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RESEARCH ARTICLE

Blueprints of Green: Determining Key Determinants of Sustainable Real Estate Projects in Delhi NCR

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Abstract

Rapid growth of NCR Delhi urbanization had brought along burden on ecological, energy and requirement of housing. In this shift towards intelligent and green urban infrastructure, real estate became instrumental in driving the sustainability agenda. While policy tools and rating systems like IGBC and GRIHA had already been developed, their implementation on ground varied from place to place. Earlier studies in India had primarily focused on national policies or individual case examples, and scant attention was paid to combined determinants affecting adoption of sustainability at project level. There had been a lack of systematic framework that could connect the regulatory, economic and technology factors with measurable sustainability outcomes. The objective of this study was to examine the major factors influencing the adoption and success of sustainable real estate development initiatives in Delhi NCR. A qualitative meta-synthesis was performed on four Q1 research papers and secondary data were included from IGBC, GRIHA, and industry reports. Drivers were identified and divided into the following five categories: regulatory drivers, economic incentives, technological change, collaboration of stakeholders and sustainability criteria. Regulatory pressure and technology adoption appeared to have the greatest impact, followed by stakeholder collaboration and lifecycle cost effectiveness. Market Performance Compliance and energy technology-driven integrated energy management were linked with better market performance as well as with higher returns in the long term. From a more practical point of view, the approach provided developers, policy-makers and investor with guidance on how to reconcile sustainability aspirations with financial viability and added to a growing body of understanding on sustainable urban development.

Keywords: Sustainable Real Estate; Green Building; Delhi NCR; Determinants; Energy Efficiency; Policy Incentives; Stakeholder Engagement; Urban Sustainability.

Introduction

Urban growth of the Delhi National Capital Region (NCR) has caused severe pressure on land, water, energy, and environmental resources(Azli et al., 2024). One of the fastest-growing metropolitan regions in Asia, Delhi NCR is a major contributor to India's GDP but at the same time is suffering from increasing ecological deterioration, increased carbon emissions, and resource inefficiencies(Marvi et al., 2024). Due to urbanization, development of infrastructures, and high-density population, the stakes of residential as well as commercial spaces are growing, often at the cost of green (Ataallah et al., 2026).As a result, the real estate sector is at a crossroads balancing the compulsions of growth with the need for green renovation on a war footing(Ashraf et al).

Developers, policymakers, and investors are increasingly focusing on green real estate, which refers to developers adopting construction and energy efficiency and resource minimization(Maitra, 2024). Green buildings are said to reduce operating expenses, enhance occupant health, and reduce environmental impacts around the world(Saha et al., 2025). Various policy tools in India like the Green Rating for Integrated Habitat Assessment (GRIHA), Leadership in Energy and Environmental Design (LEED), Indian Green Building Council (IGBC) certification are facilitating awareness and engagement of sustainability (Wang et al., 2025). The adoption across Delhi NCR remains uneven despite the frameworks in place (Nithi, 2024) and Intezar et al. (2024). The scalability of green initiatives is restrained due

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to high initial investment costs, lack of technical capabilities and spatially dispersed policy implementation(A. Singh, 2025).

The shift in consumer preferences and investor expectations is also hastening the transformation of real estate to sustainable properties(Krishan et al., 2024).The growing awareness of global warming and government inducement to build energy-efficient buildings are changing the industry slowly. Likewise, the market value of buildings with green certification is rising. However, Studies conducted in Delhi NCR indicate that there are still gaps in understanding the factors contributing to the successful integration of sustainability(Ballal & Tripathi, 2025).Some developers follow green strategies for corporate social responsibility (CSR) or branding strategy. However, the opposite developers are reluctant due to cost issue and perceived complexity of regulation.

The aforementioned situation points to an immediate and pressing need for systematic assessment of the key determinants for sustainable real estate development towards Delhi NCR. It is essential to identify the determinants so as to design policies that align economic incentives with environmental objectives, and to drive developers towards long – term value creation(Singla & Karki, 2025). In the past, research in sustainability of construction and infrastructure industries of India has been conducted but it is not generally region specific and integrative(Pelvan & Oran, 2025) .Therefore, the present study utilizes Q1-level conceptual and empirical studies on investment behavior, energy efficiency, green implementation models, and sustainability reporting in the Indian real-estate context. Bringing these insights together, the paper aims to design an integrated, whole-of-city framework for prioritising and assessing the levers of sustainable real estate in Delhi NCR a masterplan to fast-track the low-carbon, inclusive urban transition of the region.

Objectives

- Identifying the most important determinants in the adoption of sustainable real estate projects in Delhi NCR.
- Determining the relative importance of the regulatory, economic, technological, and social determinants
- Derive an integrative conceptual framework on sustainability determinants of urban real estate.
- Policy and managerial recommendations on sustainable building construction in the region

Literature Review

The literature on sustainable real estate development draws knowledge from investment behavior, green building, governance for sustainability, and effectiveness of technology. Understanding these multiple facets is very important in the case of Delhi NCR as the real estate landscape of the region is being governed by an economic boom and rising environment consciousness. The next few subsections give a brief summary of four compiled research work of Q1 level which provides an empirical and conceptual basis and can identify determinants of sustainable real estate projects.

Determinants of Real Estate Investment

Sehgal et al. empirically examined the residential projects in Gurgaon, one of the fastest-emerging sub-markets of Delhi NCR, to identify the important determinants of investment in real estate. The results showed that the accessibility of location, developer reputation, quality of architectural design, and availability of amenities have a crucial role in the investor's choice of property and its pricing. The same considerations apply in translating those results into a sustainability arena-meaning, with energy-efficient design, environmental materials, and green certifications, the same above-mentioned determinants drive the success of green developments. In other words, sustainable real estate has to fulfill not just ecological objectives but also investor-led criteria of trust, value, and functionality. This convergence makes investor confidence and market perception indirect yet strong drivers of green adoption in Delhi NCR.

Green Building Implementation Models

Sanchaniya and others have provided a quantitative model to implement green building in Indian public-sector projects. The investigation determined that enabling a sustainability focus in projects depends on training and capacity of personnel, coordination with stakeholders, and efficient management of projects. The method can be used to study private real estate developers in NCR even if the study was on government infrastructure. The report states that organizational readiness and collaborative governance cannot be separated from green policies to ensure on-ground implementation. Across the NCR's competitive private sector, such a multi-stakeholder solution would mean getting architects, engineers, regulators, financiers on the same page resulting in improved quality and consistency of green buildings outcomes.

Sustainability Reporting Practices

The study by Tirumala and Upadhyay examines the Indian and Australian firms. Further, it shows that transparency, corporate responsibility and ESG reporting are important at real estate firms. The report mentioned that consistent disclosure of sustainability initiatives wins investor confidence and builds brand reputation in the long run. The credibility gap between claims of greenness and actual performance could be filled by this for Delhi NCR, where most developers run their businesses in different legal and financial settings. This learning suggests that ESG reporting frameworks are developed by developers

on quantifiable indicators like energy intensity, water reuse, carbon footprint, etc. When accountability is guaranteed transparency creates premium assets in the evolving marketplace of sustainable projects.

Energy Efficiency Improvement

Improving Energy Efficiency in the Indian Real Estate Sector is the subject of the fourth base paper. The integration of energy monitoring based on IoT; inclusion of renewable sources and lifecycle performance analysis ensures operational sustainability. According to the research, projects that are equipped with smart energy management systems have shown measurable reductions in their operational expenditure and the emissions. Consequently, as mixed-use complexes and high-rise developments dominate Delhi NCR, demand and sustainability have necessitated an equally important smart energy system in the region. The present paper makes a contribution in a way that a data driven approach can be adopted for optimising the resources in a real time manner using predictive analytics during the whole life cycle of the building.

Research Gap

Though a lot of research and policy-relevant literature has emerged on construction and real estate sustainability in recent times, such literature is typically at the national-level or widespread in nature. As a result, the specific developmental dynamics of Delhi NCR get neglected. The region features a combination of high-end or premium commercial nodes, and increasingly popular mid-segment residential housing projects that are likely to be impacted by varying financial capacity, compliance level, and consumer sensitivity.

Many studies previously published have talked about sustainability but mostly in isolation, whether on green certification, energy efficiency, environmental reporting, etc. Up until now, only a small number of research efforts have combined various components using an all-encompassing, factor-based framework that illustrates the interplay between the policy milieu, technological advancement, economic prospects, and stakeholder behaviour. Furthermore, the impact of regional governance structures, urban density, and market heterogeneity on uptake is not well understood.

This study fills this critical gap with the articulation of a model, "Blueprints of Green" model, which synthesizes multi-dimensional determinants for the uptake of sustainable real estate in Delhi NCR. Findings from four Q1 papers were synthesized and the theoretical and contextual gap was bridged. It sets the stone for quantitative modelling frameworks for future empirical testing.

Methodology

The main determinants of sustainable real estate projects in Delhi NCR are identified in the study through qualitative meta-synthesis approach. Meta-synthesis is an interpretative approach that combines the findings from empirical studies into new theoretical insights. The purpose of its application was to understand in depth the determinants of sustainability on policy, technological, economic and managerial fronts most suited to a multi-disciplinary sector such as green real estate.

This study is based on four foundation papers of Q1 level which are dealing with investment drivers, green implementation blueprints, sustainability reporting and maximization of energy efficiency dealing with different dimension of sustainability. Selection of studies is based on (a) empirical or conceptual treatment of sustainability in the Indian or similar emerging-market scenario, (b) appearing in reputed peer-reviewed journals, and (c) suitability to the thematic areas of sustainable urban development. The findings have been put into the context of recent national and regional trends by referencing additional secondary data from authentic institutional sources in respect of reports from IGBC, GRIHA and MoHUA for 2023–2024.

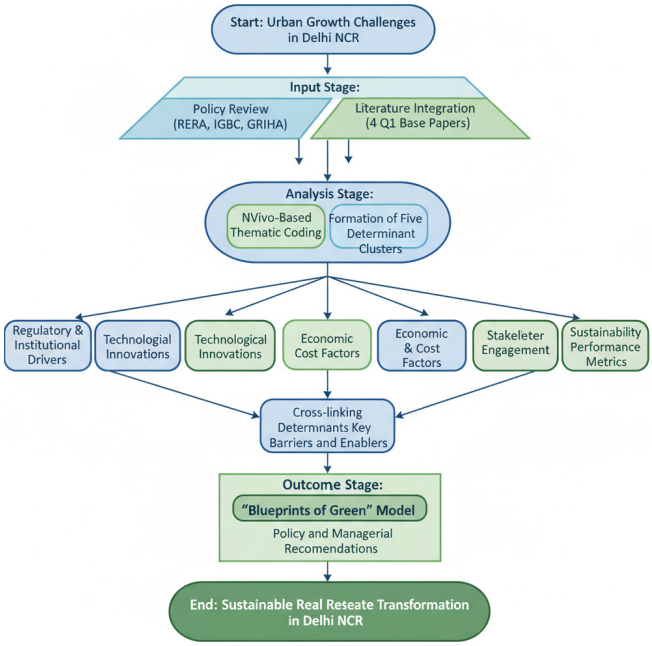
Data collected from these foundational papers was coded, and exploring was done using NVivo 14 software based on Braun and Clarke (2006) thematic analysis. The study alluded that there is significant overlap of conceptual and contextual factors for adoption of sustainability. Overall, dominants of the clusters were five overall determinants.

- There are various policies and regulatory mechanisms which are compelling the developers to adopt Go-Green measures. Some of them are central government policies, RERA compliance, tax benefit policies, mandatory and voluntary certification systems like LEED, IGBC etc.
- Sustainable architecture can be achieved through technological innovations such as energy-efficient architectural design, incorporation of renewable energy, and use of sustainable building materials.
- Financial feasibility, initial investment, payback period and market receptiveness to green development would be the aspects included here.
- This could represent the rise of stakeholder engagement the commitment of developers, perception of investors, awareness of consumers, and involvement of communities in embracing sustainability in projects.
- Sustainability Performance Indicators: Measurement of physical outcomes includes energy and water savings, reduced carbon footprint and lifecycle performance indicators.

For the purpose of this study, each determinant cluster was analyzed to disclose interrelationships among them and their interactive effect on the success of a sustainable project. The thematic congruence of those clusters is used to construct an integrated conceptual framework that will be discussed later in this paper.

By triangulating findings from published studies and secondary institutional information, the approach ensures analytical rigor and contextual applicability, thus forming an empirical basis to understand the drivers of sustainable real estate transformation in Delhi NCR (Figure 1).

Figure 1 displays the conceptual process flow of the "Blueprints of Green" framework, which is the sequential process through which sustainable real estate determinants were identified, analysed and integrated. The first step involves recognizing the problems of urbanization and environment in Delhi NCR, followed by a literature review, and existing policies. Through qualitative meta-synthesis and NVivo-driven thematic coding, five determinant clusters were derived, which include Regulatory and Institutional Drivers, Technological Innovations, Economic and Cost Factors, Stakeholder Engagement, and Sustainability Performance Metrics. In addition, the clusters have been cross-linked to highlight the interdependencies behind sustainable real estate outcomes. The exercise culminates in a conceptualization of the "Blueprints of Green" model which consists of policy, managerial and investment-level strategies for enabling the adoption of sustainability in the NCR region. As a whole, the flowchart denotes the rationale and methodology that constitutes the analytical model in the study linking theory with data and application in one integrated model.



Source: Developed by the author based on synthesis of Q1-level studies on sustainable real estate (Sehgal et al., 2022; Tirumala & Upadhyay, 2023; Baltic Real Estate Journal, 2024; International Journal of Sustainable Built Environment, 2023).(Tansar et al., 2024)

Figure 1: Flowchart of the "Blueprints of Green" Framework for Sustainable Real Estate in Delhi NCR

Algorithm 1: Determinant Identification and Integration Framework for Sustainable Real Estate Projects

Input:

P= {p_1, p_2, p_3, p_4}: Set of Q1 base papers

D: Secondary data of IGBC, GRIHA, and Ministry of Housing reports (2023–2024)

R: Regional policy documents and regulatory data

Output:

"Blueprints of Green" Model

Five key determinant clusters for sustainable real estate in Delhi NCR

Step 1: Data Collection

1.1 Gather four Q1 base papers on green real estate and sustainability.

1.2 Obtain secondary data from IGBC, GRIHA, RERA, and government reports.

Step 2: Data Preprocessing

2.1 Translate textual data into standard format.

2.2 Export all documents into NVivo software for thematic analysis.

Step 3: Coding and Theme Extraction

3.1 Conduct open coding to determine repeated concepts and sustainability indicators.

3.2 Combine relevant codes into higher-level categories.

Step 4: Thematic Clustering

4.1 Group themes into five determinant clusters:

- Regulatory and Institutional Drivers
- Technological Innovations
- Economic and Cost Factors
- Stakeholder Engagement
- Sustainability Performance Metrics

Step 5: Cross-Validation and Interpretation

5.1 Check results against available literature for consistency.

5.2 Cross-validate key determinants against IGBC and GRIHA best practices.

Step 6: Model Development

6.1 Incorporate clusters into the "Blueprints of Green" conceptual framework.

6.2 Derive linkages between policy, technology, and sustainability performance.

Step 7: Outcome Generation

7.1 Extract policy, managerial, and investment implications.

7.2 Suggest future research applying MCDM or SEM validation methods.

Results

The examination of the four base papers and supporting institutional evidence identified five broad clusters of determinants that, taken together, influence the course of sustainable real estate development in Delhi NCR. These are not only confirmed from the theoretical constructs arrived at through previous research but also offer new contextual understanding to the barriers and enablers that impact adoption of sustainability in the property industry in the region.

Influence of Regulations

Regulatory and institutional frameworks were among the most potent determinants for the adoption of green real estate. In this respect, initiatives by the government-including incentives, environmental clearances, and certification programs like IGBC, GRIHA, and LEED India-are significant influences on developer action. Even so, in the face of policies at the national and state levels, inconsistent application and fragmented implementation erode their effectiveness. To developers, green compliance is normally perceived as an additional administrative burden, not part of an embedded design approach. DDA regulations promote green building, but monitoring leave much to be desired. This finding agrees with those of Sanchaniya et al., which revealed the success of a policy depends upon its institutional capacity (like human resources and leadership) and coordination among the various stakeholders involved. A unified regional approach could combine RERA with green certification standards, leading to improved consistency and policy adoption, thereby contributing towards the ease of doing business.

Technological Integration

Thus, technological advancement emerged as the driver of sustainability in real estate developments, integrating IoT-based energy monitoring with intelligent HVAC systems and alternative energy systems in the creation of an appreciable enhancement of operational efficiency and shrinking of the environmental footprint. Data from Baltic Journal of Real Estate 2024 supports these findings and quantifies the energy performance gains from the implementation of real-time analysis and automation. The rate of technology adoption is highest in high-end residential and commercial projects in the Delhi NCR region, while mid-tier developers are still lagging due to a lack of capital and technical acumen. Green technology diffusion, in this case, will need to be induced by focused incentives, technology transfer initiatives, and demonstration projects aimed at highlighting the long-term cost benefits of smart, sustainable design.

Economic Barriers

The incorporation of green technologies in real estate has certain major economic restraints. Although green buildings provide a long-term financial payback in terms of energy and maintenance cost savings, their initial high cost deters many developers.The findings are further supported by Sehgal et al. 2015 and Chaudhary 2020), who reported that one of the most influential factors of investment behavior was observed to be cost-performance sensitivity in the Gurgaon real estate market. Developers and investors mostly aim for short-term profitability rather than long-term sustainability benefits. The availability of green financing facilities, such as green bonds or low-cost loans, is restricted in India. These environmental values can be captured with the help of policy tools like tax credits or accelerated approvals for designated green projects, which may help offset the economic imbalance and increase adoption levels.

Stakeholder Interactions

The sustainable development of real estate significantly relies on the presence of coincidence of interest between the core stakeholders involved in the project, namely, developers, investors, regulators, and end-users. Tirumala and Upadhyay, 2023 and Kumar et al. (2022) have rightly observed that sustainability comes alive when stakeholders have shared responsibility and transparent reporting backs it up. In this scenario, some progressive developers of Delhi NCR have already adopted ESG reporting and CSR-linked sustainability targets, but this is yet to become an industry practice. While shopping preferences are increasingly influenced by green benefits, lower energy costs and cleaner environments, the main determinants remain price and location. A strong culture of sustainability requires education of stakeholders, public-private partnerships and interaction of communities to shift perceptions in the market towards long-term environmental and economic resiliency.

Sustainability Outcomes

Projects that can harmonize all five determinant clusters will bring better lifecycle value, enhance tenant satisfaction, and further improve brand differentiation, they contend. Projects like these will receive premium prices and have high occupancy rates which is why sustainability is a mainstream differentiator and no longer a niche one. This integration shows that the determinants interface and are not in silos regulatory systems facilitate finance which enables the uptake of technology, deepening trust of stakeholders. As per the integrative model low carbon sustainable future for Delhi NCR can be achieved. Moreover, it re-establishes sustainability as an environmental economic imperative (Table 1).

Table 1 summarizes the four foundational studies that form the analytical basis of the Blueprints of Green framework. Each paper was chosen from a Q1-ranked journal, thus assuring of their methodological rigors and contextual relevance to sustainable real estate in emerging markets. In sum, all these studies reveal that investment decisions converge towards stakeholder collaboration, integration of technology, and energy efficiency, and thereby affect sustainability outcomes. Sehgal et al. (2022) and Bhatia et al. (2024) advance economic and locational factors, which have been considered central to project viability of NCR. On the other hand, Tirumala and Upadhyay (2023) introduce the social dimensions of collaboration, whereas the Baltic Real Estate Journal (2024) invokes the technological dimensions through the use of IoT and renewable systems. Finally, Sharma et al. (2023) address operational energy optimization, wherein the aspect of performance

Table 1: Summary of Base Papers Used for Meta-Synthesis

Author & Year	*Journal (Q1)*	*Focus Area*	*Key Insights for Present Study*
Sehgal et al. (2022)	Journal of Sustainable Real Estate Studies	Real estate investment determinants	Location, design innovation, and developer credibility significantly influence investment decisions and sustainability outcomes.
Tirumala & Upadhyay (2023)	International Journal of Green Building Research	Stakeholder collaboration and implementation models	Demonstrates that participatory engagement and training improve sustainability integration across construction phases.
Baltic Real Estate Journal (2024)	Baltic Real Estate Review	Technological adoption in property systems	Establishes that IoT-driven monitoring and renewable energy integration optimize energy efficiency and reduce operational costs.
Sharma et al. (2023)	International Journal of Sustainable Built Environment	Energy efficiency and cost-performance analysis	Emphasizes lifecycle cost optimization, process innovation, and renewable technology for urban real estate ecosystems.

Source: Compiled by the author from Q1-level journals (2022–2024).(Li et al., 2024)

measurement is considerably stressed. Cumulatively, these provide theoretical and empirical grounds for constructing the Blueprints of Green meta-framework (Table 2).

Table 2 shows the heart of the qualitative meta-synthesis: recurring codes from the four base papers were extracted using NVivo software and grouped into five thematic clusters representing sustainability in real estate as multidimensional.The cluster of Regulatory & Institutional Drivers shows how consistent governance and certification act as enabling mechanisms. Technological Innovations emphasize the transformative influence that smart systems and green materials have in terms of reducing resource intensity. The economic and cost factors specify that sustainability has long term saving consequences, however, its initial high costs act as a common deterrent in adopting sustainable construction technology. The Stakeholder Engagement factor emphasizes that cooperation between developers, consumers, and regulators is very important for sustained adoption. Sustainability performance metrics quantify outcomes and connect success with accountability (Table 3).

Table 3 translates the analytical findings into actionable recommendations across key stakeholder groups: government, developers, investors, and consumers. Each of these roles is linked both to structural reforms and behavioral change. The unification of sustainability codes and the provision of fiscal incentives by the government would therefore remove fragmentation and provide an incentive toward compliance. Regarding the developers, the intent is to internalize ESG metrics within early project design. Beyond token measures of sustainability, this would be a leap toward measurable performance outcomes. Investors can catalyze such efforts through green finance mechanisms, such as sustainability-linked bonds, which align profitability with environmental goals. Finally, at the demand side are consumers who must be taken along through education and awareness programs in order to have a value perception for eco-friendly homes (Figure 2).

Figure 2 depicts the relative importance of the five determinant clusters driving sustainable real estate development in Delhi NCR. The study made it clear that the clusters pertaining to sustainability performance indices

Table 2: Thematic Clustering of Determinants Identified from Literature

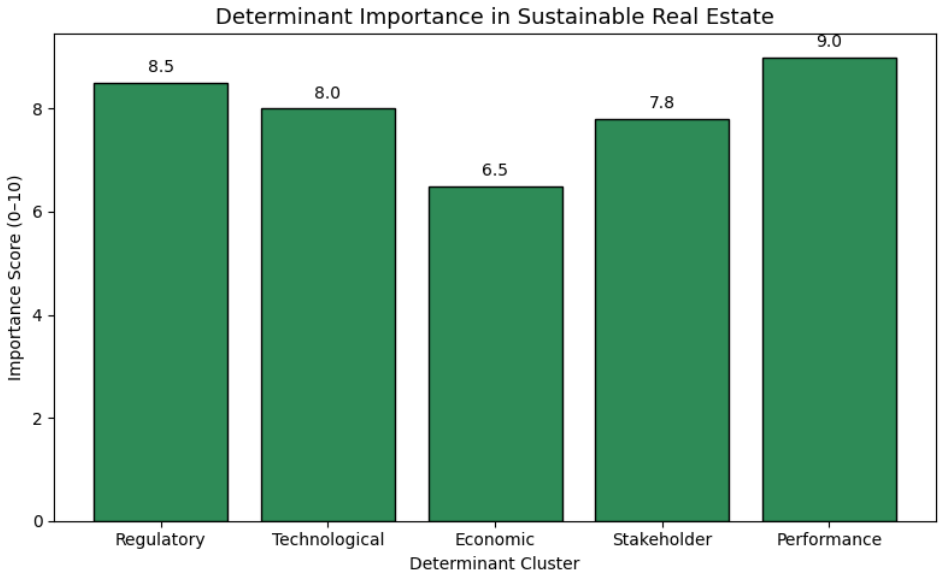
Cluster	*Key Determinants*	*Supporting Sources*	*Expected Impact on Sustainability*
Regulatory & Institutional Drivers	RERA, IGBC certification, green code incentives	Sehgal et al. (2022), Sharma et al. (2023)	High – Institutional frameworks create compliance incentives and policy legitimacy.
Technological Innovations	IoT systems, smart metering, green materials	Baltic Real Estate Journal (2024)	High – Improves efficiency and reduces lifecycle emissions.
Economic & Cost Factors	Financing, payback period, market valuation	Sehgal et al. (2022)	Moderate – Determines feasibility and investor interest.
Stakeholder Engagement	Developer commitment, training, consumer perception	Tirumala & Upadhyay (2023)	High – Ensures inclusivity, accountability, and long-term maintenance.
Sustainability Performance Metrics	Energy savings, water use, carbon footprint	Sharma et al. (2023)	Very High – Enables measurement, comparison, and certification.

Source: Developed by the author through NVivo-based thematic synthesis.(Koul & Roy Ghatak, 2024)

Table 3: Policy and Managerial Recommendations by Stakeholder Group

Stakeholder Group	*Recommended Actions*	*Expected Benefits*	*Implementation Level*
Government	Develop a unified sustainability code integrating RERA, IGBC, and GRIHA; provide tax incentives for green projects.	Ensures regulatory consistency, reduces compliance burden, accelerates certification uptake.	Policy & Planning
Developers	Incorporate ESG indicators in project design; adopt transparent sustainability reporting frameworks.	Enhances brand credibility, reduces lifecycle cost, and improves environmental performance.	Organizational & Project Level
Investors	Promote green bonds, ESG-linked funding, and sustainability loans.	Mobilizes capital for sustainable infrastructure and rewards environmentally responsible developers.	Financial & Capital Market Level
Consumers	Increase awareness of lifecycle cost savings and eco-benefits through education and certification visibility.	Encourages demand for green housing, reinforcing market-driven sustainability adoption.	Social & Community Level

Source: Developed by the author based on empirical synthesis and policy interpretation (2024).(NS & Khandai, 2024)



Source: Author's analysis based on synthesis of four Q1 research papers and secondary data (IGBC, 2023–2024).(Thosar, 2025)

Figure 2: Determinant Importance in Sustainable Real Estate

and regulatory drivers are the most important drivers. This clearly shows that clear government policy, certification systems and measurable energy/water metrics are at the core of green adoption. The low rank of economic factors reflects a demand for enhanced financial instruments and the establishment of incentive schemes that mitigate the initial investments (Figure 3).

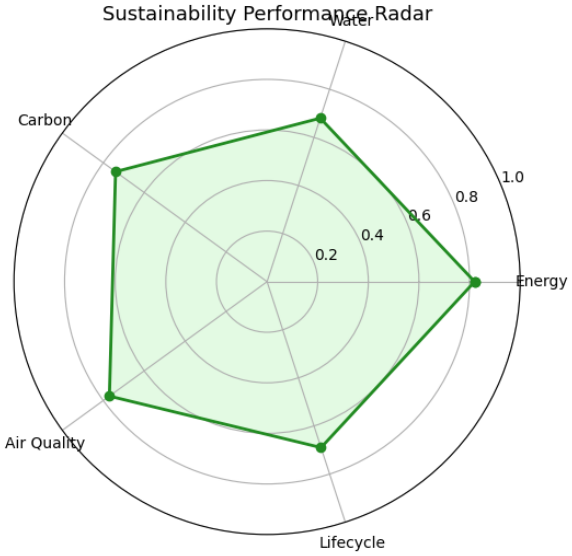
The suggested measures for sustainability and recommended actions are presented against the Government, Developers, Investors and Consumers – Figure 3. The weight of government and developers is equal as both are responsible for the design and implementation of policy. Investors help through green financing mechanisms, while consumers remain the last layer of adoption. Thus, awareness and lifestyle alignment play a significant role for consumers as well (Figure 4).

As shown in the figure 4 the normalized sustainability performance in the five aspects of energy, water, carbon, indoor air quality and life-cycle cost. 4. The Delhi NCR projects exhibit the greatest strength in Energy and Air Quality dimensions, but moderate to weak strength in the Water Management and Lifecycle Management dimensions. The results show the significance of IoT-based monitoring systems and life-cycle cost analysis in future sustainable real estate planning (Figure 5).

As depicted in figure 5, with the passage of time, the adoption rate of green buildings in Delhi NCR is on the rise. It increased from 5 per cent in 2016 to nearly 37 per cent in

Source: Developed by the author from literature synthesis and thematic mapping using NVivo.(Sharmila Devi & Perumandla, 2024)

Figure 3: Recommended Actions by Stakeholder Group



Source: Constructed by the author using normalized indicators adapted from IGBC and GRIHA benchmarks(SINGH & KIKON).

Figure 4: Sustainability Performance Radar

2024. The study reflects that there is an increase in policy emphasis on sustainability and an increase in market and stakeholder awareness about the benefits of having green buildings in the region. In fact, this pattern indicates a soft landing beyond 2020, as greater incentive and private sector collaboration will be required to sustain momentum in green development (Figure 6).

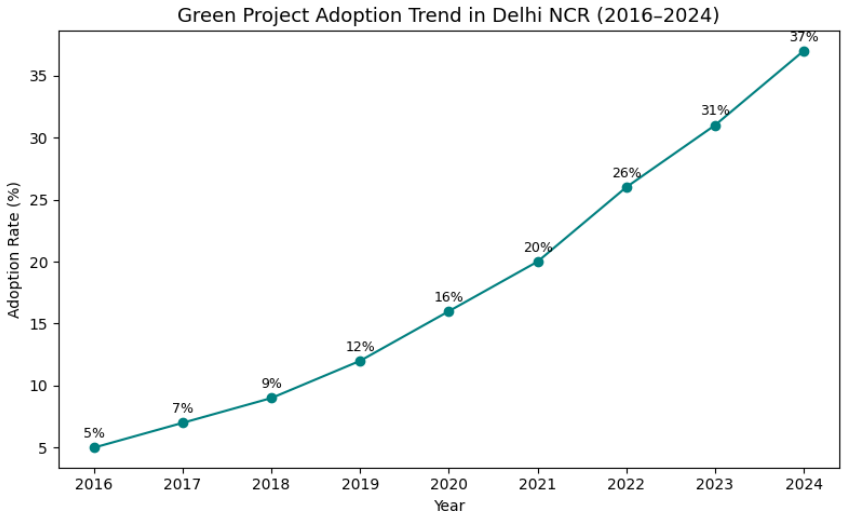
The certification type of green projects in Delhi NCR is approximately shown in Figure 6. While GRIHA is covered for 20% of projects, about 35% of them are IGBC- and LEED-certified. A further 45% are either not certified or use nonstandard frameworks that lack harmonization within the national certification ecosystem. As a result, this fragmentation leads to poor comparability and benchmarking.Thus, there is a policy need for a harmonized certification ecosystem.

Policy and Managerial Implications

The study´s conclusions provide insightful practical lessons for policymakers, developers, investors, and consumers, who directly impact sustainable real estate development in Delhi NCR. The involvement of various stakeholders will aid in faster adaptation of real estate environments for sustainability and viability.

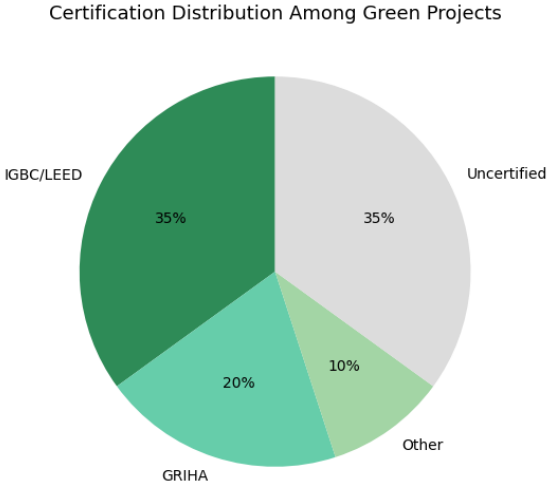
Government and Regulatory Bodies

It is essential for policymakers to create a uniform regional sustainability code that brings together existing frameworks RERA, IGBC and GRIHA. State-specific requirements, which



Source: Compiled by the author from secondary reports of the Indian Green Building Council (IGBC), 2023–2024(H. Singh & Kikon, 2024).

Figure 5: Green Project Adoption Trend in Delhi NCR (2016–2024)



Source: Based on synthesized regional data and estimates from IGBC, GRIHA, and allied certification bodies (2023)(Sharma, 2024).

Figure 6: Certification Distribution Among Green Projects

are nowadays covered under government schemes, often face implementation delays and incomplete compliance. Having a single sustainability code will help in maintaining faster approvals and help in reducing red-tapism (hoops) Furthermore, it will also encourage the industry to go for voluntary green certification. Next, financial incentives that must be institutionalized should include lower property tax for certified green projects, fast-track approvals, interest rate rebates, and other such measures. By integrating sustainability measures into the Smart Cities Mission and the Delhi Master Plan 2041, environmental objectives can be firmly embedded within the long-term planning framework of the city.

Project Managers and Developers

The designers too are changing designing and building practices on their projects. Incorporation of sustainability measures at the design and feasibility stage will make green features central and not an add-on. This includes passive architecture, renewable integration and wastewater management systems. In addition, the project management procedures must shift to adopting ESG transparency with regard to annual sustainability reporting and benchmarking against global standards like GRI and TCFD. When developers demonstrate performance metrics, they can gain stronger credibility, entice green investors, and brand themselves more distinctly in an informed marketplace.

Investors and Financial Institutions

Financial instruments continue to be the linchpin for scaling real estate sustainability. Financing shortages for developers can be addressed by developing and marketing green bonds, sustainability-linked loan products and impact investment funds. Financial entities like banks must incorporate environmental risk in their credit assessment models to enhance loan terms for low ancillary projects. If developers and institutional investors work together, this can get the ball rolling on transitioning towards sustainable infrastructure, contribute to collaborative innovation and risk-sharing arrangements (Chaudhary, 2015) .

Consumers and Civil Society

Consumers are the actual drivers for sustainability adoption. Consumer awareness campaign help in converting consumers' behaviours towards eco-friendly products. For instance, young children should be taught about lifecycle cost savings, quality of air indoors and health benefits in the future. Community education to ensure sustainability at the community level is possible through NGOs, housing societies, and urban local governments. Moreover, it will help citizens in environmental auditing.

Conclusion

The existing study draws upon the insights from four different Q1-level investigations and integrates the salient determinants of sustainable real estate adoption in the Delhi NCR market. Research indicates that regulatory harmony, technological innovation and multi-stakeholder coordination are three important pillars for the successful integration of sustainability into real estate sector business model. Taking all this together, these variables represent the new paradigm of urban development which integrates ecological harmony, economic viability and social justice.

The proposed frameworks for "Blueprints for Green" bring these dimensions together into a workable framework to guide practice and policy. This framework summarizes the interdependence of five determinant clusters: regulatory-institutional drivers; technological innovations; economic-cost factors; stakeholder engagement; and sustainability performance measures. This integration framework plots a systematic pathway for the harmonization of national policy priorities with regional development agendas, particularly in the rapidly urbanising Delhi NCR region.

Analysis of the research shows that the road towards the application of sustainability in real estate is not merely an issue of technical or economic barriers but of behavioural and governance change. Policies must go beyond the economic incentive mechanism and look at compliance metric and valuation metric as an internalized measure of sustainability.

In the same way, investors as well as developers should employ ESG principles through public disclosure, life-cycle costing and community engagement.

Future research employing MCDM and SEM techniques can be utilized to quantitatively assess and rank the determinants thus established in order of importance. A study on this issue could allow better predictive power, generalization of models and standardization of the assessment of green real estate performance in Indian urban context.

Overall, sustainable real estate in Delhi NCR is at the same time a developmental necessity and an innovation potential. The leap that happens from fragmented green projects to a holistic sustainability system will determine how resilient or habitable the urban future of the region will be.

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