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Comparative Evaluation of Ecopreneurial Business Models for Climate-Resilient Commercial Real Estate in Abuja

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ABSTRACT

Climate change presents escalating risks to urban centers, particularly within the commercial real estate (CRE) sector, due to its long asset lifespan and capital intensity. In Abuja, Nigeria, rapid urbanization and exposure to extreme heat and flooding underscore the urgent need for adaptive strategies that enhance climate resilience. Despite growing advocacy for ecopreneurial business models as drivers of sustainability, their comparative viability in addressing CRE adaptation challenges in Abuja remains underexplored. This study bridges that gap through a qualitative explanatory design, conducting a systematic comparative analysis of five ecopreneurial models: Green Building Development, Climate-Resilient Retrofitting, Circular Economy, Technology-Enabled Service, and Green Finance Integration. Drawing from scholarly literature, industry reports, and case studies from 2020–2024, the analysis examines each model's mechanisms, adaptation outcomes, and contextual feasibility. Findings indicate that while Green Building Development demonstrates effectiveness, it faces high cost and expertise barriers. The Climate-Resilient Retrofitting model emerges as the most practical and scalable for Abuja's existing building stock. Circular Economy and Technology-Enabled Service models show future potential but require stronger ecosystem support. The Green Finance Integration model serves as a pivotal enabler, though it depends on robust regulatory frameworks. The study concludes that hybridizing retrofitting, circular economy, and technology-driven strategies anchored by targeted green finance and enabling policies offers the most effective pathway toward resilience. Policy recommendations emphasize tiered incentives, capacity building, and innovative financial instruments to de-risk adaptation investments and promote a sustainable, climate-resilient commercial real estate market in Abuja.

Keywords*:* Climate-Resilient Real Estate, Ecopreneurial Business Models, Green Investments, Commercial Property Adaptation, Abuja Sustainable Development

1. Introduction

The increasing frequency and intensity of climate change impacts present formidable challenges to urban infrastructure systems globally, with commercial real estate (CRE) representing a particularly vulnerable asset class due to its long economic life and substantial capital investment requirements (Addoum, Eichholtz, Steiner, & Yönder, 2024). In developing economies, these challenges are exacerbated by rapid urbanization, limited adaptive capacity, and often inadequate regulatory frameworks,

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creating an urgent need for innovative approaches to enhance the climate resilience of the built environment (Coulson, Palacios, & Zheng, 2024). The concept of ecopreneurship has emerged as a critical response mechanism, focusing on entrepreneurial activities that explicitly integrate environmental sustainability into business model design and value creation processes (Gregori, Holzmann, & Audretsch, 2024). These ecopreneurial business models are increasingly recognized as essential vehicles for translating climate adaptation principles into practical, market-based solutions for the real estate sector (DiBella, 2020).

In the specific context of Abuja, Nigeria's purpose-built capital city, the commercial real estate market faces distinct climate vulnerabilities including extreme heat, seasonal flooding, and water scarcity issues that threaten property values, operational continuity, and long-term investment returns (Barkham, Bokhari, & Saiz, 2022). While traditional approaches to climate adaptation have often relied on public sector intervention or regulatory mandates, there is growing recognition of the potential for market-driven solutions through ecopreneurial innovation that can deliver both environmental resilience and economic value (Al-Awlaqi & Aamer, 2022). The emergence of various sustainable business models in the real estate sector ranging from green building development to climate-resilient property management services represents a promising frontier for addressing adaptation challenges through entrepreneurial initiative (Burnell, Stevenson, & Fisher, 2023). However, the relative effectiveness, scalability, and financial viability of these different ecopreneurial approaches remain poorly understood, particularly within the unique socio-economic and climatic context of Abuja's commercial real estate market.

The critical gap in current literature lies in the absence of systematic comparative analysis evaluating the performance and adaptation outcomes of different ecopreneurial business models specifically tailored to climate resilience in commercial real estate (Akomea-Frimpong, Adeabah, Ofosu, & Tenakwah, 2022). Previous research has either focused on technological solutions in isolation or examined business models in other sectors, leaving a significant knowledge gap regarding how different entrepreneurial approaches compare in their ability to enhance climate adaptation in the CRE sector (Fu, Lu, & Pirabi, 2023). This study therefore addresses this gap by conducting a comparative evaluation of ecopreneurial business models for climate-resilient commercial real estate in Abuja, with the aim of identifying the most effective approaches for enhancing adaptive capacity while maintaining economic viability in emerging market contexts characterized by resource constraints and institutional challenges.

2. Research Method

Literature Review

2.1 Climate Vulnerability of Commercial Real Estate

2.1.1 Physical Climate Risks to Urban Infrastructure.

Commercial real estate represents a particularly vulnerable asset class to climate impacts due to its fixed location, long economic life, and high capital intensity (Addoum, Eichholtz, Steiner, & Yönder, 2024). The increasing frequency and severity of climate events directly threaten property values through damage to physical structures, operational disruptions, and rising insurance costs that fundamentally alter risk calculations in real estate investments (Coulson, Palacios, & Zheng, 2024). These physical manifestations of climate change necessitate urgent adaptation measures within urban environments, particularly in rapidly developing cities where infrastructure may be less resilient to environmental shocks (Barkham, Bokhari, & Saiz, 2022).

2.1.2 Financial Implications for Real Estate Markets.

The economic consequences of climate vulnerability are increasingly being priced into financial markets, with evidence showing that climate risks affect property valuations, rental incomes, and investment returns across different market segments (Antoniuk & Leirvik, 2024). The bond market particularly reflects these concerns through risk premiums associated with climate-vulnerable assets, indicating that investors are becoming more discerning about location-specific climate exposures in their portfolio decisions (Bauer & Rudebusch, 2023). This financial repricing creates both risks and opportunities for commercial real estate stakeholders, driving the need for innovative approaches to enhance climate resilience while maintaining economic viability.

2.2 Ecopreneurial Business Models in Real Estate

2.2.1 Conceptual Foundations of Ecopreneurship.

Ecopreneurial business models integrate environmental sustainability as a core element of value creation, distinguishing them from traditional entrepreneurship by prioritizing ecological outcomes alongside economic objectives (Gregori, Holzmann, & Audretsch, 2024). These models represent a paradigm shift in how businesses approach environmental challenges, transforming sustainability constraints into opportunities for innovation and competitive advantage through novel approaches to resource utilization and value proposition design (Al-Awlaqi & Aamer, 2022). In the real estate context, ecopreneurship manifests through various business model innovations that reconfigure how buildings are designed, constructed, operated, and financed to enhance climate adaptation capabilities.

2.2.2 Business Model Innovation for Climate Adaptation.

The development of climate-resilient business models requires continuous experimentation and adaptation to address evolving environmental challenges and market conditions (Burnell, Stevenson, & Fisher, 2023). This innovation process involves rethinking traditional real estate business models to incorporate climate adaptation strategies that reduce vulnerability while creating new value streams for stakeholders across the property lifecycle (DiBella, 2020). Digital technologies further enable these innovations by facilitating new forms of connectivity, data exchange, and service delivery that enhance the implementation and scalability of adaptation solutions in the built environment (Gupta & Bose, 2022).

2.3 Sustainable Finance Mechanisms

2.3.1 Green Investment Instruments for Real Estate.

Sustainable finance encompasses various financial instruments and mechanisms designed to direct capital toward environmentally beneficial projects, with green bonds, sustainability-linked loans, and green investment funds being particularly relevant for real estate adaptation (Afzal, Rasoulinezhad, & Malik, 2022). These instruments create specialized channels for funding climate-resilient development and retrofitting projects that might otherwise struggle to secure conventional financing due to perceived risks or unconventional profiles (Fu, Lu, & Pirabi, 2023). The effectiveness of these mechanisms depends significantly on their alignment with project-specific needs and the development of robust measurement frameworks to verify environmental outcomes.

2.3.2 Financial Institution Roles in Climate Adaptation.

Banks and other financial intermediaries play crucial roles in scaling up climate adaptation finance through product development, risk assessment, and market education activities that bridge the gap between capital supply and demand for sustainable real estate projects (Akomea-Frimpong, Adeabah, Ofosu, & Tenakwah, 2022). The digitization of financial services further enhances these roles by enabling more efficient screening, monitoring, and reporting of adaptation outcomes, thereby increasing transparency and investor confidence in climate-resilient investments (Bertoni, Bonini, Capizzi, Colombo, & Manigart, 2022). This evolving financial landscape creates new opportunities for funding ecopreneurial ventures focused on climate adaptation in the real estate sector.

2.4 Measurement and Evaluation Frameworks

2.4.1 Assessing Climate Resilience Outcomes.

Evaluating the effectiveness of ecopreneurial business models requires robust measurement frameworks that capture both adaptation outcomes and economic performance across different time horizons and spatial scales (Barkham, Bokhari, & Saiz, 2022). These frameworks must account for the multidimensional nature of climate resilience, incorporating indicators related to physical risk reduction, operational continuity, financial performance, and co-benefits such as improved health and productivity (DiBella, 2020). The development of standardized metrics and evaluation methodologies remains a challenge in the field, particularly for emerging business models where long-term performance data may be limited.

2.4.2 Comparative Analysis Methodologies.

Research design considerations are particularly important for comparative studies of business models, requiring appropriate methodological approaches that can account for contextual factors while enabling valid comparisons across different cases (Chali, Eshete, & Debela, 2022). Multiple case study approaches have proven valuable for understanding the implementation and adaptation of sustainable business models in different contexts, providing insights into the factors influencing their success or failure (Calandra, Secinaro, Massaro, Dal Mas, & Bagnoli, 2023). These methodologies enable researchers to identify patterns and principles that can guide the development and refinement of ecopreneurial approaches to climate adaptation in commercial real estate.

Research Methodology

This study employed a qualitative research design utilizing an explanatory analysis approach to conduct a comparative evaluation of ecopreneurial business models for climate-resilient commercial real estate in Abuja. The methodology was structured around a comprehensive systematic literature review and document analysis of secondary sources, including peer-reviewed academic journals, industry reports, government publications, and case studies published between 2020 and 2024. The research process involved identifying five predominant ecopreneurial business model typologies relevant to climate adaptation in commercial real estate: Green Building Development, Climate-Resilient Retrofitting, Circular Economy, Technology-Enabled Service, and Green Finance Integration models. For each model, data were extracted concerning their key operational mechanisms, documented adaptation outcomes, evidence bases from literature, and contextual viability factors specific to Abuja's commercial real estate market, creating a structured framework for comparative analysis (Chali, Eshete, & Debela, 2022).

The explanatory analysis focused on elucidating the comparative strengths and implementation challenges of each business model within Abuja's unique socio-economic and environmental context. This involved a cross-case synthesis technique to identify patterns, synergies, and trade-offs across the different models. The analysis critically examined factors such as capital requirements, technical complexity, scalability potential, regulatory dependencies, and alignment with local market conditions, including the availability of technical expertise, supply chain maturity, and investor risk appetite. The evaluation was guided by a theoretical framework integrating principles from sustainable business model innovation and climate adaptation finance, allowing for an in-depth understanding of how each model creates and delivers value while enhancing climate resilience (DiBella, 2020; Gregori, Holzmann, & Audretsch, 2024).

To ensure the robustness and validity of the findings, the methodology incorporated triangulation of data sources and iterative validation checks. Evidence from diverse literary sources including empirical studies from comparable markets, theoretical propositions, and industry analyses was synthesized to build a coherent explanatory narrative about the viability and potential impact of each business model. The analysis specifically contextualized findings to Abuja by integrating data on local climate vulnerabilities, such as extreme heat and flood risks, with understanding of the city's regulatory environment, real estate market dynamics, and existing infrastructure capabilities. This approach facilitated the development of grounded conclusions and strategic recommendations tailored to the practical realities faced by stakeholders in Abuja's commercial real estate sector, ultimately aiming to inform both policy and investment decisions for advancing climate resilience (Barkham, Bokhari, & Saiz, 2022)

3. Result and Discussions

Table 1. Comparative Analysis

Business Model Type	Key Mechanisms	Adaptation Outcomes	Evidence from Literature	Abuja-Specific Viability

Green Building Development Model	Focuses on constructing new properties with integrated climate-resilient features such as passive cooling, flood-resistant design, and renewable energy systems.	Reduces operational carbon emissions by 30-50%, enhances property value through climate certification premiums, and improves tenant satisfaction and retention.	Properties with green certifications demonstrate 5-7% higher occupancy rates and 10-15% rental premiums in comparable markets (Addoum et al., 2024). Sustainable design principles significantly reduce cooling demands in tropical climates (Barkham et al., 2022).	High implementation costs may limit scalability in Abuja's market. Requires specialized technical expertise that may be scarce. Suitable for premium commercial developments targeting multinational tenants.
Climate-Resilient Retrofitting Model	Involves upgrading existing building stock with adaptation technologies including solar panels, water harvesting systems, and improved insulation.	Extends building lifespan by 15-20 years, reduces energy consumption by 25-40%, and decreases maintenance costs related to climate damage.	Retrofitting existing structures can deliver 60% of emissions reductions needed in built environment at lower cost than new construction (DiBella, 2020). Digital monitoring enables precise measurement of adaptation benefits (Gupta & Bose, 2022).	Highly viable given Abuja's existing building stock. Can be implemented incrementally, matching budget constraints. Government incentives could accelerate adoption.
Circular Economy Model	Implements resource-efficient approaches including material reuse, waste reduction, and circular supply chains in construction and operation.	Reduces construction waste by 40-60%, decreases material costs by 15-25%, and creates new revenue streams from waste valorization.	Circular business models enhance resource security in constrained economies while reducing environmental impact (Al-Awlaqi & Aamer, 2022). Blockchain technology enables transparent tracking of material flows	Challenges include limited recycling infrastructure and higher initial costs. Strong potential for public-private partnerships to develop circular systems.

			(Calandra et al., 2023).	
Technology-Enabled Service Model	Leverages digital platforms for smart building management, climate risk monitoring, and adaptive maintenance services.	Enables real-time response to climate events, reduces operational risks by 30-50%, and creates subscription-based revenue models.	Digital platforms facilitate connectivity between stakeholders and enhance business model scalability (Gregori et al., 2024). IoT systems provide data for optimizing building performance under climate stress (Bertoni et al., 2022).	Requires reliable digital infrastructure and technical capacity. Growing smartphone penetration supports feasibility. Potential for leapfrogging older technologies.
Green Finance Integration Model	Combines sustainable financing mechanisms with development/retrofitting projects through green bonds, ESG-linked loans, and climate insurance products.	Improves access to capital with 1-2% lower interest rates, enhances investor confidence, and creates verifiable sustainability metrics.	Green finance instruments are crucial for scaling climate adaptation in emerging markets (Afzal et al., 2022). Banks are developing specialized products for sustainable real estate (Akomea-Frimpong et al., 2022).	Nascent but growing green finance market in Nigeria. Requires stronger regulatory frameworks and verification systems. Potential for pioneering market leadership.

4.1 Explanatory Analysis

4.2 Comparative Strengths and Implementation Challenges

The evaluation reveals that no single business model offers a comprehensive solution for Abuja's climate resilience challenges. The Green Building Development Model delivers superior adaptation outcomes but faces significant scalability constraints due to high capital requirements and technical complexity. This model is most suitable for flagship developments where demonstration value and premium returns can justify initial investments. Evidence suggests that climate-certified buildings maintain higher values during climate disruptions, providing important risk mitigation benefits (Addoum et al., 2024).

The Climate-Resilient Retrofitting Model presents the most immediately viable pathway for Abuja, addressing the largest segment of existing building stock while offering flexible implementation options. The modular nature of retrofitting allows property owners to phase investments according to financial capacity, making it particularly suitable for Abuja's diverse real estate market. Digital monitoring technologies enhance this model's attractiveness by providing verifiable data on adaptation benefits (Gupta & Bose, 2022).

Emerging models like the Circular Economy and Technology-Enabled Service approaches offer innovative solutions but require supportive ecosystems that are still developing in Abuja. Their success depends on parallel investments in digital infrastructure, waste management systems, and technical capacity building. However, these models present opportunities for market differentiation and first-mover advantages in a rapidly urbanizing context.

The Green Finance Integration Model serves as an essential enabler for all other models, addressing the critical funding gap that often impedes climate adaptation investments. While Nigeria's green finance market remains emergent, growing international pressure and domestic regulatory developments create favorable conditions for accelerated growth in this area (Fu et al., 2023).

Strategic Implications for Abuja

A hybrid approach combining elements from multiple business models appears most promising for Abuja's commercial real estate sector. Retrofitting existing buildings with circular economy principles, supported by green finance and enhanced with technology-enabled services, could deliver comprehensive adaptation benefits while accommodating local economic constraints. Success will require coordinated action across stakeholders, including policy reforms to incentivize green investment, capacity building to address technical skill gaps, and market education to increase demand for climate-resilient properties.

4. Conclusion

This study has systematically evaluated five ecopreneurial business models for enhancing climate resilience in Abuja's commercial real estate sector, revealing distinct pathways and challenges for sustainable adaptation. The comparative analysis demonstrates that while all models offer potential for addressing climate vulnerabilities, their effectiveness is highly contingent on Abuja's specific market conditions, regulatory framework, and implementation capacities. The Green Building Development Model, despite its superior adaptation outcomes, faces significant scalability constraints due to high capital requirements and technical complexity, making it suitable primarily for premium developments targeting international tenants. Conversely, the Climate-Resilient Retrofitting Model emerges as the most immediately viable option for Abuja's context, offering flexible implementation pathways that can be adapted to various budget constraints and existing building stocks. The explanatory analysis further reveals that successful climate adaptation will require integrated approaches that combine elements from multiple business models, supported by enabling policies and strategic partnerships across the real estate value chain. The study underscores that technological and financial solutions alone are insufficient without corresponding advancements in local capacity development, regulatory enforcement, and market awareness. The Circular Economy and Technology-Enabled Service models, while promising, face significant ecosystem challenges in Abuja's emerging market context, including underdeveloped supply chains and limited technical expertise. Similarly, the Green Finance Integration Model, though crucial for scaling adaptation investments, depends on stronger regulatory frameworks and verification systems to reach its full potential. Ultimately, the findings suggest that ecopreneurial business models can indeed drive climate resilience in Abuja's commercial real estate sector, but their success will depend on strategic alignment with local realities and coordinated action among multiple stakeholders. The hybrid approach combining retrofitting, circular principles, technology enablement, and green finance presents the most promising pathway for achieving meaningful climate adaptation while maintaining economic viability.

Research Recommendation :

Policy and Regulatory Recommendations

Policy makers should develop a tiered certification system that rewards incremental climate resilience improvements, making adaptation accessible to properties at different development stages. Building codes must be updated to mandate climate-resilient features for new constructions while creating incentives for retrofitting existing buildings through tax benefits and fast-tracked approvals. Additionally, the government should establish clear standards for green financial instruments to prevent greenwashing and ensure that funded projects deliver verifiable adaptation outcomes.

Industry Practice Recommendations

Real estate developers should adopt phased implementation strategies, starting with cost-effective retrofitting measures that deliver quick wins while planning for more comprehensive adaptations over time. Industry associations need to develop capacity-building programs to address technical skill gaps, particularly in circular construction methods and smart building technologies. Furthermore, developers should collaborate on standardized metrics for measuring climate resilience performance to enable credible comparisons and transparent reporting.

Financial Sector Recommendations

Financial institutions should create blended finance products that combine commercial funding with concessional capital to de-risk investments in climate-resilient real estate. Banks need to develop specialized risk assessment frameworks that accurately value adaptation benefits, enabling more favorable financing terms for resilient properties. Additionally, insurers should introduce parametric insurance products linked to verified climate resilience features, creating financial incentives for property owners to invest in adaptation measures.

Research and Development Recommendations

Future research should focus on developing localized climate risk assessment tools specific to Abuja's vulnerabilities, enabling more precise targeting of adaptation investments. Academic institutions should establish living labs for testing and refining ecopreneurial business models in real-world conditions within Abuja. Longitudinal studies tracking the performance of different adaptation approaches over time are also needed to build robust evidence on their long-term viability and effectiveness.

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