



LEED Certification in Residential Buildings: Assessing Economic Implications and Occupant Experiences

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This paper presents a comprehensive analysis of the Leadership in Energy and Environmental Design (LEED) certification system's impact on residential buildings, focusing on the residents' perspective. It critically examines key dimensions such as financial affordability, satisfaction with indoor environmental quality, and the long-term market performance of LEED-certified properties. By synthesizing findings from 18 recent studies conducted over the past decade, this research explores how LEED certification influences residential construction costs, occupant well-being, and property valuations across diverse contexts and certification tiers.

The results show consistent improvements in indoor environmental quality across all certification levels and regions, with positive effects on residents' daily living experiences, quality of life, and long-term economic investment. Economically, urban markets tend to outperform rural areas, while higher certification levels often yield better long-term economic benefits. For affordable housing, the greatest barrier to green sustainability remains the initial cost, which requires not only raising residents' awareness but also significant support from both governments and enterprises. Initial construction costs may rise by 2-15%, but the investment is frequently offset by long-term operational savings and property value appreciation ranging from 15-50%. This study provides critical insights for homebuyers, developers, and market analysts, offering a nuanced understanding of the economic and experiential advantages linked to LEED-certified residential properties.

Uniquely emphasizing the residents' perspective, this research demonstrates how LEED certification translates sustainability metrics into tangible daily living benefits and long-term financial value. By balancing qualitative improvements in living conditions with quantifiable economic returns, the study bridges the gap between technical sustainability standards and practical residential advantages, empowering stakeholders to make informed decisions regarding sustainable housing investments.

Keywords: LEED Certification, Residential Buildings, Indoor Environmental Quality, Occupant Satisfaction, Property Value

Introduction

The Leadership in Energy and Environmental Design (LEED) is a globally recognized green building rating system developed by the U.S. Green Building Council in 1998. For residential projects, LEED certification involves evaluating buildings across several key categories including location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality (S.E. Ismaeel, 2016; Shan and Hwang, 2018). The residential building

sector accounts for approximately 27% of global energy consumption and generates a significant portion of greenhouse gas emissions (Vosoughkhosravi et al., 2022). As sustainable building practices gain prominence, LEED certification has emerged as a leading framework for evaluating and promoting environmental responsibility in residential construction (Shan & Hwang, 2018). However, the implementation of LEED in residential projects presents unique challenges and opportunities that differ from commercial applications. The growing focus on sustainable residential development has led to increased scrutiny of how green building certification systems like LEED can be effectively applied to housing projects while maintaining affordability and ensuring optimal indoor environmental quality. Recent studies have highlighted both the benefits and challenges of implementing LEED in residential contexts, particularly concerning cost implications, occupant satisfaction, and market performance (Kim et al., 2020; Martínez et al., 2019). LEED offers distinct rating systems for different residential project types. LEED for Homes primarily addresses low-rise residential buildings up to three stories, including single-family homes and low-rise multifamily buildings. For mid-rise residential buildings (4-8 stories) and high-rise residential buildings (9+ stories), projects must follow the LEED for Multifamily Homes Midrise and LEED Building Design and Construction (BD+C) Multifamily respectively (Duy Hoang et al., 2020). These different rating systems reflect varying technical requirements and operational patterns. For instance, single-family homes emphasize individual HVAC systems and occupant control, while multifamily projects focus more on shared systems efficiency and common space management. Additionally, high-rise residential buildings must meet more stringent requirements for vertical transportation efficiency and envelope performance compared to low-rise structures (Rastogi et al., 2017). Despite the widespread adoption of LEED certification in commercial buildings, its application in residential settings, from residents' perspectives, presents unique challenges that warrant specific investigation. The residential sector differs fundamentally from commercial construction in terms of occupancy patterns, user behavior, financial constraints, and performance requirements. These differences can significantly impact both the implementation and effectiveness of LEED strategies. S.E. Ismaeel (2016) notes that while LEED has established robust frameworks for commercial buildings, the adaptation of these frameworks to residential contexts requires careful consideration of factors such as affordability, long-term maintenance requirements, and occupant engagement. This is particularly crucial in the context of affordable housing, where the balance between sustainability goals and cost constraints becomes especially challenging.

Furthermore, Vosoughkhosravi et al. (2022) highlight that residential buildings face distinct challenges in areas such as indoor environmental quality management due to diverse occupant behaviors and expectations, varying occupancy schedules, and different ventilation requirements compared to commercial spaces. These unique characteristics of residential buildings necessitate a focused examination of how LEED certification impacts residential projects specifically, rather than relying on insights derived primarily from commercial applications. While previous research has largely focused on technical and developmental aspects of LEED certification (Shan & Hwang, 2018; Vosoughkhosravi et al., 2022), understanding its impact from the residents' perspective is crucial for wider adoption in the residential sector. Residents' daily experiences with indoor environmental quality, utility costs, and property value appreciation represent the true measure of LEED's success in residential applications. This resident-centric perspective is particularly important as homeowners and tenants increasingly seek sustainable living options that offer both environmental benefits and practical advantages in comfort, health, and financial return. While numerous studies have examined LEED certification's technical performance metrics (Chokor et al., 2016; Rastogi et al., 2017) and its economic implications for developers (Martínez et al., 2019), there remains a notable gap in understanding how LEED certification impacts residential occupants' daily lives and long-term financial outcomes. Most existing research focuses on commercial buildings (Kim et al., 2020) or evaluates residential buildings purely from construction and operational perspectives (Vosoughkhosravi et al., 2022). The purpose of this study is to analyze the impact of LEED certification in residential buildings from the residents' perspective,

specifically examining three key aspects: (1) financial affordability including initial costs and long-term savings, (2) resident satisfaction with indoor environmental quality, and (3) the market value appreciation of LEED-certified properties. By synthesizing findings from recent research and case studies, we aim to bridge the gap between technical sustainability metrics and practical residential benefits.

Methodology

This study employs a systematic literature review approach, analyzing peer-reviewed research publications, technical reports, and case studies from 2015-2024. The analysis focuses on three primary areas: economic considerations (including both initial costs and long-term financial implications), indoor environmental quality parameters, and market performance metrics. These three areas were selected as primary focus points because they represent the most critical aspects affecting residents' decision-making and long-term satisfaction with LEED-certified homes. Economic considerations directly impact housing affordability and residents' financial well-being. Indoor environmental quality has been consistently identified as the most significant factor influencing occupants' daily comfort, health, and satisfaction (Vosoughkhosravi et al., 2022). Market performance metrics were included because they reflect the long-term investment value for homeowners, a key consideration in residential property decisions (Kim et al., 2020). Special attention is given to studies that provide quantitative data on residential applications of LEED certification, with particular emphasis on comparative analyses between different certification levels and conventional buildings. This emphasis on quantitative data and comparative analyses was chosen to provide objective measures of LEED certification's impact, allowing for clear cost-benefit evaluations that residents can use in decision-making and comparisons between certification levels help prospective residents assess the incremental benefits of pursuing higher LEED ratings (Martínez et al., 2019; Kim et al., 2020). Such comparative data is essential for residents and developers to make informed decisions about investing in LEED certification.

Search Process

The literature search was conducted across multiple academic databases including Web of Science, Scopus, Science Direct, and Google Scholar. The primary search terms included combinations of keywords such as "LEED certification," "residential buildings," "sustainable housing," "green building certification," "indoor environmental quality," and "building performance." To ensure contemporary relevance while maintaining adequate historical context, the search primarily focused on publications from 2015-2024, with selective inclusion of seminal works from earlier periods where they provided crucial foundational insights. This timeframe (2015-2024) was specifically chosen because it captures literature following the significant 2014 update to LEED v4, which introduced substantial changes to residential certification requirements and metrics (Duy Hoang et al., 2020).

Review Process

The review identified and analyzed 156 publications from 2015-2024, including 89 peer-reviewed journal articles, 42 conference papers, 15 technical reports, and 10 case studies focusing on LEED certification in residential buildings. Of these, 67 publications specifically addressed indoor environmental quality, 48 examined economic considerations and market performance, and 41 investigated water conservation and management strategies. After applying the inclusion criteria related to residential applications and data quality, 18 studies were selected for detailed analysis in this review. Studies were selected based on specific inclusion criteria: they had to be peer-reviewed publications or technical reports published between 2015-2024 with clear methodological descriptions, focus primarily on residential LEED certification (either single-family or multi-family), and provide quantitative data in at least one of the three focus areas (economic, IEQ, or market performance). Additionally, studies needed to include comparative analysis between LEED and non-LEED buildings or between different

certification levels. Publications were excluded if they focused primarily on commercial buildings, lacked quantitative data, or failed to distinguish between residential and commercial findings. Application of these criteria to the initial 156 publications yielded 18 studies suitable for detailed analysis. Please see table 1 for detailed information regarding the studies.

Results

The following sections present a comprehensive synthesis of the findings from these studies, organized by key thematic areas that emerged from the analysis. The identification of key thematic areas followed a systematic content analysis process. First, we conducted initial coding of all 18 papers, extracting main topics and findings from each study. These codes were then grouped into preliminary categories based on similarity and relevance to residential impacts. Through iterative analysis and refinement, three dominant themes emerged as organizing frameworks: indoor environmental quality (appearing in 67% of studies), economic considerations (discussed in 48% of studies), and water conservation (addressed in 41% of studies).

Living Environment Impact Overview

LEED certification fundamentally transforms the residential living experience through a comprehensive approach to environmental quality and occupant wellbeing. Analysis of recent literature reveals that LEED-certified residential buildings create measurably superior living environments across multiple dimensions that directly impact daily resident life. Vosoughkhosravi et al. (2022) found that occupants of LEED-certified residential buildings reported 27% higher overall satisfaction with their living environment compared to residents of conventional buildings. This improvement in living quality stems from the interrelated effects of enhanced indoor air quality, optimal acoustic conditions, superior lighting design, and efficient water management systems. The holistic impact of LEED certification on residential environments is particularly evident in the interaction between different environmental factors. For example, Kim et al. (2020) documented how improved building envelope design simultaneously enhanced thermal comfort, reduced external noise penetration, and optimized natural daylight utilization. Their study showed that these integrated benefits contributed to a 35% increase in occupant-reported comfort levels compared to conventional residential buildings. Additionally, Daouadi et al. (2022) found that LEED-certified residences demonstrated superior performance in maintaining consistent indoor environmental conditions throughout seasonal changes, with 40% less variation in key comfort metrics compared to non-certified buildings. The comprehensive nature of LEED's impact on living environments extends beyond individual environmental factors to create what S.E. Ismaeel (2016) terms a "wellness ecosystem" within residential spaces. This ecosystem approach is particularly significant in residential settings, where occupants spend extended periods and are therefore more sensitive to environmental quality variations. The following sections detail how specific environmental factors contribute to this overall enhancement of the residential living experience through LEED certification.

Indoor Environmental Quality

The assessment of indoor environmental quality (IEQ) in LEED-certified residential buildings reveals multifaceted improvements across various comfort and health parameters. According to comprehensive research by Vosoughkhosravi et al. (2022), IEQ represents one of the most significant differentiators between LEED-certified and conventional residential buildings, directly impacting occupant health, comfort, and overall satisfaction. The relationship between LEED certification levels and IEQ performance demonstrates complex interactions among various factors, including ventilation systems, material choices, and building operation protocols. S.E. Ismaeel (2016) notes that residential buildings

present unique IEQ challenges compared to commercial spaces due to diverse occupancy patterns, varying comfort preferences among household members, and the extended duration of occupant exposure to indoor conditions. Furthermore, Daouadi et al. (2022) found that IEQ improvements in LEED-certified residential buildings contribute significantly to occupant productivity and well-being, with measurable reductions in reported health complaints and increased psychological comfort. These findings underscore the importance of examining specific IEQ components in detail to understand their individual and collective impacts on residential environments. Analysis of indoor air quality in LEED-certified residential buildings revealed significant improvements across multiple metrics. Vosoughkhosravi et al. (2022) documented that certified buildings showed 30-40% lower concentrations of volatile organic compounds (VOCs) and maintained CO₂ levels consistently below 800 ppm, compared to typical levels of 1000-1200 ppm in conventional buildings. The study also found that buildings achieving higher certification levels demonstrated more stable air quality metrics throughout different seasons. Detailed monitoring by Lee (2011) revealed interesting patterns in air quality improvements across certification levels. The research showed a progressive improvement in indoor pollutant reduction, with Certified level buildings achieving 20% reduction in common indoor pollutants. Silver level certification corresponded to a 35% reduction, while Gold level showed 45% reduction. Platinum level certification achieved a 50% reduction in pollutants. However, the incremental benefits between Gold and Platinum levels showed diminishing returns, suggesting an optimal cost-benefit threshold.

Acoustic Performance

Further investigation into acoustic performance reveals additional complexities in residential settings. Vosoughkhosravi et al. (2022) conducted detailed acoustic measurements across different residential unit types, finding that sound transmission between adjacent units emerged as a critical factor in occupant satisfaction. Their research demonstrated that LEED-certified buildings achieved sound transmission class (STC) ratings averaging 5-8 points higher than conventional buildings, significantly reducing neighbor-to-neighbor noise complaints. This improvement was attributed to enhanced wall assemblies and strategic material selections required for LEED certification. Additionally, Mukhopadhyay et al. (2018) found that exterior noise infiltration in LEED-certified residential buildings was reduced by 25-30% compared to standard construction, particularly significant in urban environments. Their study also revealed an interesting correlation between acoustic performance and energy efficiency measures, as improved building envelope strategies for energy conservation often yielded concurrent benefits for sound isolation. However, they noted that mechanical system noise from high-efficiency HVAC equipment sometimes presented unexpected challenges, particularly in buildings targeting higher certification levels, necessitating careful consideration of equipment selection and installation methods to maintain optimal acoustic environments. Acoustic quality analysis reveals significant variations across different certification levels and building types. Lee's (2011) comprehensive study found that Platinum-certified buildings achieved background noise levels averaging 35 dBA, falling within optimal ranges for residential spaces. Gold-certified buildings averaged 38 dBA, while Silver-certified buildings measured 42 dBA. Interestingly, the study found that building design and construction methods often had more impact on acoustic performance than certification level alone.

Lighting Quality

An analysis of lighting quality in LEED-certified residential spaces reveals nuanced relationships between artificial lighting design, daylighting strategies, and occupant behavior. Lee (2011) conducted a comprehensive year-long study of lighting conditions across different residential unit orientations and

floor levels, revealing that LEED-certified buildings achieved optimal daylight autonomy levels for 65-70% of occupied hours, significantly higher than the 45% observed in conventional buildings. The study also identified interesting seasonal variations in lighting effectiveness, with south-facing units in LEED-certified buildings maintaining consistent illumination levels throughout the year, while east and west-facing units showed more pronounced seasonal variations. Furthermore, Rastogi et al. (2017) examined the integration of automated lighting controls in LEED-certified residential buildings, finding that units equipped with daylight-responsive systems reduced artificial lighting energy consumption by an additional 15-20% compared to manually controlled systems. However, their research also highlighted potential challenges in user adaptation to automated systems, particularly among elderly residents, suggesting the importance of user-friendly interfaces and occupant education in maximizing the benefits of advanced lighting technologies. The study emphasized that successful lighting design in LEED-certified residential buildings requires careful balance between automation, user control, and occupant preferences to achieve optimal results in both energy efficiency and occupant satisfaction. Research on lighting quality shows consistent improvements in LEED-certified buildings, particularly in daylighting utilization. Vosoughkhosravi et al. (2022) found that occupant satisfaction with lighting quality was 15-20% higher in LEED-certified residential buildings. Natural daylight availability increased by 25-40% compared to conventional buildings, while glare-related complaints decreased by 30%. The study also noted improved lighting control flexibility, which corresponded with reduced artificial lighting energy consumption, averaging 22% lower than in conventional buildings.

Water Management and Conservation

An analysis of water conservation strategies reveals sophisticated approaches to water management in LEED-certified residential developments. According to Kim et al. (2020), the integration of water monitoring systems in LEED-certified residential buildings has transformed traditional conservation approaches. Their longitudinal study spanning three years demonstrated that buildings equipped with real-time water monitoring systems identified and addressed leaks 75% faster than conventional buildings, resulting in significant water savings beyond the designed efficiency measures. Duy Hoang et al. (2020) examined the effectiveness of graywater recycling systems in LEED-certified multi-family residences, finding that properly implemented systems reduced potable water demand for toilet flushing and irrigation by up to 40%. However, their research also revealed important considerations regarding maintenance requirements and occupant acceptance of water reuse systems. Notably, buildings that implemented comprehensive occupant education programs about water conservation features showed 25% higher water savings compared to those without such programs. The study further highlighted the economic implications of advanced water management systems, demonstrating that while initial installation costs were 15-20% higher than conventional systems, the payback period in water-stressed regions averaged 4.3 years, making these investments particularly attractive for long-term property owners and affordable housing developments where utility costs significantly impact operational budgets. Water conservation achievements in LEED-certified residential buildings show substantial improvements over conventional construction. Daouadi et al. (2022) documented average reductions in water consumption of 30-50%. High-efficiency fixtures contributed to a 35% reduction in indoor water use, while rainwater harvesting systems provided 20-30% of non-potable water needs. Smart irrigation systems proved particularly effective, reducing outdoor water use by 50-60%. Regional variations proved significant, with water-stressed regions showing even higher conservation rates, reaching up to 65% reduction in total water consumption (Rastogi et al., 2017).

Economic Considerations and Affordability

Analysis of economic factors reveals a complex relationship between initial investments and long-term returns in LEED-certified residential projects. Martínez et al. (2019) conducted a detailed study of affordable housing projects in Bogotá, finding that LEED certification increased initial construction costs by 5.5%, with variations depending on the targeted certification level. This finding aligns with broader research by Duy Hoang et al. (2020), who documented cost premiums ranging from 2% for basic certification to 15% for Platinum certification in residential projects across different markets. The operational cost benefits present a compelling counterpoint to initial investments. Kim et al. (2020) found that LEED-certified residential buildings demonstrated 25.6% lower maintenance and repair costs compared to conventional buildings over a five-year period. Additionally, their study revealed annual energy cost savings ranging from 15% to 30%, with higher certification levels correlating with greater savings. These operational savings proved particularly significant in affordable housing contexts, where utility costs represent a substantial portion of housing expenses. Financial incentive mechanisms play a crucial role in project viability. Research by Martínez et al. (2019) identified several effective support mechanisms. Their analysis showed that property tax reductions typically ranged from 5% to 15%, while expedited permitting processes reduced approval times by up to 45%. Furthermore, density bonuses allowed for 10-20% increased floor area ratios. These incentives significantly improved the financial feasibility of LEED certification, particularly for affordable housing projects. The market impact of LEED certification demonstrates strong positive trends across multiple indicators. Kim et al. (2020) found price premiums for certified residential properties ranging from 15% to 49.9%. These variations were influenced by certification level, with higher levels commanding larger premiums. Market location also played a significant role, with urban centers showing stronger premiums than suburban areas. Additionally, multi-family buildings showed different premium patterns compared to single-family homes. Occupancy and demand metrics also show positive trends in the market. LEED-certified properties experienced 5-10% higher occupancy rates and 20-30% shorter vacancy periods compared to conventional properties, according to research by Duy Hoang et al. (2020). The market advantage appears particularly strong in regions with high environmental awareness and supportive policy frameworks. These findings suggest that LEED certification provides tangible market benefits beyond the environmental and operational improvements.

Challenges and Opportunities

Our analysis reveals distinct challenges and opportunities in residential LEED implementation across three key areas. Economic considerations show a 2-15% initial cost premium (Martínez et al., 2019), offset by 15-30% annual operational savings and 15-50% property value appreciation (Kim et al., 2020). Indoor environmental quality challenges include integrating complex systems and balancing occupant preferences, counterbalanced by improved health metrics including 30-40% lower VOC levels and 25-40% increased natural daylight (Vosoughkhosravi et al., 2022). Market performance challenges in stakeholder education are offset by demonstrated benefits of higher occupancy rates and shorter vacancy periods (Duy Hoang et al., 2020). Regional context significantly impacts implementation success, with urban markets showing stronger performance than rural areas due to better access to specialized expertise and materials (S.E. Ismaeel, 2016).

Table 1. Reviewed studies details

| Study/ Year | LEED Version/ Location | Method/ Sample Size | Primary Focus |
|-------------------------------|---------------------------|------------------------|----------------------------|
| Vosoughkhosravi et al. (2022) | v4/v4.1, USA | Mixed, n=45 | IEQ, Occupant Satisfaction |
| Daouadi et al. (2022) | v4, Algeria | Case Study, n=12 | Environmental Quality |
| Duy Hoang et al. (2020) | v4, S. Korea | Quant., n=32 | Cost Analysis |
| Kim et al. (2020) | v3/v4, USA | Mixed, n=28 | Economic Benefits |
| Gul & NezamiFar (2020) | v4, Turkey | Quant., n=15 | Energy Performance |
| Martínez et al. (2019) | v3/v4, Colombia | Mixed, n=8 | Affordable Housing |
| Mukhopadhyay et al. (2018) | v3, USA | Quant., n=25 | HVAC Systems |
| Shan & Hwang (2018) | v3/v4, Singapore | Mixed, n=18 | Maintenance |
| Roy et al. (2016) | v3, USA | Quant., n=200 | Market Value |
| S.E. Ismaeel (2016) | v3, Italy | Case Study, n=5 | Implementation |

Discussion

The synthesis of recent research reveals significant patterns in the implementation and impact of LEED certification in residential buildings. Regional context plays a crucial role in shaping LEED effectiveness. S.E. Ismaeel (2016) and Daouadi et al. (2022) identified challenges in aligning LEED requirements with varying geographical and cultural contexts, particularly in regions with distinct climate conditions or building traditions. This underscores the necessity for more flexible certification criteria tailored to local conditions. Occupant behavior has emerged as a pivotal factor influencing building performance. Gul & NezamiFar (2020) observed deviations of 15-30% between actual and predicted energy performance due to variations in occupant behavior. Similarly, Chokor et al. (2016) highlighted that active occupant engagement programs led to significantly better performance, emphasizing the importance of user education and involvement.

The economic impact of LEED certification demonstrates considerable market dependence. Kim et al. (2020) documented substantial increases in building values for LEED-certified properties, while Roy et al. (2016) reported premium rents ranging from 4% to 12% above market rates for certified residential properties. However, these benefits exhibit regional and market condition variability. Long-term maintenance considerations also influence sustainable implementation. Shan & Hwang (2018) noted that LEED-certified buildings often require specialized maintenance approaches, particularly relevant for affordable housing projects where maintenance capacity and costs are critical concerns.

These findings collectively suggest that while LEED certification offers significant benefits in residential contexts, successful implementation demands careful consideration of local context, occupant engagement, economic constraints, and long-term operational requirements. Context-sensitive strategies are essential, particularly for affordable housing projects, to optimize outcomes. Regarding costs, Martínez et al. (2019) demonstrated that LEED certification adds an average premium of 5.5% for affordable housing projects, necessitating evaluations against long-term benefits. Duy Hoang et al. (2020) further established that higher certification levels can generate significant operational cost savings despite larger initial investments.

Performance variations across certification levels further illustrate the complexity of cost-benefit analysis. Vosoughkhosravi et al. (2022) reported 23% higher occupant satisfaction in LEED Platinum

buildings compared to non-certified properties, while Lee (2011) observed variations in incremental benefits across different certification levels. From a resident perspective, these findings affirm that LEED certification provides a compelling blend of quality-of-life improvements and long-term economic advantages. Enhanced indoor environmental quality directly improves daily comfort and well-being, while operational cost savings and property value appreciation yield tangible financial returns, supporting the initial premium of LEED certification.

The implementation of LEED certification in residential projects, particularly affordable housing, reveals a complex balance between benefits and accessibility barriers. While operational cost reductions of 15-30% annually (Kim et al., 2020) underscore financial advantages, the initial cost premium of 2-15% presents a significant barrier for affordable housing developers (Martínez et al., 2019). This challenge is especially pronounced in low-income housing projects where budgets are limited. Furthermore, advanced systems in LEED buildings often require specialized maintenance, contributing to higher service costs that strain operational budgets. However, innovative strategies have emerged to mitigate these barriers. Martínez et al. (2019) documented public-private partnerships that provided supplemental funding to offset initial certification costs while maintaining affordable rent levels. Duy Hoang et al. (2020) demonstrated that comprehensive staff training programs could reduce ongoing maintenance costs by 25%, offering a practical pathway to sustainability. Beyond financial constraints, technical expertise remains a challenge, particularly in underserved areas where green building professionals may be scarce. Expanding LEED adoption in affordable housing, therefore, necessitates both financial solutions and investment in local technical capacity and maintenance infrastructure.

Conclusion

LEED certification in residential buildings represents a transformative approach to sustainable development, offering both significant challenges and vast opportunities for creating healthier, more energy-efficient, and economically viable housing. While initial costs remain a notable barrier, especially within the affordable housing sector, the long-term benefits—including substantial operational savings, superior indoor environmental quality, and enhanced market value appreciation—highlight LEED's considerable potential as a strategic investment in sustainable infrastructure. Achieving success with LEED certification requires a holistic approach that balances local market dynamics, robust policy frameworks, occupant needs, and the long-term operational sustainability of certified buildings.

This study makes four critical contributions to advancing the discourse on sustainable residential development: (1) presenting the first comprehensive synthesis of resident-centric outcomes across diverse performance dimensions, providing a richer understanding of how LEED certification influences everyday living experiences, (2) revealing the multifaceted interplay between economic, environmental, and market factors in shaping resident satisfaction and long-term property valuation, (3) offering an evidence-based framework for evaluating LEED certification's implications across varying residential contexts, with a strong focus on affordable housing solutions and social equity, and (4) emphasizing the importance of integrative policy recommendations and strategic partnerships among stakeholders, including policymakers, developers, and community organizations, to maximize LEED's impact and accessibility.

For residents, LEED certification offers a multifaceted value proposition, combining immediate enhancements in living quality and well-being with long-term financial advantages such as reduced utility costs and property value appreciation. Beyond direct benefits, the creation of healthier indoor environments and lower operational expenses fosters broader social and economic equity, particularly

in marginalized communities. As sustainable building practices continue to evolve, maintaining a resident-focused perspective will be pivotal for driving the next wave of LEED adoption, ensuring that the principles of sustainability, equity, and resilience are embedded in the future of residential development.

Implications for Future Work

The reviewed studies recommended several key areas that require further research to advance the understanding and implementation of LEED certification in residential buildings. Extended longitudinal studies are needed to better quantify the relationship between initial certification costs and lifetime operational savings. These studies should track both quantitative performance metrics and qualitative factors such as occupant satisfaction and behavior patterns over multiple years. Research should focus on developing innovative approaches to reducing the cost premium associated with LEED certification while maintaining high environmental performance standards. This includes investigating alternative materials, construction methods, and certification pathways that could make LEED more accessible for affordable housing projects. Further investigation is needed to understand how occupant behavior influences the actual performance of LEED-certified residential buildings compared to their designed performance. This includes studying the effectiveness of various occupant education programs and feedback systems in maximizing the benefits of LEED features. More research is needed on adapting LEED criteria to different regional contexts, particularly in developing markets where affordable housing needs are acute. This could lead to the development of more locally appropriate certification pathways that better reflect specific regional challenges and opportunities. Future research should explore how emerging smart building technologies can be integrated with LEED certification to enhance building performance monitoring, occupant comfort, and operational efficiency.

Limitations

This systematic review has four key limitations: (1) the 2015-2024 timeframe excludes earlier research on long-term outcomes, (2) reliance on academic literature omits industry insights and failed implementations, (3) geographic concentration in developed markets limits understanding of emerging market contexts, and (4) focus on successful implementations may underrepresent certification challenges. The emphasis on quantitative data may also exclude valuable qualitative insights about resident experiences.

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