

The interpretation of the findings derived from the three-tier survey reveals several key conclusions. From the perspective of potential buyers, it was observed that 20% exhibit a comprehensive understanding of the green building concept, whereas nearly 50% possess a moderate awareness of the same. The majority of potential buyers fall within the age brackets of 18–35 years and 35–49 years, with the most informed individuals belonging to the former group. Furthermore, a large portion of potential buyers hail from the middle and upper middle class, with 47% falling within the income range of Rs. 2–5.9 LPA and 42% falling within Rs. 6–12 LPA. Print media emerges as the primary source of

awareness regarding green buildings, accounting for 42%, while social media contributes 10% to the awareness pool. Notably, burgeoning areas in Bhopal such as Hoshangabad Road, Ayodhya Bypass, and Arera Colony Extension attract considerable customer interest at rates of 30%, 22%, and 28% respectively. A significant 40% of potential buyers harbor misconceptions regarding the green building concept.

From the perspective of the developers, it is noted that a significant percentage, specifically 80%, have acquired knowledge regarding the concept of green building, yet have not implemented it practically. Furthermore, a vast majority, around 90%, are currently employing various sustainable practices such as rainwater harvesting, renewable energy sources, natural lighting, and water recycling techniques in their projects. However, there exists a reluctance among 30% of developers to embrace green building technology due to regulatory concerns, while 40% refrain from opting for it because of market-related issues. Additionally, 50% of developers express hesitance towards green building technology due to the intricate nature of information and the complex guidelines necessary for obtaining green certifications. Another 40% abstain from green development owing to the substantial initial investment linked with green construction. The primary source of awareness among potential buyers regarding green building concepts predominantly stems from print media, accounting for 42%, followed by social media with a share of 10%.

It is noteworthy that a staggering 90% of developers believe that governmental bodies such as the Government and City Administration should play a crucial role in promoting green development within the residential real estate sector. Half of the developers advocate for the government's active involvement in fostering awareness about green building concepts among the general populace. Shifting focus to the Government's perspective, the Government of Madhya Pradesh is currently engaged in collaboration with EPCO, BDA, and BMC towards establishing a Clean Development Management Agency in Bhopal. This agency aims to tackle issues related to sustainable development and facilitate the growth of green homes within the city. Officials opine that revising the existing guidelines and rating systems to be more developer-friendly is essential to promote green building development in the residential real

estate sector. Moreover, there is a discernible potential for residential green development in the near future as per the officials' viewpoint. The Government of Madhya Pradesh is poised to launch initiatives promoting sustainable development and green building technology to enhance public awareness.

In conclusion, the burgeoning development across various realty sectors has led to a notable surge in property prices in Bhopal. Notably, prices in prime locations have witnessed a significant increase due to the real estate growth in the city. The residential sector has seen the emergence of both luxury villas and affordable housing options, diversifying the housing landscape in Bhopal. With the property market in Bhopal gaining traction and national developers showing interest in the city, there is a growing focus on realty development. As the city transitions through a dynamic phase of real estate growth, the need for residential green building development becomes increasingly evident. Cooperation among all stakeholders involved in the process can pave the way for feasible residential green buildings in Bhopal. By considering the insights presented in this project report, the vision of establishing green homes in Bhopal can undoubtedly be realized.

CONCLUSIONS

Based on the Analysis and Interpretation, the subsequent set of recommendations is presented to enhance the feasibility of residential green building development in the Bhopal region:

To foster awareness among the general public regarding green building development, it is imperative to devise an efficacious promotional strategy and campaign targeting the predominant demographic of potential buyers, specifically individuals within the middle to upper-middle class aged between 18–49 years. The promotional strategy must encompass all facets of green building construction and development to ensure comprehensive customer awareness and prevent developers from exploiting customers unlawfully. The primary source of awareness is print media, closely trailed by the internet and social media. Considering that a substantial portion of potential buyers fall within the 18–49 age bracket, which also constitutes the primary users of internet and social media, the promotional strategy should emphasize the utilization of internet and social media as potent promotional tools for the green building concept.

The Government of Madhya Pradesh should take part in conducting training programs for developers and engineers to equip them with the requisite technical knowledge associated with green building construction. Furthermore, the Government should incentivize partial funding for green building projects to facilitate developers in establishing green residential projects and instil a sense of trust in potential buyers towards green home projects due to governmental involvement. The Green Building Principles (GBPs) and Rating Systems for Green should be reinstated and structured favourably for developers to encourage investments in green residential development projects. Collaboration among various governmental entities such as the Bhopal Municipal Corporation (BMC), Environmental Planning & Conservation Organisation (EPCO), Bhopal Development Authority (BDA), local developers, and Non-Governmental Organizations (NGOs) is essential to ensure seamless coordination in facilitating the feasibility and success of residential green building development in the foreseeable future.

References

- [1] Li, Y.Y., Chen, P.H., Chew, D.A.S., Teo, C.C. and Ding, R.G. (2011), "Critical project management factors of AEC firms for delivering green building projects in Singapore", *Journal of Construction Engineering and Management*, Vol. 137 No. 12, pp. 1153–1163.
- [2] Castleton, H.F., Stovin, V., Beck, S.B.M. and Davison, J.B. (2010), "Green roofs; building energy savings and the potential for retrofit", *Energy and Buildings*, Vol. 42 No. 10, pp. 1582–1591.
- [3] Potbhare Varun, Syal Matt, Korkmaz Sinem, 2009, "Adoption of Green Building guidelines in developing countries based on US and India experiences" *Journal of Green Building*, Vol. 4 No 2, pp 158
- [4] Gupta Rajat, Gregg Matt, Manu Sanyogita, Vaidya Prasad 2019, "Customized performance evaluation approach for Indian green buildings," *Building Research and Information*, Vol. 47 No 01, pp 56–74
- [5] Dr. Bidyut, Gogoi Jyoti, October 2017, "Green Building Requirement in India and Factors driving green building purchase" *International Journal of Civil Engineering and Technology*, Volume 8, Issue 10, , pp. 153–165
- [6] Satya, Singh Sonu, Sridharan U, 2016 "Environment sustainability guidelines for Green Buildings in India," *International Journal of Scientific Research and Technology*, Vol.4 Issue1, https://www.vpupadhyay.org/papers/03-INDJSRT20160409_green.pdf
- [7] M. Gehlot S. Shrivastava, 2022, "Sustainable construction Practices: A perspective view of Indian construction industry professionals" *Materials today*, Elsevier, Vol. 61 Part 2, pp. 315–319
- [8] Yinqi Zhang, He Wang, Weijun Gao, Fan Wang, Nan Zhou, Daniel M. Kammen, Xiaoyu Ying, "A Survey of the Status and Challenges of Green Building Development in Various Countries" *Sustainability MDPI* Sep. 2019, 11(19)
- [9] Madhya Pradesh Pollution Control Board, District Environmental Plan for Bhopal district, September 2021, <https://www.mppcb.mp.gov.in/Proc/Tech/FINAL-SEP-2021.pdf>
- [10] Directorate of Town and Country Planning, Government of Madhya Pradesh, Draft Bhopal Development Plan 2031 Volume 2, <https://mptownplan.gov.in/LU-panel/Bhopal/Amrut/ENGLISH/VOL2.pdf>
- [11] School of Planning and Architecture Bhopal, Climate Informed Environmental Planning for the Smart Cities of Madhya Pradesh, Bhopal city, October 2019, http://www.climatechange.mp.gov.in/sites/default/files/resources/SPAB_CIEP_Compiled%20Report.pdf
- [12] India Census 2011 Council on Energy, Environment and Water (CEEW), Making Madhya Pradesh's Smart Cities Climate Resilient, January 2020, https://www.ceew.in/sites/default/files/makingmp_compressed.pdf
- [13] Atal Bihari Vajpayee Institute of Good Governance and Policy Analysis (AIGGPA) & Indo Global Social Service Society (IGSSS) Publications.; Urban Shelter and Housing for the Marginalised in Madhya Pradesh: A Study for Inclusive Policy Roadmap, January 2021, https://aiggpa.mp.gov.in/uploads/project/Urban_Shelter_for_Marginalised_in_Madhya_Pradesh_English.pdf
- [14] Urban Development and Housing department, Government of Madhya Pradesh, Madhya Pradesh Electric Vehicle (EV) Policy 2019, <https://www.nsws.gov.in/s3fs/2021-08/Madhya%20Pradesh%20EV%20Policy%202019%20-%20Draft.pdf>
- [15] World Resources Institute, Accelerating Building Decarbonization: Eight Attainable Policy Pathways to Net Zero Carbon Buildings for All, September 2019, <https://www.wri.org/research/accelerating-building-decarbonization-eight-attainable-policy-pathways-net-zero-carbon>
- [16] Indore Municipal Corporation, Water systems in Indore: An integrated approach, February 2023, <https://imcindore.mp.gov.in/>
- [17] Anon, 2011, Real Estate, Indian Brand Equity Foundation, November, www.ibef.org, accessed on 24 November 2011
- [18] Federspiel, C., Q. Zhang and E. Arens. (2002). Model-based benchmarking with applications to laboratory buildings, *Energy and Buildings*, Vol. 34(3), pp. 203–214.
- [19] Hicks, T. and B Von Neida. (2005). US National Energy Performance Rating System and ENERGY STAR Building Certification Program.
- [20] Kinney, S. and M.A. Piette. (2002). Development of a California commercial building benchmarking database, Lawrence Berkeley National Laboratory: Lawrence Berkeley National Laboratory. LBNL Paper LBNL–50676.
- [21] Matson, N., M.A. Piette. (2005). Review of California and national methods for energy-performance benchmarking for commercial buildings, California Energy Commission, Public Interest Energy Research Program, LBNL No. 57364.
- [22] Olofsson, T., A. Meier and R. Lamberts. (2004). Rating the energy performance of buildings, Lawrence Berkeley National Laboratory: Lawrence Berkeley National Laboratory. LBNL Paper LBNL–58717.
- [23] Sankhe, S. et al, 2010, India's urban awakening: building inclusive cities, sustaining economic growth, May, McKinsey Global Institute.
- [24] Sartor, D., M.A. Piette, W. Tschudi, and S. Fok. (2000). Strategies for Energy Benchmarking in Cleanrooms and Laboratory-Type Facilities, Proceedings of the ACEEE 2000 Summer Study on Energy Efficiency in Buildings, Vol 10, pp. 191–203.



ISSN: 2067-3809

copyright © University POLITEHNICA Timisoara,
Faculty of Engineering Hunedoara,
5, Revolutiei, 331128, Hunedoara, ROMANIA
<http://acta.fih.upt.ro>