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Greta Butkutė

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VERSLO STRATEGIJOS PEREINANT PRIE ŽALIŲJŲ PASTATŲ	**BUSINESS STRATEGIES FOR TRANSITIONS TOWARDS GREEN BUILDINGS**

Supervisor Assoc. Prof. Dr. Viktorija Cohen

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TABLE OF CONTENTS

INTRODUCTION 3
1. CONCEPTUAL FRAMEWORK AND STRATEGIES FOR GREEN BUILDING 6
1.1. Theoretical aspects of green building concept 6
1.2. The importance and benefits of green buildings 7
1.3. Barriers and challenges to green building adoption 9
1.4. Review of regulatory and certification frameworks 14
1.4.1. Leadership in Energy and Environmental Design 17
1.4.2. Building Research Establishment Environmental Assessment Methods 19
1.4.3. Comparison of green building frameworks 21
1.5. Business strategies for green building transition 23
2. METHODOLOGY 25
2.1. Aim, model and hypotheses 25
2.2. Analysis Method 28
3. THE ANALYSIS OF EMPIRICAL RESEARCH RESULTS 32
3.1. Research sample and data structure 32
3.2. Descriptive analysis of the main constructs 34
3.2.1. Adoption of green building practices 34
3.2.2. Perceived barriers to green building adoption 34
3.2.3. Perceived drivers to green building adoption 35
3.2.4. Perceived project outcomes of green building adoption 35
3.3. Hypotheses testing and relationships between variables 36
3.3.1. Construct indices and correlation analysis 36
3.3.2. Regression analysis: determinants of adoption (Model 1) 37
3.3.3. Regression analysis: adoption and project outcomes (Model 2) 39
3.3.4. Regression diagnostics and model validity 40
3.3.5. Summary of hypotheses testing results 41
3.4. Analysis of open-ended survey responses 42
CONCLUSIONS AND RECOMMENDATIONS 46
SUMMARY 50
SANTRAUKA 52
LIST OF REFERENCES 54
ANNEXES 60

INTRODUCTION

Relevance: The concept "green building" is rapidly becoming more important in modern real estate development not only because of climate change and waste problems in the world, but also because it addresses developers' strategies based on changing residents' mentality and investors' focus on sustainability. Green buildings are promoted to address environmental problems, occupants' well-being, as well as lowering operating costs and enhancing property value in real estate market.

The importance of green buildings in Lithuania, as in other EU member countries, is promoted by European Union initiatives such as Energy Performance of Buildings Directive and the broader low-carbon building agenda, which aims to reduce building related energy use and emissions (European Commission, 2024; European Parliament and Council, 2024) However, the adoption of green building practices among real estate developers and other stakeholders faces financial, regulatory and organizational barriers, including higher initial costs, regulatory uncertainty and limited technical capacity (Hong et al., 2025; Rita et al., 2023; Nooradzhar et al, 2024). There is a need for a better understanding of which drivers and barriers contribute to this transition and how green building adoption is shaped, as existing studies highlight patterns of adoption (Hong et al, 2025; Falana et al, 2025). This thesis contributes to discussions on green building transitions in real estate sector by providing new empirical evidence from Lithuania's real estate development sector.

Level of research and novelty: Research within green buildings examines the economic, environmental and social benefits, also identifying barriers and drivers for green transitions, analyzing policy and regulatory frameworks in various countries world-wide, including work on certification schemes and stakeholder cooperation (Kim et al., 2020; Tseng et al., 2023; Hong et al, 2025). At the theoretical level. Studies apply frameworks such as socio-technical transition theory, institutional theory and innovation diffusion theory to explain how green building practices spread among developers and other stakeholders (Hong et al., 2025; Wang et al., 2024; Tetteh et al., 2025). However, the reasons for slow and uneven transitions remain complex, and empirical reference that links perceived barriers, perceived drivers and perceived project outcomes from the perspective of real estate developers is still limited (Gottlieb et al, 2023; Falana et al., 2025). This thesis combines insights on the green building concept, benefits and transition challenges, with empirical research that analyzes perceived barriers, perceived drivers and perceived project outcomes among professionals working in real estate development in Lithuania. The empirical model is based on innovation adoption perspective and stakeholder theory and contributes to academic discussions on how to accelerate green building adoption by providing new survey-

based evidence on how Lithuanian real estate developers, architects, and other related professionals perceive green building adoption.

Problem: Previous studies show that green buildings offer important economic, environmental and social benefits and identify a range of barriers and drivers for their adoption, including higher initial costs, knowledge and capacity gaps, and policy or market related uncertainties (Kim et al., 202; Liu at al., 2018; Rita et al., 2023; Nooradzhar et al., 2024; Falana et al, 2025; Hong et al., 2025). However, there is still limited empirical evidence on how real estate developers and other related stakeholders perceive those barriers, drivers and project outcomes in specific national contexts such as Lithuania, where green building adoption remains uneven despite EU-level policy pressure and growing sustainability expectations (Hong et al., 2025; European Commission, 2024; European Parliament and Council, 2024). The research problem is to understand how perceived barriers, perceived drivers and perceived project outcomes influence the adoption of green building practices in Lithuania's real estate sector from the perspective of real estate developers and related professionals.

Aim: To evaluate how perceived barriers and drivers influence the adoption of green building practices and associated project outcomes among real estate development professionals in Lithuania.

Objectives:

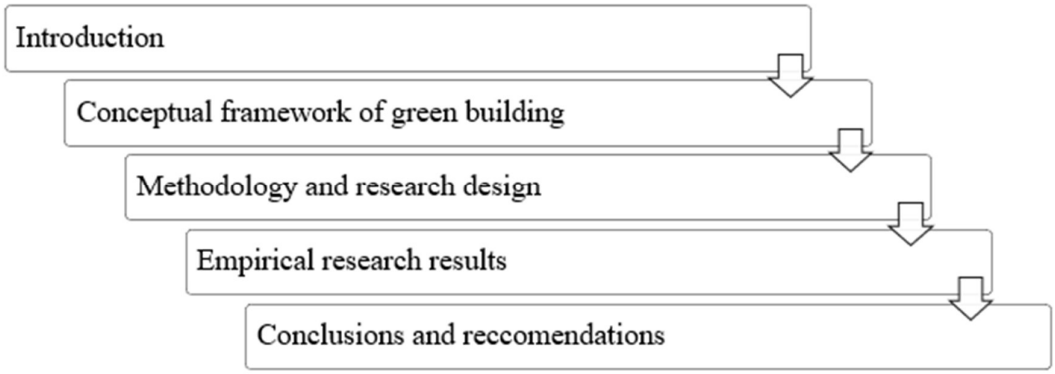
1. To review existing literature and analyze empirical research on green buildings, indicate what drivers and barriers influence the adoption of green practices, as well as identify main certification frameworks and transition supporting theories.
2. To develop empirical models of green building adoption based on relevant theories, specifying barriers, drivers and outcomes, that are perceived by real estate developers and related stakeholders, and formulating research hypotheses.
3. To conduct a survey of professionals in the real estate industry related to development.
4. To apply statistical methods to analyze survey data by evaluating relationships between drivers, barriers and project outcomes and test the data with research hypotheses.
5. To analyze and interpret results of empirical research and provide recommendations for private and public sector on business strategies for transitioning towards green buildings.

Methods: This study employs systematic literature review analysis, quantitative survey of 70 experts involved in real estate development, structured questionnaire is used with Likert-scale items, multiple choice questions and open questions to gather data. Ordinary Least Squares (OLS) analysis, descriptive statistics and correlation analysis are used to analyze and interpret data, using R (RStudio) software.

Use of artificial intelligence (AI): AI tools are used as instruments for designing tables, searching for relevant scientific articles, Lithuanian – English language translations, also for assistance with using R (RStudio) software. AI assistance is also used for checking grammar, coherence, phrasing suggestions and overall editing of the document, while all modeling, structure, interpretations of empirical results and other substantial decisions are made by the author.

Structure of the thesis: Thesis consists of introduction, three key chapters, conclusions and recommendations, list of references and annexes. The first chapter represents the concept and frameworks related to green buildings, defines conceptual understanding of certifications and overall benefits of green buildings. It also reviews the importance of sustainable buildings, analyzes existing research on barriers and drivers for green building transitions capturing the theoretical frameworks. Second chapter describes methodology and research design, specifying the models, hypotheses, data collection and analysis methods. The third chapter consists of empirical research results using descriptive statistics, OLS analysis, hypotheses testing and overall alignment with theoretical frameworks. The conclusions and recommendations summarize the main findings of the study, discussing limitations and future research, also provides recommendations for public and private sectors addressing the research objectives.

Fig. 1. **Thesis structure**



Source: compiled by the author.

1. CONCEPTUAL FRAMEWORK AND STRATEGIES FOR GREEN BUILDING

1.1. Theoretical aspects of green building concept

Green buildings have received significant attention all over the world as an effective approach to address problems related to climate change (Chang, Lu, 2017). The concept of a green building refers to a sustainable, environmentally friendly, energy-efficient building that mainly focuses on protecting natural resources, regulating the impact on the environment to a minimum, improving residents' health and comfort throughout the life cycle of the building (Zhang, He, 2024). Additionally, the pursuit of energy efficiency in buildings has expanded into the broader concept of sustainable real estate development, transforming traditional construction practices by emphasizing environmental protection, pollution reduction, and integration of innovative technologies to support long-term sustainability (Liu, Guo, 2021). Green buildings can save between 25-50% in energy consumption, 10-40% in water usage, and reduce maintenance costs by about 12% and these savings translate to a potential return on investment of up to 40% over a buildings' lifetime (International Energy Agency, 2013). In addition, green and energy-efficient buildings should incorporate various functions, including air pollution control, noise reduction, sterilization, deodorization, and water conservation, and should be characterized by the following features: 1. Energy saving; 2. Utilization of renewable energy sources; 3. Water conservation; 4. Minimizing environmental impact; 5. Enhancing user experience (Zhang, He, 2024). Green buildings offer economic, environmental, and social benefits by being energy and water-efficient, durable, and non-toxic; they utilize long-lasting materials, improve user satisfaction and sustainability, and lower operation and maintenance costs (Iqbal et al., 2023).

Table 1. **Green building features**

1. Energy saving	Energy consumption can be reduced through effective energy-saving measures such as utilizing high-efficiency equipment, enhancing building insulation, and improving airtightness.
2. Utilization of renewable energy sources	To enhance building self-sufficiency, renewable energy systems such as solar, wind, and geothermal can be utilized for energy supply.
3. Water conservation	Water-saving devices and systems can be implemented, alongside optimizing water recycling, to promote effective water conservation.
4. Minimizing environmental impact	Reducing unnecessary pollution is essential, which involves careful selection of building materials and ensuring environmentally friendly construction practices.
5. Enhancing user experience	Optimizing architectural design can enhance the indoor environment: improving factors like air quality and lighting – to boost user comfort and overall quality of life.

Source: modified, based on Zhang, He, 2024.

1.2.The importance and benefits of green buildings

Understanding the social, economic, and environmental reasons for transitioning to green buildings requires an analysis of their significance and benefits within sustainable real estate development. Since the 1970s, the concept of green building has gained acceptance and experienced rapid development (Zhang, He, 2024). As key players in urban development and the real estate market, developers drive the technological shift toward green building by delivering sustainable projects and leveraging resources like people, materials, assets, and capital (Zhang, He, 2022).

Gomes et al. (2025) show that temporary multi-organization project teams often face tensions during green building certification, and that strong leadership and clear green building project leader are crucial for coordinating actors and resolving practical everyday challenges. The results confirm three out of four expected types of tensions and show that leadership – particularly the role of the green project champion – is especially important and explains how developers and consultants deal with both big-picture and day-to-day issues. It is also noticed that although green building certification can bring extra work and risks, these are often seen as chances to learn. The study concludes that strong teamwork and leadership are key to successfully completing green building projects. This highlights that organizational and leadership strategies are an important part of real estate developers' approach of delivering green building into the real estate market.

According to Lu et al. (2025), collaboration among key stakeholders affects their strategic decision-making – developers and homebuyers adapt their strategies in green building transactions to gain benefits, while governments may adjust regulations to support green building progress and maximize value for both the public sector and the industry. The study concludes that dynamic government incentives (like adjustable taxes and subsidies) can lead to a stable transition toward green building adoption, unlike static measures which lack long-term stability – it emphasizes that initial conditions and strategic advantages play a key role in this transition. This suggests that well designed policy incentives can act as important drivers of green building adoption next to market and stakeholder pressures.

Another research by Si et al. (2025) developed an evolutionary game model involving the government, shopping center investors, and tenants to analyze how their decisions impact the energy-efficient renovation of buildings. The study reveals that government incentives, tenant awareness, and investor profit expectations play key roles in shaping stakeholder behavior. It concludes that early-stage market development benefits from direct government incentives, but as the market matures, support should shift toward guidance rather than strict regulation. Recently,

improving the energy efficiency of both old and new buildings has become the focus of increasing regulatory attention, with a range of measures either encouraging or obligating owners to cut their buildings carbon footprint including the introduction of stricter energy efficiency standards for new constructions and requirements to renovate the worst performing existing buildings (St-Pierre, Gareau-Lindsay, 2025). Together, these studies underline that green building benefits are closely related to policy design, stakeholder collaboration and changing market expectations.

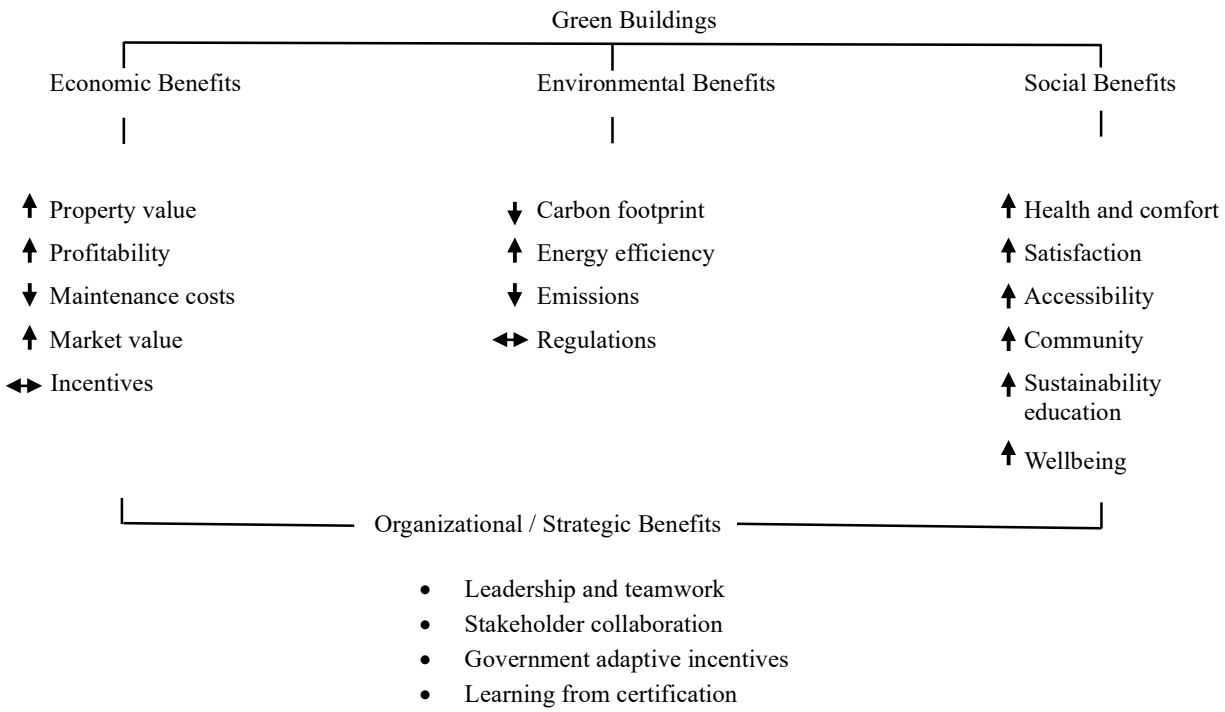
Green buildings and their certification system represent an investment in present and future wellbeing, requiring consideration of environmental, social, and economic factors, and it does indeed deliver a positive economic impact (Kim, JM et al., 2020). By comparing LEED certified and non-certified buildings researchers Kim, JM et al. (2020) show that certified buildings cost more to construct, but their long-term economic benefits – including up to up to 49.9% higher building value and 25.6% lower maintenance costs – are achieved through energy and water savings, reduced operating expenses, improved productivity, and better health outcomes, effectively offsetting the initial investment. A study by Kim, KH et al. (2020) also emphasizes on green building benefits by analyzing real estate price differences between green certified and non-certified apartment buildings concludes that G-SEED (G-SEED, according to Gültekin and Park (2023), is a domestic South Korean certification system, used to assess the environmental performance of both new and existing residential and non-residential buildings) certified apartments have prices that are significantly higher – by 9.52% - demonstrating that G-SEED certification delivers measurable economic benefits through energy savings, lower maintenance costs, and incentives. These findings indicate that green buildings can create financial value for developers and homeowners, which is an important driver of adoption in the real estate market.

Green building social sustainability is analyzed by Tseng et al. (2023) since the authors notice that this aspect is often overlooked during practical efforts to implement sustainable development. The main social aspects of green buildings are enhancing occupant health and comfort, improving accessibility and convenience, fostering social equity and cohesion, supporting cultural value, and promoting sustainability education as community wellbeing. This research is complemented with a comparative study by Liu et al. (2018), analyzing the occupant satisfaction in green certified office buildings. According to this research, occupants were more satisfied with certified buildings, especially Three-Star rated buildings, which showed statistically significantly higher satisfaction scores than non-certified ones. These results show that green buildings can improve user satisfaction and well-being, adding other social benefits, as well as economic and environmental advantages.

These studies review how green buildings have become central to sustainable real estate development, detailing their economic, social and environmental benefits: their adoption is driven

by developers' strategic choices and policies, delivering measurable increases in property values and reductions in operating costs through green certifications, fosters healthier and more inclusive communities, supports clime targets via energy efficiency and lower emissions, with research highlighting the importance of strong leadership, stakeholder collaboration and adaptive incentives in long-term green building success.

Fig. 2. **Green Building Benefits**



Source: compiled by the author, based on the research discussed above.

1.3. Barriers and challenges to green building adoption

According to Hong et al. (2025), research on green buildings has evolved over the past decade from primarily investigating the drivers and barriers of adoption to exploring the broader transition process itself. The shift reflects a growing interest in understanding the complex technological and societal changes of green building transformation. Their review highlights that studies increasingly use system-level frameworks such as Multi Level Perspective (MLP) and evolutionary game theory to analyze how actors, technologies and policies co-evolve and that barriers to green building are often built into wider socio-technical regimes rather than being only technical issues.

Building on this shift towards systematic analyses, understanding the socio-technical transition theory is crucial in analyzing the shift towards green building. Socio-technical regimes are commonly used to describe a particular industry or business sector as a set of connected elements that are shaped by and organized around a technological path (Gottlieb et al., 2023). In their study of a Danish construction firm, Gottlieb et al. (2023) investigated the barriers and drivers associated with transitioning towards green building, with a particular focus on adoption of biogenic building materials. They show that cultural norms, market practices, policies, infrastructure and technical knowledge create resistance to new materials, also reveal opportunities for change when niches and regimes are aligned.

Other relevant frameworks include innovation diffusion theory. Wang et al. (2024) use this theory to analyze how new technologies spread in society through five attributes, with the article focusing on three: relative advantage, complexity, and compatibility. These determine whether users perceive smart homes as better, easier to use, and fitting their needs. Authors also mention switching costs theory, that represents the barriers, both financial and non-financial, that discourage users from adopting a new product or service. While the article notes switching costs are less prominent for smart home adoption, in green building adoption stakeholders may face loss of established relationships with traditional builders, or lack of trust in new technologies and providers. The article's framework provides a theoretical basis for understanding and addressing barriers to green building adoption, demonstrating that both innovation attributes (benefit, fit, simplicity) and switching costs (effort, financial commitment) critically shape consumer intentions and behavior. These insights suggest that perceived benefits, complexity and compatibility of green buildings, as well as the effort and risk of switching costs, are important elements behind green building adoption decisions.

Tetteh et al. (2025) introduce an extended institutional theory framework to explain the adoption of green building practices in the construction industry, particularly in Sub-Saharan Africa. The framework identifies not only the traditional institutional forces – coercive, mimetic, and normative – but also adds two novel forces: custodial (traditional authority) and civic (NGO/civil society pressure). All these forces interact to affect organizational adoption of green building practices. Their findings show that regulations, professional norms, imitation of peers, traditional authorities and civil society pressure can all push or discourage organizations from adopting green building practice, because firms seek legitimacy and acceptance as well as efficiency. Adoption of green building is best understood through a multi-framework perspective, revealing it as a dynamic process of co-evolution between innovation, institutional pressures, and stakeholder engagement, where successful implementation relies on integrating technological benefits within enabling social and institutional contexts.

Another important framework is the dynamic capabilities framework, reviewed by Brock and Hitt (2024). According to the authors, dynamic capabilities framework is structured around four categories of capabilities: Functional Capabilities, General Capabilities, Strategic Dynamic Capabilities, and Meta Dynamic Capabilities. General Capabilities include basic routines, resources and business functions; functional capabilities consist of resources such as intellectual capital and technology; higher order capabilities – Strategic Dynamic – develop lover level capabilities, providing firms with the ability to gain or sustain competitive advantage; and the highest order – Meta Dynamic Capabilities – create and enrich other dynamic capabilities, effectively enabling firms to develop new dynamic capabilities and respond to highly dynamic international environments. The article by Brock and Hitt (2024) emphasizes the importance of this hierarchical framework for both empirical research and practical management, especially in the context of complex and dynamic international business environments. Similarly, Bocken and Thijs (2020) define dynamic capabilities by adopting its original definition, focusing on dynamic capabilities as enabling integration, building, and reconfiguration of competences in the face of rapid change. Bocken and Thijs (2020) state that strong dynamic capabilities are needed for sustainable business model innovation and their research puts emphasis on organizational design and sustainability integration, offering practical applications in various fields. In the context of green building, these ideas imply that firms need capabilities to sense sustainability opportunities, integrate new technologies and reconfigure their processes to overcome barriers and implement green projects.

Green building development faces a range of structural, financial, and cultural challenges that slow its adoption. Recent studies emphasize how high construction and certification costs, limited knowledge and training, policy barriers, and entrenched industry practices make implementation difficult. According to Rita's et al. (2023) study, which analyzes barriers of green building development in Indonesia, there are five key barriers: (1) high costs for green products, materials, and technology; (2) additional cost of obtaining green certification; (3) different occupants' perceptions of quality of life and consumption habits; (4) lack of green building technology training for project staff; and (5) high operating and maintenance costs for green buildings. Furthermore, Nooradzhar et al. (2024) also highlight primary barriers to green building implementation, including high construction costs, lack of knowledge and skills, government or policy-related constraints, and resistance to move away from established construction norms due to concerns about profitability and risks. The authors emphasize that overcoming these challenges requires coordinated policy, financial incentives, public education, improved regulatory frameworks, capacity-building, and community engagement.

A systematic review of Falana et al. (2025) further identifies 11 critical recurrent obstacles of stakeholder partnership in delivering net zero emissions buildings (NZEB) and 12 strategies that address those barriers. Considering relevance to the real estate developers' operational activities, the most important barriers with suggested solutions are given in the table below.

Table 2. **Stakeholder partnership barriers and strategies**

Barriers and the intended goals of stakeholder partnership in delivering NZEB	**Main partners involved in applying successful measures to resolve barriers to NZEB stakeholder partnership**
Insufficient stakeholder participation → *Successful collaboration with stakeholders*	• Government. • Construction project managers. • Construction professionals. • Researchers. • Public Media.
Limited knowledge regarding NZEB concepts → *Comprehensive NZEB knowledge access*	• Government. • Construction professionals. • Researchers. • Public Media.
Lack of clarity in stakeholder functions → *Specifying responsibilities for each NZEB stakeholder*	• Construction project managers. • Construction professionals. • Government. • Researchers.
Stakeholder resistance to cooperation → Reviewing stakeholder attitude	• Government. • Construction project managers. • Construction professionals. • Researchers. • Public Media.
Poor leadership → Efficient management of leadership	• Government. • Construction project managers. • Construction professionals. • Researchers.

Source: modified, based on Falana et al., 2025.

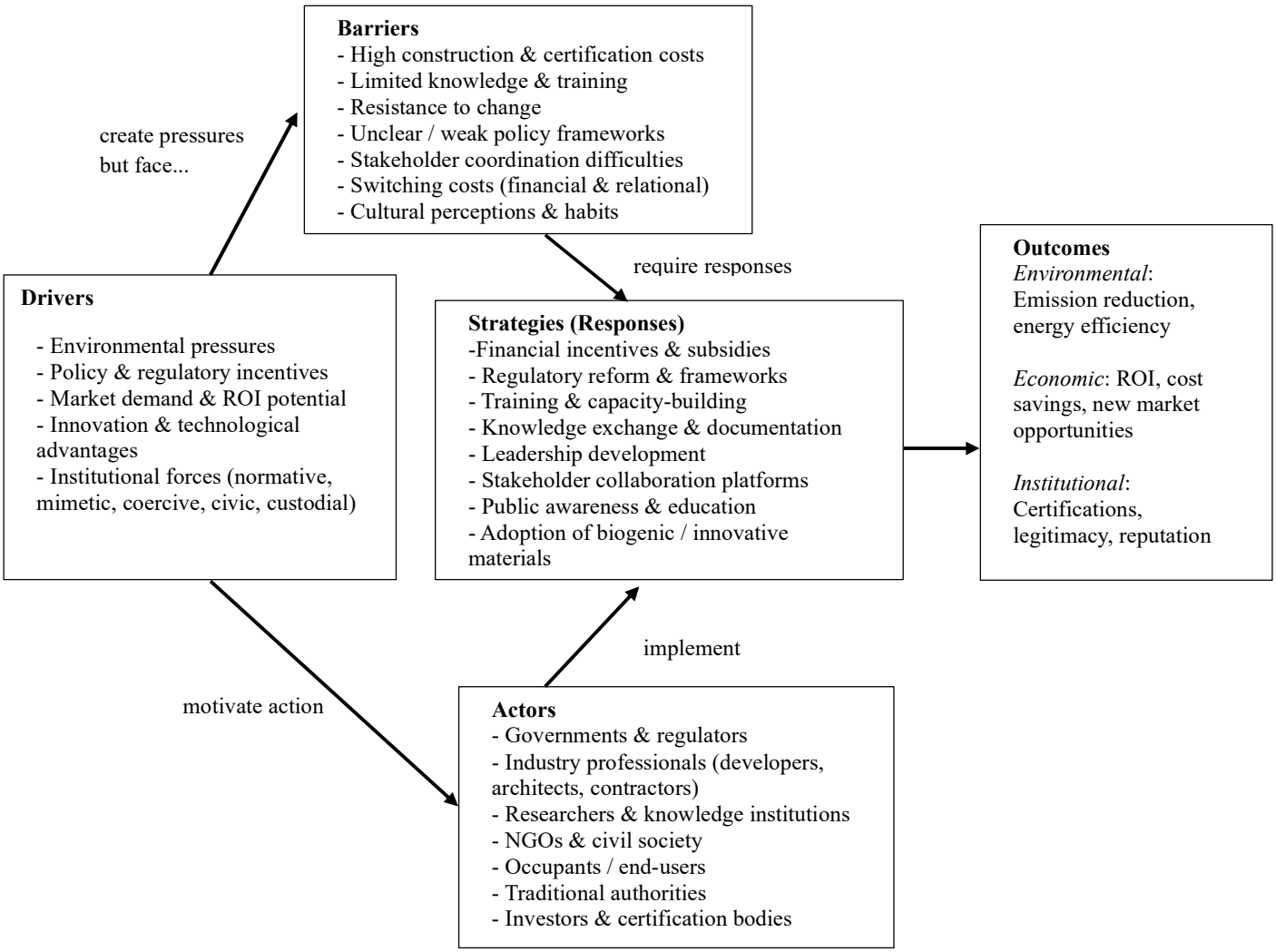
Additionally, Shi and Liu (2019) suggest that while green building offers greater environmental benefits, their costs are significantly higher than those of traditional construction, and current green building materials face issues such as high production costs, complex manufacturing processes, limited material options, and a lack of reusability. Effective solutions involve coordinated policies, financial incentives, education, capacity-building, and strong stakeholder collaboration between governments, industry professionals, researchers, and the public.

Gottlieb et al. (2023) analyze a Danish construction company, which is undergoing a transition towards green building through substituting traditional materials with biogenic alternatives. The research identifies 60 barriers, which were grouped into 13 main categories across 7 dimensions of the socio-technical regime, each playing an important role in shaping the challenges associated with transitions towards green building. These dimensions include culture, infrastructure, technologies, markets and users, policies, techno-scientific knowledge and

industrial networks. Based on this analysis, the authors propose short, medium, and long-term measures to support the adoption of biogenic materials. The findings complement the work of Falana et al. (2025), who similarly outlines barriers and strategic goals with each regime dimension. Boths studies emphasize the importance of knowledge development and practical experience, the need for systematic collection and documentation of technical properties, practical suitability, lifecycle data of biogenic materials, and experience feedback from completed projects, as well as stakeholder engagement and enhanced knowledge exchange between companies to support successful transition.

Overall, the reviewed studies reveal that the transition towards green building is constrained by complex barriers, ranging from high construction, certification, operating costs to limited technical knowledge, insufficient training, unclear policies and resistance to change. Despite these challenges, research highlights that progress is possible when barriers are addressed through coordinated policies, financial incentives, improved regulatory frameworks, and effective stakeholder collaboration. While the challenges are diverse and interconnected, they can be overcome if stakeholders actively engage in knowledge sharing, adopt innovative practices, and commit to long term systemic change. These findings provide a strong foundation for policymakers and industry leaders to design integrated strategies that not only reduce barriers but also accelerate the transition towards sustainable green building.

Fig. 3. **Visual model of the process for strategic transition**



Source: compiled by the author, based on the research discussed above.

1.4.Review of regulatory and certification frameworks

There are significant differences in evaluating green buildings among different countries due to the lack of common standards, although currently used evaluation standards include LEED (Leadership in Energy & Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), China 3 Stars Green Building Evaluation Standard (Zhang, He, 2024). While LEED and BREEAM are well-established and widely used by developers around the world, there are also other certification systems such as Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan, Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) in Germany, Miljöbyggnad in Sweden, Green Star in Australia,

Green Mark in Singapore, Thailand's Rating of Energy and Environmental Sustainability (TREES) in Thailand, and other regional systems (Chantry, Turcu, 2024).

These systems not only directly encourage the construction of green buildings but also help raise public awareness about environmental protection and support the development and research of green technologies, that is why as result, many studies are being conducted on the benefits of eco-friendly certification systems, such as higher occupancy rates, rental prices, sale values, and improved energy efficiency (Kim, Son, K., Son, S., 2020).

Looking into international frameworks like Energy Performance Building Directive (EPBD), specifically this regulatory framework with a purpose to improve building energy performance in EU. (Salvalai et al., 2024). According to researchers Salvalai et al. (2024), EPBD main actions include standards, mandatory Energy Performance Certifications (EPC), infrastructure for Electric Vehicles (EV) and renovation plans. In response of the latest revision of the directive in March 2024, a new generation EPC was introduced – a standardized template containing a set of indicators aimed at comprehensively evaluating building energy performance. The key improvements include indicators for energy efficiency such as the energy performance class, calculated annual primary and final energy use, as well as operational greenhouse gas emissions and greenhouse emission class. Additional parameters include recommendations for plant systems, building envelope quality, operational pollution, indoor thermal comfort, air quality, and metered energy consumption. Other improvements consist of digital integration (reality-based room scanning), user-centric approach (clarity, accessibility, ease of understanding for residents, tenants) and lastly the preparation for digital ecosystems – EPC links to the buildings smart-readiness assessment and the Digital Building Logbook. Salvalai et al. (2024) discusses the importance of the new generation EPC and clarifies, that it enables precise benchmarking and monitoring, drives renovation and investment by delivering clearer, user-friendly information, supports policy and climate goals and lastly empowers all stakeholders by ensuring that all information reaches and is actionable by experts, property owners, policy makers, financers, and the public, accelerating the transition to a low-carbon building stock. Authors state that the new generation EPC represents a significant evolution from existing practice, making the certificate both a technical and societal cornerstone of EU sustainable energy transformation. Furthermore, Fokaides et al. (2017) has a slightly different angle in addressing EPBD and energy performance – authors in the research focus on assessment of EPBD's impact on Cyprus' social housing stock and documents significant energy savings after EPBD implementation. However, authors describe EPBD as mandatory energy performance certification and public announcement of energy class when advertising buildings for sale or rent. Article includes explanations for obligatory inspections for heating and air conditioning, requirements for new buildings to achieve nearly zero energy,

minimum energy performance standards for new renovated buildings, as well as national support measures and renovation strategies. Fokaides et al. (2017) explain EPBD as a major historic policy shift, describes its requirements, and focuses on its measured impact on social housing sector, while Salvalai et al. (2024) describe EPBD as the current standard and future direction for energy building policies, driven by technology, harmonization, and user needs. Nevertheless, both authors provide complementary insights into EPBD, that offers a clear understanding of EPBD's role in EU building energy performance.

Taking a closer look into key international frameworks, it is worth mentioning Energy Conservation Building Code (ECBC) of India. Mahesh et al. (2022) explains ECBC as a framework, launched in 2007 to reduce the impacts of increasing energy consumption and carbon emissions in commercial buildings, addressing environmental and climate change concerns. According to authors, ECBC sets specifications for main building systems: (1) building envelope (walls, roofs, fenestrations), (2) HVAC (Heating, Ventilation, and Air Conditioning), (3) lighting (interior and exterior) and (4) electrical power generators and motors. Article mentions that the code is applicable to various categories of commercial buildings and provides nominal guidelines and requirements for the energy-efficient design of buildings. ECBC compliance can be achieved through two approaches: Prescriptive Method (requires buildings to meet prescribed minimum or maximum values for all building systems) and Whole Building Performance Method (proposed simulation model for the building must achieve lower net annual energy consumption than a standard design model). The authors emphasize that while government notifies national standards, state governments can amend the code for local needs and notify accordingly, for example, the state of Karnataka adopted mandatory ECBC compliance for commercial buildings in 2014 and has modified the code to suit local requirements.

Another regulatory and widely adopted building energy code in the U.S. for improving building energy efficiency is International Energy Conservation Code (IECC) (Golbazi and Aktas, 2018). According to Golbazi and Aktas (2018), IECC serves as a model code for states and local jurisdictions, which may adopt it as a part of their building regulations and standards with modifications tailored to specific demands if needed. While IECC adoption is voluntary at the federal level, once adopted at the state or local level, it becomes mandatory regulation for that specific region, which means that the architects, engineers, and contractors must comply with its provisions and, according to the authors, IECC is key for driving efficiency in the U.S. building sector, setting consistent minimum standards, providing a regulatory framework for commercial and residential buildings. Golbazi and Aktas (2018) mention key features of IECC, including minimum insulation levels, maximum thermal transmittance for windows and doors, addresses air leakage, controls for HVAC and lighting, require efficiency ratings for mechanical equipment to

reduce energy losses; recent versions of IECC increasingly encourage readiness for integrating renewable energy sources and electric vehicle (EV) charging. The authors give insight into IECC as a flexible and comprehensive regulatory framework for building energy efficiency in the U.S., supporting both mandatory code implementation and voluntary practices tailored for diverse climates and building types.

Based on literature research, this green building concept literature review further focuses on analyzing LEED and BREEAM more deeply because they are the most established and widely used green building certification systems globally, making them the most relevant for understanding the economic, environmental, and social benefits of sustainable construction.

1.4.1. Leadership in Energy and Environmental Design

LEED (Leadership in Energy and Environmental Design) has emerged as a worldwide benchmark for the design, construction, and operation of environmentally responsible, high-performing buildings and within this movement, architectural firms play a crucial role – not only by implementing LEED principles but also by driving the wider sustainability agenda forward (Xu et al., 2025). Launched in 1993 (Sandoval, Prakash, 2017), LEED certification, now recognized worldwide as a system for measuring a building's environmental impact throughout its life, according to Xu et al. (2025) is an important standard in the architecture field – showing a commitment to sustainability by using less energy and water, cutting operating costs, improving air quality inside, and supporting environmentally friendly design. This certification system is one of the most common certification systems in the United States and represents a great reputation for buildings as LEED certified buildings are noticed to consume less electricity (by 32%) and reduces CO2 emission (average 385 tons yearly), as well as reduced use of water and energy, along with increased occupant productivity and improved health (Kim, Son, K., Son, S., 2020). LEED program includes four levels of certification: Certified, Silver, Gold, and Platinum (Sandoval, Prakash, 2017).

Table 3. **LEED tier points comparison and distribution of certified buildings**

LEED tier	**Points earned**	**Tier distribution of LEED buildings, U.S. (2017 data)**
Certified tier	40-49 points earned	14%
Silver tier	50-59 points earned	33%
Gold tier	60-79 points earned	45%
Platinum tier	80+ points earned	8%

Source: modified, based on Sandoval, Prakash, 2017 and USGreenBuildingCouncil, 2025.

According to USGreenBuildingCouncil (2025), LEED takes a holistic approach, covering areas like energy and water use, material choices, waste management, and indoor environmental quality through different credit categories suited to each rating system, thus, to get LEED certified, a project must first meet all the required prerequisites, then earn points by meeting specific credit criteria. The project is then reviewed and verified by GBCI (Green Business Certification Inc.), and based on the number of points earned, it is awarded one of four certification levels (USGreenBuildingCouncil (2025). Differently from the other certification systems, LEED focuses on material aspects and sets minimum performance requirements in areas like energy use, erosion control, and indoor air quality, awarding points based on the level of performance achieved across these categories. (Sandoval, Prakash, 2017). LEED offers five main credit categories – 26 points for sustainable sites, 10 points for water efficiency, 35 points for energy and atmosphere, 14 points for materials and resources, and 15 points for indoor environmental quality – 100 points in total, with the possibility of earning an additional 10 bonus points through innovation in design (6 points) and regional priority (4 points), making the maximum achievable score 110 points for the building (Sandoval, Prakash, 2017). The process of LEED certification includes (1) registration, (2) verification, (3) application submission, (4) review and (5) certification (Freitas, Zhang, 2018). The analysis of Xu et al. (2025) conducted research shows a clear upward trend in the number of top architectural firms in the United States taking on LEED-certified projects over time, starting with just 4 firms in 2000 and rising steadily to 18 in 2004, 21 in 2008, 22 in 2012, and reaching a peak of 24 in 2016, before slightly declining to 20 firms in 2020, which reflects the growing dedication of leading architecture companies to environmentally responsible and sustainable building practices throughout the years.

LEED is for all kinds of buildings and project stages, including new buildings, building additions, interior renovations, building operations, neighborhoods, and even cities. It includes:

(1) Building Design and Construction (BD+C): for designing and building entire new buildings or major renovations across different building types.
(2) Interior Design and Construction (ID+C): for full interior renovation projects in commercial spaces where the building's exterior and site work are not included.
(3) Building Operations and Maintenance (O+M): for existing buildings that are already in use and are being improved with little or no construction work; this focuses on how the building is run and maintained and applies to buildings that have been fully operating and occupied for at least one year.
(4) Neighborhood Development (ND): for new or redeveloped land that includes homes, businesses, or a mix of both. Projects can be at any stage – from early planning to construction.

(5) Residential: for designing and building energy-efficient and sustainable homes.
(6) Cities: for entire cities or parts of cities, helping them track and improve their use of water, energy, transportation, waste, and overall quality of life (USGreenBuildingCouncil, 2025).

Overall, LEED has established itself as a leading global standard for environmentally responsible building design, construction, and operation. Its tiered certification system motivates projects to achieve higher sustainability performance across key areas such as energy efficiency, water conservation, material selection, and indoor environmental quality. The growing adoption of LEED by architectural firms highlights a strong industry commitment to sustainable development. With its comprehensive approach and applicability across various project types and scales – from individual buildings to entire neighborhoods and cities – LEED continues to play an essential role in advancing green building practices worldwide.

1.4.2. Building Research Establishment Environmental Assessment Methods

BREEAM is the world's first and leading sustainability assessment system for the built environment, using a holistic approach to promote buildings that support net zero carbon goals, whole life performance, health and social well-being, circularity, resilience, and biodiversity conservation BREEAM has been used in over 78 countries to certify more than half a million buildings throughout their life cycle, and it is widely applied to new construction, refurbishment and fit-out projects, buildings in use, and community developments through various dedicated schemes:

(1) BREEAM Communities for the master-planning of large-scale community developments.
(2) BREEAM New Construction for newly built domestic and non-domestic buildings.
(3) BREEAM New Construction (Infrastructure) for new infrastructure projects.
(4) BREEAM In-Use for existing non-domestic buildings that are currently in operation.
(5) BREEAM Refurbishment and Fit Out for the renovation and interior upgrades of both domestic and non-domestic buildings (Adewumi, Opoku, Dangana, 2024).

BREEAM certification ratings, ranked from lowest to highest, are as follows: Pass (over 30%), Good (over 45%), Very Good (over 55%), Excellent (over 70%), and Outstanding (over 85%) (Rebelatto et al., 2024). Conducted research of Adewumi, Opoku, Dangana (2024) focused on BREEAM New Construction, which is, according to the researchers, the most widely used scheme within the BREEAM family, therefore 10 assessment categories were provided that serve

as the main themes for evaluating new developments; these categories are management, health and wellbeing, energy, water, materials, waste, land use and ecology, pollution, transport, and innovation. It is noted that BREEAM is one of the leading science-based certification systems for supporting and promoting sustainability in the built environment across the globe, its independently certified standards have played a key role in improving the performance of buildings at every stage – from design and construction to use and renovation; millions of buildings worldwide are engaged in BREEAM's comprehensive approach to help meet goals related to ESG (Environmental, Social, and Governance), health, and net-zero targets (Rebelatto et al., 2024). The categories listed by Rebelatto et al. (2024) include Energy, Land Use, Materials, Pollution, Waste, Water, Health and Wellbeing, Transport, Management, and Innovation, therefore BREEAM evaluates projects based on these ten main categories. When it comes to energy efficiency in new commercial construction projects, BREEAM is considered the most demanding system in terms of the criteria required to earn points in this category and it is the only system that specifically includes flood risk as part of its assessment (Awadh, 2017). Sijakovic et al. (2020) investigated the attributes of resilient architectural design by conducting a case study of the Z Hotel Holborn (London), which is a successful example of adaptive reuse because it optimizes the building site by converting a college into a hotel and renovating the existing structure while preserving its identity and helping to conserve the surrounding neighborhood. When evaluated using BREEAM criteria, the building demonstrated strong performance in terms of both durability and resilience. Another research was conducted that analyzed LEED and BREEAM assessment methods for educational institutions, therefore the strengths of BREEAM were presented by researchers Reed et al. (2010) which are given at the table below.

Table 4. **Strengths of BREEAM certification**

Tiered Prerequisites	BREEAM's tiered system adjusts requirements based on the target rating, ensuring that higher-rated school projects prioritize the most impactful sustainability credits.
Accountability	To keep an 'Outstanding' rating, buildings must earn a BREEAM In-Use Certification within three years or be downgraded to 'Excellent.' 'Excellent' buildings must also submit case study data, ensure accountability and help improve the system through post-occupancy insights.
Metering	Sub-metering helps track energy and water use after construction. LEED could improve by requiring it for major systems, and BREEAM should make it mandatory at all levels.
Life Cycle Analysis	BRE's Green Guide and Green Book Live help designers easily compare products' environmental impacts, making it simpler to choose sustainable options and earn credits – unlike LEED, which requires more research.
Transport	BREEAM's Transport credits 5 rewards projects that create a travel plan with physical and behavioral measures to reduce single-occupancy car use in schools. Without such a plan, credited design features might be ignored or underused.

Source: modified, based on Reed et al., 2010, An Analysis of LEED and BREEAM Assessment Methods for Educational Institutions.

To understand the uniqueness of BREEAM system, it is important to note that it is known for its strict standards, especially in energy efficiency and water management, and its tiered system that prioritizes impactful sustainability measures based on certification level. BREEAM also emphasizes accountability through ongoing certification reviews and promotes practical tools to help designers select environmentally friendly products. Overall, it supports resilient, low impact building practices worldwide.

1.4.3. Comparison of green building frameworks

According to the authors analyzed before, the landscape of green building frameworks is shaped by geographic, policy, and market contexts. International voluntary certification systems like LEED (USA) and BREEAM (UK) have established broad market recognition and are widely used by developers, designers, and owners to demonstrate commitment to sustainability, add economic value, and ensure comprehensive consideration of environmental issues throughout the buildings lifecycle. LEED is structured with four certification tiers and covers new construction, interiors, neighborhoods and entire cities, with credits across energy, water, materials, waste and indoor quality. BREEAM, on the other hand, offers similarly holistic but distinct evaluation matrix, marked by requirements in energy water, and ongoing accountability, with multiple certification levels and specific post-occupancy performance verification.

By contrast, regulatory frameworks such as the EU Energy Performance of Buildings Directive (EPBD) and Energy Performance Certificates (EPC) focus on setting legally binding minimum standards for energy performance, mandatory disclosure, with targets for nearly zero energy buildings and large-scale renovation strategies. The latest revision brings a user-centric, digital, and indicator-driven new generation EPC that emphasizes not just technical measurement but also user accessibility and digital integration. Similarly, the Energy Conservation Building Code (ECBC) of India is a regulatory code targeting commercial buildings, prescribing minimum or maximum values for envelope, systems, adapted by state governments as needed.

The International Energy Conservation Code (IECC) in the U.S. provides a model regulatory code adopted on a mandatory basis by states, seeking to improve the energy efficiency of both residential and commercial buildings.

Key differences emerge regarding the degree of compulsion (voluntary system vs. government mandated codes), core focus (holistic sustainability vs. energy efficiency), and the approach to implementation (market-driven vs. policy-driven). Additionally, EPBD puts significant emphasis on user-friendliness and actionable benchmarking by extending its role from

technical compliance to supporting investment, renovation, and citizen empowerment. LEED and BREEM, on the other hand, remain the gold standards for voluntary sustainability assessment, integrated into real estate markets across the world.

All frameworks serve as powerful tools, where voluntary systems often go beyond minimum codes, raising the bar for sustainability, while regulatory systems ensure energy performance on higher standards according to policy objectives.

Table 5. **Comparison of Green Building Frameworks**

Framework	LEED	BREEAM	EPBD/ EPC (EU)	ECBC (India)	IECC (USA)
Type	Voluntary	Voluntary	Regulatory	Regulatory	Regulatory
Coverage	All buildings, all phases	All buildings, all phases	All EU buildings	Commercial buildings	Commercial/ residential building
Focus	Holistic sustainability	Holistic sustainability	Energy efficiency	Energy efficiency	Energy efficiency
Enforcement	Market-driven	Market-driven	Law-mandated	Law (state level)	Law (state/local)
Key features	Points based, 4 levels, broad credits, third party independent review	5 levels, energy, water, post-occupancy reviews, modular	Minimum standards, renovation strategy, user-centric	Prescriptive, performance paths, envelope/HVAC/lighting/ power regulations	Model code, insulation/HVAC/ lighting, adaptable, sets minimum standards
Scope	Global	Global/UK	EU	India	USA
Certification/ compliance/ tiers	Certified, Silver, Gold, Platinum	Pass, Good, Very Good, Excellent, Outstanding	New generation EPC with score and label	Compliance certificate	Code compliance
Region	Global/USA	Global/UK	EU	India	USA
References	Xu et al., (2025), Sandoval, Prakash (2017), USGreen-BuildingCouncil (2025), Freitas, Zhang (2018)	Adewumi, Opoku, Dangana (2024), Rebelatto et al. (2024), Awadh (2017), Sijakovic et al. (2020), Reed et al. (2010)	Salvalai et al. (2024), Fokaides et al. (2017)	Mahesh et al. (2022)	Golbazi, Aktas (2018)

Source: compiled by the author, based on the references listed in the table.

Overall, the comparison shows that voluntary certification systems such as LEED and BREEAM, provide sustainability benchmarks that often go beyond minimum regulatory requirements, while regulatory frameworks like EPBD, ECBC and IECC establish mandatory

energy performance baselines through legal requirements. Together, these instruments shape the incentives and constraints that real estate developers face when deciding whether and how to invest in green buildings in different regions. For this thesis, these frameworks are important because they influence both perceived barriers and drivers for green building adoption – voluntary certifications can act as market drivers by signaling quality and value, and regulatory frameworks can create compliance-based pressures and additional costs. Understanding how these instruments operate, provides a background for analyzing how Lithuanian real estate professionals perceive green building requirements, incentives and project outcomes in the empirical part of the study.

1.5. Business strategies for green building transition

Since real estate companies increasingly focus on integrating environmental, social, and economic goals into their projects as key strategies to achieve sustainable development and meet evolving market and regulatory demands, several studies analyze the strategies they adopt in practice. For instance, most facilities easily achieved Sustainable Site credits due to existing campus infrastructure, while Water Efficiency and Energy and Atmosphere categories significantly impacted overall LEED ratings (Kim et al., 2017). Higher rated facilities prioritized energy optimization, indoor environmental quality, and invested in green power. Common strategies included waste management, use of regional and recycled materials, and indoor air quality measures, while features like daylighting and architectural innovation helped top-performing buildings stand out. These strategies–energy optimization, material efficiency – are directly transferable to the commercial real estate sector, where developers face similar sustainability goals and LEED certification pressures. In summary, key strategies include (1) energy and atmosphere optimization, (2) indoor environmental quality enhancement, (3) water efficiency and stormwater management, (4) sustainable sites and materials, (5) innovation and design process.

Another research by Guo et al. (2022) addresses the strategies adopted by real estate developers regarding sustainable development through green building practices The study explores strategies like corporate reputation improvements, adapting to consumer preferences, and responding to government incentives or penalties that influence developers' use of sustainable building materials. The findings suggest that optimal strategy for high quality development of green buildings using recycled materials is to encourage upcycling among suppliers and recycled building materials adoption by developers and homebuyers, with the local government stepping back from direct intervention once the market is mature. This shows that green building strategies

include not only technical design choices, but also decisions about materials, responding to buyer preferences and using policy incentives, which is relevant for understanding developers perceived barriers and drivers analyzed in this thesis.

2. METHODOLOGY

2.1. Aim, model and hypotheses

Purpose of the empirical research: This study examines the key factors influencing the adoption of green building practices among professionals involved in real estate development in Lithuania. The analysis focuses on how perceived barriers and perceived drivers relate to adoption, and whether higher adoption levels are associated with more favorable project outcomes.

Theoretical framework: The empirical model is based on two complementary theoretical perspectives:

(1) **Stakeholder theory** proposes that organizations operate within a network of actors whose expectations, requirements and pressures influence organizational decisions (Freudenreich et al., 2019). In the context of real estate development, relevant stakeholders include clients, investors, architects, contractors, sustainability consultants and local communities. Their expectations may create drivers or barriers to adopting green building practices. Freudenreich et al. (2019) show that value creation for sustainability takes place in relationships with multiple stakeholders. This means that understanding stakeholder expectations and contributions is essential when analyzing how companies design and implement sustainability-oriented business models. This framework therefore provides a conceptual basis for analyzing how perceived stakeholder-related pressures and incentives influence the adoption of sustainable building measures.

(2) **Innovation Adoption Perspective** examines how organizations decide whether to implement a new practice based on their overall evaluation of its expected benefits, costs and risks. Prior research shows that adoption is more likely when organizations perceive that a new practice offers clear advantages – such as economic gains, improved performance, or reduced long-term risks – and when potential obstacles appear manageable (Hami et al., 2025). Hami et al. (2025) emphasize that potential adopters assess innovations based on perceived benefits, perceived risks and value that they expect to create, and that these perceptions strongly influence whether a new solution is accepted or rejected. Applied to green building, this perspective helps to explain why perceived barriers reduce adoption and why supportive conditions, such as available financial incentives, can strengthen organizations' willingness to integrate sustainable building measures.

Together, these two perspectives provide a clear theoretical basis for the model: Stakeholder Theory clarifies why organizations face specific drivers and barriers, while the Innovation Adoption Perspective explains how these perceptions influence adoption and its expected outcomes. In this thesis, these perspectives are directly reflected in the main constructs (perceived barriers, perceived drivers, adoption, and project outcomes) and in the hypotheses about how they are related. Therefore, these frameworks support the relationships analyzed in this study.

Structural Model: The empirical model consists of four main constructs:

(1) **Perceived barriers** *(Section 4)* – refers to the constraints that respondents perceive as constraining the implementation of green building practices. The construct is measured through items assessing:

- High initial costs of green solutions
- The bureaucratic or costly nature of certification
- Complexity and cost of operating and maintaining green technologies
- Lack of internal technical expertise
- Limited availability of materials or qualified suppliers
- Low client willingness to pay for sustainability
- Unclear or inconsistent regulatory requirements

(2) **Perceived drivers** *(Section 5)* – refers to the extent to which respondents view government incentives as supporting or enabling the implementation of green building practices. The construct is measured using items assessing:

- Whether financial incentives improve the economic feasibility of green projects
- Whether such incentives are easy to apply for and access
- Whether the organization expects to use available incentives in future projects

(3) **Adoption of green building practices** *(Section 3)* – captures the extent to which organizations have integrated sustainability-oriented practices into their development projects. The construct is measured using items that assess:

- Whether sustainability and energy performance targets are set in projects
- Whether energy performance indicators are monitored
- Whether low-carbon or biogenic materials are specified
- Whether energy modeling or simulation is applied during design

- Whether independent certification is pursued in suitable project

(4) **Perceived project outcomes** *(Section 6)* – reflects respondents' assessments of the benefits achieved in projects that include green building measures. The construct is measured using items evaluating whether such projects have:

- Achieved energy cost savings
- Increased rents, sales prices, or tenant uptake
- Reduced long-term operation and maintenance costs
- Improved brand reputation and marketability
- Facilitated financing or permitting processes
- Generated a positive overall return on investment (ROI)

All items of each construct are rated on a 1-5 Likert scale and averaged into a single index. Before estimating the regression models, the distributions of the construct indices were examined using summary statistics (means, standard deviations, skewness) and histograms (Annex 2) to check for strong skewness or other violations of the linear OLS assumptions.

Measurement approach: The constructs included in the empirical model – perceived barriers, perceived drivers, adoption and perceived project outcomes – are measured using multi-item Likert-scale questions from the questionnaire. Using several items to represent each construct improves measurement accuracy, as multi-item scales better capture the underlying concept and reduce random error (Jebb et al., 2021). For each construct, responses to the corresponding Likert-scale items are first checked for missing values and coding errors and then averaged to obtain a mean index score. This approach treats all items within a construct as equally weighted indicators of the same concept and allows comparisons across respondents on a 1-5 scale. Before creating the indices, internal consistency for each item set is evaluated using Cronbach's alpha to verify that the items reliably measure the same construct (see Reliability and validity section). In addition to the quantitative indices, two open-ended questions are included to capture qualitative insights into the main barriers and potential improvements for green building adoption. These responses are used to contextualize the survey findings rather than as part of the statistical models.

Table 6. **Construct-item mapping**

Construct	**Questionnaire Section**	**Question items**	**Index calculation**
Adoption Index	Section 3	Q11(1) – Q11(5)	Mean of 5 items
Barriers Index	Section 4	Q12(1) – Q12(7)	Mean of 7 items
Drivers Index	Section 5	Q13(1) – Q13(3)	Mean of 3 items
Outcomes Index	Section 6	Q14(1) – Q14(6)	Mean of 6 items

Source: compiled by the author.

Questionnaire Validation: The questionnaire is pre-tested with 5 professionals from the target group to ensure clarity, relevance and consistent interpretation of the items. Early-stage pre-testing is recommended in the development of Likert type measures, as it helps verify item clarity and alignment with the constructs without requiring large samples (Jebb et al., 2021). Based on the pre-test, minor wording changes were made to improve clarity for the respondent, and the final version of the questionnaire was then used for data collection. The full questionnaire is provided in Annex 1.

Research Hypotheses:

H1: Perceived barriers are negatively associated with the adoption of green building practices.

H2: Perceived drivers are positively associated with the adoption of green building practices.

H3: Adoption of green building practices is positively associated with perceived project outcomes.

2.2.Analysis Method

The data analysis is conducted in R (R-Studio) and proceeds through the following steps:

(1) **Descriptive statistics.** Means, standard deviations, distributions are used to summarize all study variables and understand the general structure of the dataset. For each construct index, skewness and histograms are examined to check for strong asymmetry that could affect the regression models. This step follows recommendations emphasizing that descriptive statistics help characterize what is typical in a dataset and support initial exploration of data (Kotronoulas et al., 2023).

(2) **Correlation analysis and multicollinearity diagnostics**. Pearson correlations are examined to identify initial relationships between variables. Multicollinearity is assessed using Variance Inflation Factors (VIF), which are essential indicators for diagnosing whether predictors contribute to multicollinearity in regression models – large VIF values may inflate standard errors and distort regression estimates (Marcoulides & Raykov, 2019). In this study, VIF values are calculated for the predictors in Model 1 to verify that multicollinearity is not a major concern. The diagnostics for multicollinearity are reported in the results chapter together with the regression output to document that the VIF values remain well below typical thresholds. VIF for predictors can be obtained by regressing that predictor on the remaining predictors applying the standard formula $VIF_j = 1 / (1 - R^2_j)$, where R^2_j is the coefficient of determination from the auxiliary regression (Marcoulides & Raykov, 2019).

(3) **Linear regression models and assumption checks**. Two Ordinary Least Squares (OLS) regression models are estimated to test the hypotheses. **Model 1** examines whether perceived

barriers and drivers predict adoption. **Model 2** tests whether adoption predicts perceived project outcomes. Regression assumptions are assessed using graphical and statistical diagnostics. Residual plots and histograms are inspected to assess linearity and the approximate normality of residuals, and tests for heteroskedasticity are used to evaluate the constancy of error variance. This follows methodological guidance emphasizing the importance of checking residual patterns, heteroscedasticity and model specification rather than relying solely on normality assumptions (Schmidt & Finan, 2018). Best practice reporting standards also highlight the need to systematically document model assumptions, diagnostics and error structure to ensure correct interpretation of regression findings (Jones et al., 2025).

Empirical Model Specification: The model examines three directional relationships between the constructs defined in the study. These relationships follow from the theoretical framework and the formulated hypotheses and are tested using OLS regression models.

The model includes the following links:

1. **Perceived barriers → Adoption**

Higher levels of perceived barriers are expected to reduce the adoption of green building practices.

2. **Perceived drivers → Adoption**

Stronger perceived drivers are expected to increase the adoption of green building practices.

3. **Adoption → Perceived Outcomes**

Higher adoption levels are expected to be associated with more favorable project outcomes.

To estimate these relationships, two regression models are used:

Model 1: tests the effects of perceived barriers and perceived drivers on adoption.

Model 2: tests the effect of adoption on perceived outcomes.

The regression equations:

$$Adoption_i = \beta_0 + \beta_1 Barriers_i + \beta_2 Drivers_i + \epsilon_i$$

where $Adoption_i$ is the adoption index for respondent i, $Barriers_i$ and $Drivers_i$ are the perceived barrier and driver indices, β_0 is the intercept, β_1 and β_2 are regression coefficients, and ϵ_i is the error term.

$$Outcomes_i = \gamma_0 + \gamma_1 Adoption_i + u_i$$

where $Outcomes_i$ is the perceived project outcomes index, γ_0 is the intercept, γ_1 is the coefficient for the adoption index and u_i is the error term.

The hypotheses H1, H2, H3 are tested by examining the sign magnitude and statistical significance of the coefficients β_1, β_2 and γ_1. In both models, the indices are constructed as described above by averaging the corresponding Likert-scale items.

Data Collection and Sample: Data is collected through an online questionnaire completed by **70 professionals** involved in real estate development in Lithuania, including **developers, architects, construction project managers and sustainability consultants**. A **purposive expert sampling** approach is used to ensure that respondents possess relevant knowledge about sustainability-related decisions in development projects – this method is appropriate when participants are intentionally selected because they are most likely to provide informed insights on the research topic (Campbell et al., 2020). These respondent groups are selected because they directly participate in real estate development projects and make or influence decisions related to the adoption of green building practices, which aligns with the aim of the study.

The questionnaire was distributed from 2025-12-11 to 2025-12-15 via email, that contained a link to Google Forms. From professional network 43 contacts got a direct invitation to participate in the survey, that included project managers, general managers, engineers and architects involved in real estate development in Lithuania. Also, 5 real estate developer firms and 7 architect firms were invited to participate in the survey, as well as the Lithuanian Green Building Council's manager ensured the further sharing of the questionnaire link within related professionals in the real estate market – developers, sustainability consultants, certification experts. In total 70 complete responses were obtained, after that, the online questionnaire was deactivated. In this case, there is no possibility to clearly state what the response rate was, because of the nature of personal professional network. The inclusion criteria required respondents to be involved in real estate development projects in Lithuania. There were no respondents who did not meet these criteria, since the questionnaire was distributed purposefully using personal professional networks.

The questionnaire was pre-tested with 5 professionals from the target group to ensure clarity, relevance and consistent interpretation of the items. Minor wording adjustments were made based on their feedback, and only fully completed questionnaires were used for the final dataset. Partially completed responses that were used for pre-testing were removed and are not included in the sample of 70 respondents.

Reliability and validity: Internal consistency of the multi-item indices is assessed using Cronbach's alpha for each construct (Jebb et al., 2021). The results indicate acceptable to good reliability, with alpha values of approximately 0.87 for the adoption index, 0.87 for the barriers index, 0.63 for the drivers index, and 0.86 for the outcomes index. This suggests that the items within each construct measure the same underlying concept. Content validity is supported by developing questionnaire items based on the literature in this thesis about green building barriers, drivers and outcomes and by conducting a pre-test from the target group, who confirmed the relevance and clarity of the questions. Construct validity was examined through Pearson correlations between the indices. Barriers were moderately and negatively correlated with adoption ($r = -0.49$) and project outcomes ($r = -0.41$), whereas drivers showed strong positive correlations with both adoption ($r = 0.63$) and outcomes ($r = 0.74$). Adoption was also strongly positively correlated with project outcomes ($r = 0.75$), which is consistent with the theoretical expectations described in this thesis.

Limitations: The study relies on self-reported survey data, which may contain systematic measurement errors such as overreporting of socially desirable behaviors or inaccuracies arising from subjective interpretation and recall, both of which can reduce the validity of the obtained measures (Koller et al., 2023). In addition, the cross-sectional research design captures all variables at a single point in time, making it impossible to establish causal relationships or determine the direction of influence between the analyzed constructs (Wang & Cheng, 2020).

Ethics: All survey procedures will comply with Vilnius University ethical standards: participation will be voluntary, responses anonymous, and data managed in compliance with GDPR and faculty guidelines.

3. THE ANALYSIS OF EMPIRICAL RESEARCH RESULTS

3.1.Research sample and data structure

The empirical study is based on a survey of **70** professionals representing organizations active in real estate sector. Prior to analysis, minor formatting adjustments were made to categorical labels to prevent automatic data type conversion, as well as the descriptions of questionnaire items were corrected for easier data analysis, without altering the meaning of responses.

The dataset consists of total 43 variables, including organizational and project-related characteristics (organization size, years active, market scope, project scale), sustainability context indicators (use of certification frameworks and the share of project incorporating green building practices), and item level measures used to measure the **4 main constructs** of the study. These constructs capture the adoption of green building practices, perceived barriers to green building adoption, perceived drivers to green building adoption, and perceived project outcomes. Each construct is measured using multiple Likert-scale items, allowing for a reliable representation of the concepts. In addition, open-ended questions are included to provide qualitative insights that support the interpretation of the quantitative results.

Respondent organization size: sample consists of organizations of different sizes, with most respondents representing small and medium-sized firms. Specifically, 60.0% of respondents indicated that their organization employs from 10 to 49 employees, while 21.4% represented micro-organizations employing from 1 to 9 employees. Organizations with 50 to 249 employees accounted for 18.6% of the sample. This organization size distribution reflects a strong presence of small and medium-sized organizations.

Respondent roles: The respondent group is dominated by professionals directly involved in real estate development activities. More than half of the respondents (52.9%) identify themselves as real estate developers, indicating that the survey largely captures perspectives from actors who play a central role in initiating and managing construction projects. Construction engineers specializing in HVAC, electrical, and water systems account for 21.4% of the sample, while architects represent 18.6% of respondents. A smaller share of the sample consists of sustainability consultants or green building certification experts (5.7%). Other roles are minimally represented (1.4%). Overall, the distribution of respondent roles suggests that the findings primarily reflect the views of practitioners who are directly responsible for project development and decision making.

Table 7. **Distribution of respondent roles (N=70)**

Respondent role	Number of respondents	Percentage
Real estate developer	37	52.9%
Construction engineer (HVAC, electrical, water systems)	15	21.4%
Architect	13	18.6%
Sustainability consultant / green certification expert	4	5.7%
Other	1	1.4%

Source: compiled by the author based on survey data.

Market scope: The respondents primarily represent organizations operating only in Lithuania. Specifically, 78.6% of the sample indicate that their organization works exclusively in the Lithuanian market. A smaller share report operating in the European Union (11.4%) or across the Baltic region (10.0%). Overall, the market distribution suggests that the empirical results mainly reflect the Lithuanian context, while still incorporating a limited proportion of organizations with broader regional and EU level exposure.

Table 8. **Market scope of respondent organizations (N=70)**

Market scope	Number of respondents	Percentage
Lithuania only	55	78.6%
European Union	8	11.4%
Baltic region	7	10.0%

Source: compiled by the author based on survey data.

Project scale: Majority of respondents indicate that their organizations primarily work on multi-building projects, which account for 70.0% of the sample. District-scale developments represent 15.7% of responses, while single-building projects account for 14.3%. This distribution suggests that most respondents are engaged in projects of moderate to larger scale.

Table 9. **Project scale of respondent organizations (N=70)**

Market scope	Number of respondents	Percentage
Multi-building	49	70.0%
District-scale	11	15.7%
Single building	10	14.3%

Source: compiled by the author based on survey data.

In terms of **experience** in the sector, majority of respondents represent organizations with substantial operational history, with 40.0% having been active for 11-20 years and 30.0% for more than 21 years.

3.2. Descriptive analysis of the main constructs

3.2.1. Adoption of green building practices

This section presents the descriptive statistics (means, standard deviations and distributions) for all main constructs and thus corresponds to the first (1) step of the analysis described in methodology.

Respondents' assessments of green building practice adoption show a mixed pattern across different practices. The highest average ratings are observed for setting sustainability targets (M=3.76, SD=1.00) and pursuing certification related practices (M=3.77, SD=1,28), indicating that these elements are relatively more established among the observed organizations. In contrast, monitoring and tracking energy performance receives the lowest mean score (M=2.46, SD=1.30), suggesting that systematic performance tracking is less consistently applied. The use of low-carbon materials (M=3.23, SD=1.13) and energy modelling (M=3.13, SD=1.23) fall in the mid-range, reflecting moderate uptake with noticeable variation across organizations.

Table 10. **Adoption of green building practices (Q11) – descriptive statistics (N=70)**

Item (practice)	Mean (M)	Standard deviation (SD)
Setting sustainability targets	3.76	1.00
Certification-related practices	3.77	1.28
Use of low-carbon materials	3.23	1.13
Energy modelling	3.13	1.23
Tracking energy performance	2.46	1.30

Source: compiled by the author based on survey data. *Items measured on a Likert-scale 1-5 (higher values indicate greater adoption)*.

3.2.2. Perceived barriers to green building adoption

Respondents perceive several barriers as highly relevant for green building adoption. The strongest barrier is low client willingness to pay more for green certified buildings (M=4.32, SD=0.93), followed by high initial costs for implementing green building practices (M=4.20, SD=0.88) and certification related bureaucracy (M=4.16, SD=0,97). Barriers related to operational complexity (M=3.99, SD=0,97) are also rated relatively high. Lack of skills and knowledge regarding green building implementation receives moderately high rating (M=3.83, SD=1.02), while unclear regulation is evaluated as the least severe barrier in this set (M=3.54, SD=1.00). Overall, the pattern indicates that market and cost related constraints are perceived as the most limiting green building adoption.

Table 11. **Adoption of green building practices (Q12), (N=70)**

Barrier item	Mean (M)	SD
Low client willingness to pay	4.34	0.93
High costs	4.20	0.88
Certification-related bureaucracy	4.16	0.97
Operational complexity	3.99	0.99
Limited supplier availability	3.96	0.97
Lack of skills	3.83	1.02
Unclear regulation	3.54	1.00

Source: compiled by the author based on survey data. *Items measured on a Likert-scale 1-5 (higher values indicate stronger agreement that the factor acts as a barrier).*

3.2.3. Perceived drivers to green building adoption

Respondents' evaluations of drivers related to green building adoption, as assessed through statements focusing on incentives, show a differentiated pattern across the three assessed aspects. The statement that incentives improve financial viability of green projects receives a relatively high mean score (M=3.87, SD=0.92), indicating that incentives are generally perceived as contributing positively to the economic feasibility of green projects. In contrast, the statement that incentives are easy to apply for and access is rated substantially lower (M=2.17, SD=0.98), suggesting that limited accessibility may reduce the effectiveness of incentives as a practical driver. The statement "our future projects will likely use incentives" receives a moderate evaluation (M=3.32, SD=1.05), indicating cautious expectations regarding the continued use of incentives in future projects. Overall, the results suggest that while incentives are recognized as a relevant driver through their contribution to financial viability, their perceived administrative complexity may constrain their role in promoting green building adoption.

Table 12. **Perceived drivers – incentives related factors (Q13), (N=70)**

Incentives-related driver	Mean (M)	SD
Contribution of incentives to financial viability	3.87	0.92
Intended future use of incentives	3.34	1.05
Accessibility of incentives	2.17	0.98

Source: compiled by the author based on survey data. *Items measured on a Likert-scale 1-5 (higher values indicate stronger agreement that the factor acts as a driver).*

3.2.4. Perceived project outcomes of green building adoption

Respondents' assessments of project outcomes associated with green building adoption vary across the evaluated dimensions. The highest mean score is reported for the statement that green practices improved brand reputation and marketability (M=3.71, SD=1.21), indicating that reputational outcomes are most consistently recognized. Energy cost savings achieved by projects

(M=3.44, SD=0.97) and overall return on investment (M=3.40, SD=0.92) are also evaluated relatively positively. More moderate evaluations are observed for outcomes related to increased rents, sales prices, or tenant uptake (M=3.09, SD=1.14) and reduced long-term operational and maintenance costs (M=3.01, SD=1.14). The lowest mean score is associated with the statement that certification improved financing or permitting conditions (M=2.40, SD=1.26), suggesting that such benefits are less consistently experienced by respondents.

Table 13. **Perceived project outcomes of green building adoption (Q14), (N = 70)**

Project outcome (Q14)	**Mean (M)**	**SD**
Improved brand reputation and marketability	3.71	1.26
Achieved energy cost savings	3.44	0.97
Positive overall ROI	3.40	0.92
Increased rents, sales prices, or tenant uptake	3.09	1.14
Reduced long-term operation and maintenance costs	3.01	1.14
Improved financing or permitting conditions due to certification	2.40	1.26

Source: compiled by the author based on survey data. *Items measured on a Likert-scale 1-5 (higher values indicate stronger agreement).*

3.3. Hypotheses testing and relationships between variables

3.3.1. Construct indices and correlation analysis

Before testing the hypotheses, reliability of indices was verified. The indices showed acceptable to good consistency, with Cronbach's alpha being 0.87 for adoption, 0.87 for barriers, 0.63 for drivers and 0.86 for project outcomes.

To test the hypotheses, composite indices are created for each main construct in the study. In line with the methodology, each index is calculated as the average of the corresponding Likert-scale items. The adoption index is based on five items from Question 11 related to the use of green building practices, the barriers index is based on seven items from Question 12 describing perceived obstacles, the drivers index is calculated from three incentives-related items in Question 13, and the outcomes index is based on six items from Question 14 assessing project results. These indices are then used in the correlation and regression analyses to examine the relationship between the main study variables. In addition, skewness values and histograms for the construct indices were inspected (skewness ranged from approximately -0.89 for barriers to -0.12 for adoption), and no strong deviations form symmetry were observed.

Table 14. **Construct indices (N = 70)**

Index	Mean	SD	Min	Max
Adoption index	3.27	0.97	1.00	5.00
Barriers index	4.00	0.72	1.57	5.00
Drivers index	3.13	0.74	1.00	5.00
Outcomes index	3.18	0.86	1.00	5.00

Source: compiled by the author based on survey data. *Indices are calculated as mean values of the corresponding Likert-scale items.*

The second (2) step of the analysis, as outlined in the methodology, is implemented by examining Pearson correlations between the construct indices and by reporting multicollinearity diagnostics for the predictors in Model 1.

Pearson correlation analysis is used to examine the relationships between the main constructs. The results show a negative association between perceived barriers and the adoption of green building practices, while perceived drivers are positively associated with adoption. Adoption is also positively associated with perceived project outcomes. In addition, perceived drivers show a positive association with perceived project outcomes, whereas perceived drivers are positively associated with outcomes.

Table 15. **Pearson correlation matrix of the main study constructs**

Construct	Barriers	Drivers	Adoption	Outcomes
Perceived barriers	1.000	−0.342	−0.495	−0.410
Perceived drivers	−0.342	1.000	0.626	0.742
Adoption of green building practices	−0.495	0.626	1.000	0.746
Perceived project outcomes	−0.410	0.742	0.746	1.000

Source: compiled by the author based on survey data.

3.3.2. Regression analysis: determinants of adoption (Model 1)

To test H1 and H2, an OLS regression model is estimated with the adoption of green building practices as the dependent variable. This implements the third (3) step of the analysis described in the methodology, where OLD regression is used to test the relationships between the constructs. In line with the methodology chapter, the model includes perceived barriers and perceived drivers as independent variables and control variables for basic organizational characteristics such as organization size, years active in the market, market scope and project scale.

The results indicate that perceived barriers are negatively and significantly associated with adoption (β=-0.43, $p < 0.01$), meaning that higher levels of perceived barriers are related to lower levels of green building adoption (Figure 1). Perceived drivers are positively and significantly associated with green building adoption (β=0.67, $p < 0.001$), indicating that stronger perceived drivers are related to higher adoption levels (Figure 2). The model explains a substantial share of

variance in adoption (R^2=0.48), suggesting that perceived barriers and drivers together play an important role in explaining differences in green building adoption across respondents. Based on these results, **H1 and H2 are supported.**

These findings are consistent with the Innovation Adoption Perspective, where adoption depends on how organizations balance expected benefits and perceived costs and risks (Hami *et al.,* 2025), and they also reflect Stakeholder Theory, as cost-sensitive clients, regulators and incentives providing governments shape both the barriers and drivers (Freudenreich *et al.,* 2019) observed in the Lithuanian real estate market. In addition, the strong role of cost and bureaucracy related barriers and incentive related drivers aligns with empirical research of Rita *et al.* (2023), Nooradzhar *et al.* (2024) and Gottlieb *et al.* (2023), who show that well designed incentives can effectively support green building adoption.

Table 16. **Regression results for adoption of green building practices (Model 1)**

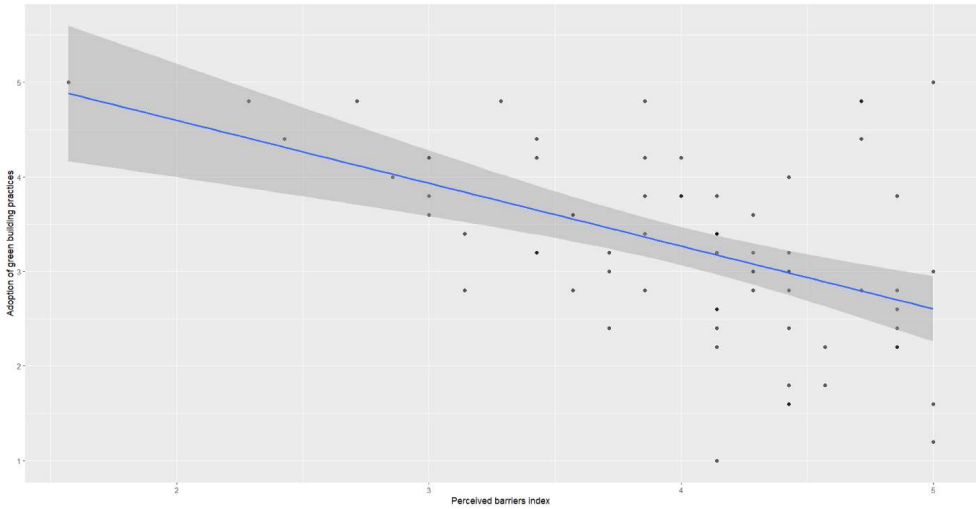
Predictor	B	Std. Error	t-value	p-value
Intercept	2.86	0.73	3.91	< 0.001
Perceived barriers	−0.43	0.13	−3.39	0.001
Perceived drivers	0.67	0.12	5.53	< 0.001

Source: compiled by the author based on survey data.

Model statistics:

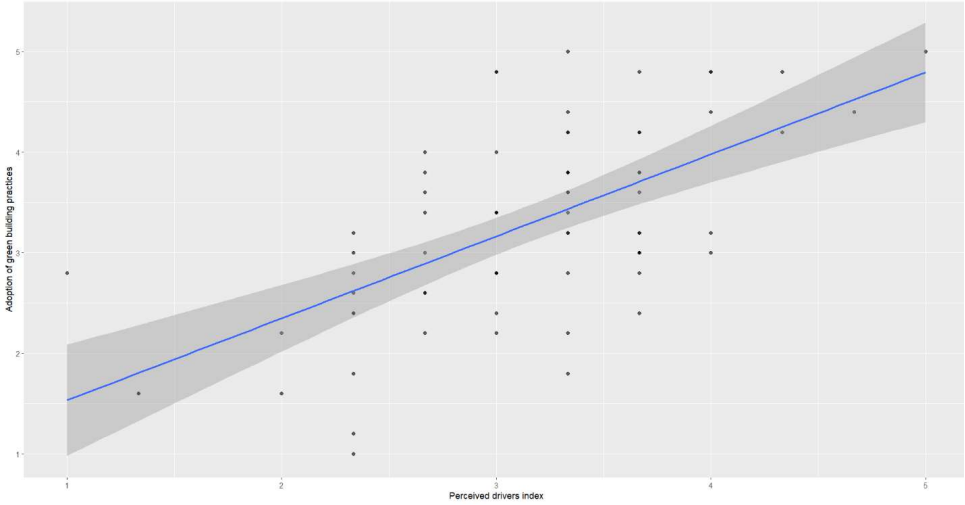
- R^2=0.48
- Adjusted R^2=0.47
- F(2, 67)=31.08, p<0.001
- N=70

Fig. 4. **Barriers → Adoption (negative relationship)**



Source: compiled by the author based on survey data.

Fig. 5. **Drivers → Adoption (positive relationship)**



Source: compiled by the author based on survey data.

3.3.3. Regression analysis: adoption and project outcomes (Model 2)

To test H3, an OLS regression model is estimated with perceived project outcomes as the dependent variable and adoption of green building practices as the independent variable. This model forms part of the third (3) analysis step by examining the effect of adoption on perceived project outcomes using OLS regression. Consistent with the methodology, the model also includes control variables for the organizational characteristics such as organization size, years active in the market, market scope and project scale, so that estimated effect of adoption reflects differences in outcomes beyond basic structural differences between organizations. The results show that adoption is positively and significantly associated with perceived project outcomes (β=0.66, $p < 0.001$), indicating that higher levels of green building adoption are related to more favorable project outcomes (Figure 3). The model explains substantial proportion of variance in perceived outcomes (R^2=0.56), suggesting that adoption plays an important role in shaping how project results are evaluated. Based on these results, **H3 is supported.**

These findings are consistent with the Innovation Adoption Perspective, as organizations that implement green practices report clearer benefits in terms of performance and risk reduction (Hami *et al.,* 2025). Findings are also supported by Stakeholder Theory as well, because higher adoption appears linked to reputational gains and value creation for key stakeholders such as clients, investors and local communities (Freudenreich *et al.,* 2019). Additionally, the positive association between adoption and project outcomes aligns with empirical findings on benefits of green buildings reported by Kim *et al.* (2020), Iqbal *et al.* (2023) and Liu *et al.* (2018), who

document improved property value, lower operating costs and higher user satisfaction in certified or energy efficient buildings.

Table 17. **Regression results for perceived project outcomes (Model 2)**

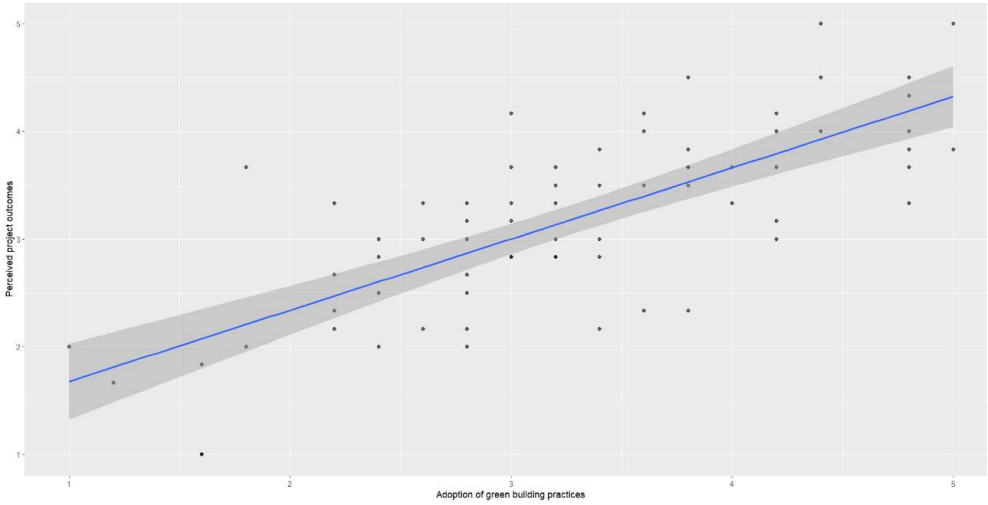
Predictor	B	Std. Error	t-value	p-value
Intercept	1.01	0.24	4.16	< 0.001
Adoption of green building practices	0.66	0.07	9.23	< 0.001

Source: compiled by the author based on survey data.

Model statistics:

- R^2=0.56
- Adjusted R^2=0.55
- F(1, 68)=85.16, p<0.001
- N=70

Fig. 6. **Adoption → Outcomes (positive relationship)**



Source: compiled by the author based on survey data.

3.3.4. Regression diagnostics and model validity

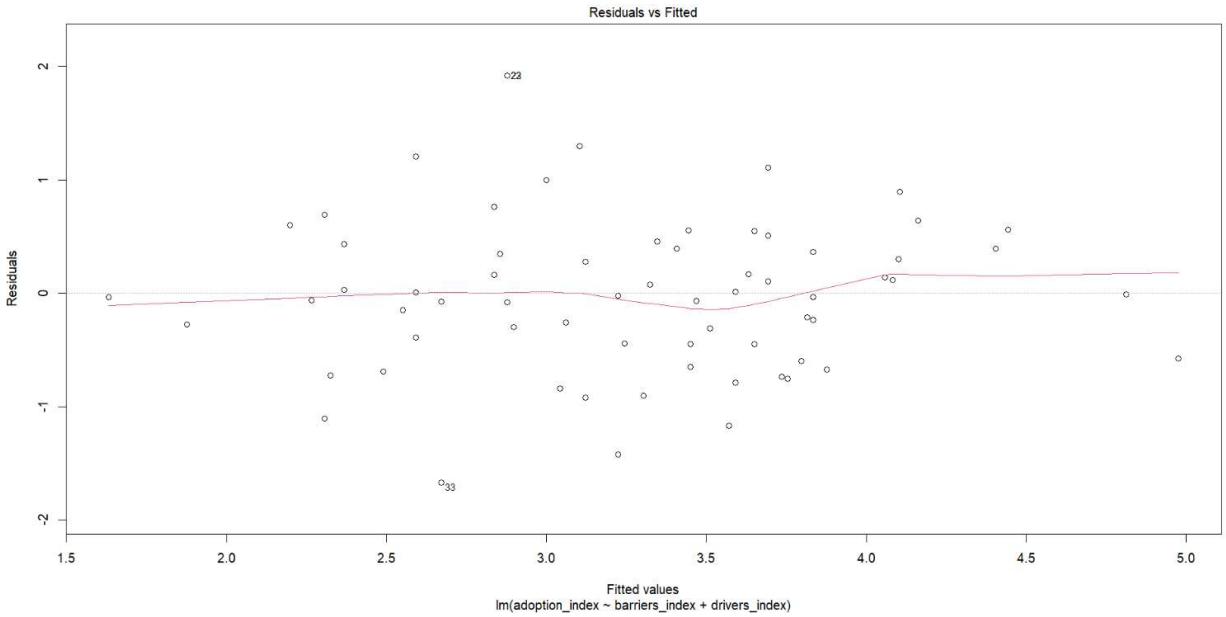
Multicollinearity diagnostics indicate no concerns in the regression models. The VIF for the predictors included in Model 1 are low (VIF=1.13), suggesting that perceived barriers and perceived drivers are not highly correlated and can be reliably included in the same model.

Regression assumptions are assessed and using standard diagnostic plots. In line with the third (3) analysis step in the methodology, this subsection reports the diagnostic checks for linearity, homoscedasticity, normality of residuals and heteroscedasticity. Visual inspection of residuals

indicates no systematic patterns in the residuals versus fitted values plot, suggesting that the assumption of linearity and homoscedasticity is reasonably met. The normal Q-Q plot shows that residuals are approximately normally distributed, while the scale location plot indicates stable variance across fitted values. Breusch-Pagan tests did not detect strong heteroskedasticity (Model 1: BP = 5.49, df = 2, p = 0.06; Model 2: BP = 0.49, df = 1, p = 0,49), which is consistent with the conclusion that the OLS assumptions are reasonably satisfied. Overall, the diagnostic results support the validity of the estimated regression models and suggest that the reported coefficients can be interpreted reliably. Figure 4 shows the residuals versus fitted values for Model 1. The residuals are randomly scattered around zero with no clear pattern, indicating that the assumptions of linearity and homoscedasticity are reasonably satisfied.

This diagnostic is consistent with the regression analysis approach described in the methodology chapter and ensures that the statistical criteria used to test the hypotheses and evaluate the relationships between constructs are methodologically robust.

Fig. 7. **Residuals versus fitted values for Model 1**



Source: compiled by the author based on survey data.

3.3.5. Summary of hypotheses testing results

The results of the hypotheses testing based on the regression analysis presented below. The findings indicate that all three hypotheses formulated in the study are empirically supported. Perceived barriers are negatively associated with the adoption of green building practices, while

perceived drivers show positive relationship with adoption. In addition, higher levels of adoption are positively related to more favorable perceived project outcomes.

Taken together, these results confirm the three relationships in the empirical model and are consistent with the theoretical expectations derived from Stakeholder Theory and the Innovation Adoption Perspective presented in the methodology. Additionally, results align with the broader transition perspectives discussed in the literature review, such as Socio-Technical Transition Theory (Hong *et al.,* 2025), Institutional Forces (Tetteh *et al.,* 2025) and Innovation Attributes and Switching Costs (Wang *et al.,* 2024).

Table 18. **Summary of hypotheses testing**

Hypothesis	**Expected relationship**	**Empirical result**
H1	Perceived barriers → Adoption (negative)	Supported
H2	Perceived drivers → Adoption (positive)	Supported
H3	Adoption → Perceived project outcomes (positive)	Supported

Source: compiled by the author based on survey data.

Although the sample includes different professional roles (developers, architects, engineers, consultants) the analysis focuses on the overall relationships between the constructs and does not estimate separate models for each group, because the group samples are relatively small. Future research with larger samples per group could investigate whether the effects of barriers, drivers and adoption differ across different professional roles in the real estate development process.

3.4. Analysis of open-ended survey responses

Analysis of the open-ended responses regarding the main barriers to green building adoption indicate several recurring themes. The answers were first reviewed to identify repeated ideas and words related to costs, regulation, market conditions and knowledge gaps within the company. Individual responses were then coded into initial categories – high initial costs, bureaucratic procedures, low client willingness to pay, which were merged into broader themes by grouping similar codes. Finally, these themes were compared to quantitative indices, and the barriers discussed in the literature to ensure consistency and alignment. Respondents most often refer to high costs and higher initial investments, emphasizing that green solutions are perceived as significantly more expensive than regular alternatives. The most frequently mentioned theme concerned costs and initial investments which appeared in the majority of responses ("*brangu*"

("it's expensive"), "*Per brangios medžiagos*" ("materials are too expensive"), "*Aukštesnės pradinės investicijos ir neaiškus atsipirkimo horizontas*" ("Higher initial investment and unclear payback period"), "*Brangu ir nerealistiška pradėti projektą su žaliaisiais sprendimais, atsižvelgiant į IRR ir ROI*" ("it is expensive and unrealistic to start a project with green solutions, given IRR and ROI"),"*Finansinė*" ("financial")).

Another theme relates to administrative and bureaucratic complexity, including certification procedures and difficulties associated with accessing public support or incentives, as illustrated by statements such as "*Biurokratija, kaštai*" ("bureaucracy, costs"), "*Labai sudėtinga ES parama*" ("EU support is very complicated"), "*Mažai informacijos apie valstybės rėmimą*" ("little information about state support measures") and references to the need for "*Aiškesnis reglamentavimas*" ("clearer regulation").

In addition, respondents highlight limited market demand and low client willingness to pay for sustainability, noting that certified green buildings are often seen as less competitive in the current Lithuanian real estate market ("*Klientai, pirkėjai nesutinka daugiau mokėti už NT, kuris, lyginant su projektais be sertifikatų, yra brangesnis. Toks NT yra nekonkurencingas rinkoje*" ("clients and buyers are not willing to pay more for real estate that is more expensive than non-certified projects, such properties are not competitive in the market"), "*Niekas brangiau nemokės už žaliąjį pastatą*" ("no one will pay more for a green building"), "*Nėra paklausos*" ("There is no demand"), "*Kol kas tai tik marketinginis veiksnys, realios paklausos Lietuvoje sertifikuotiems pastatams nėra*" ("so far this is only a marketing factor, there is no real demand for certified buildings in Lithuania").

Some responses also point to uncertainty about the actual benefits of certification and concerns regarding the long-term operational complexity of maintaining certified buildings, for example "*Neaišku, ar yra naudos*" ("it is unclear whether there is any benefit") and "*Tokių pastatų išlaikymas yra sudėtingas, kad išlaikytų sertifikavimo prasmę, jį reikia nuolat atnaujinti, dėl to pirkėjų/nuomininkų kaštai ilgainiui išauga*" ("maintaining such buildings is complex if the certification is to remain meaningful; it must be regularly renewed, which increases buyers' and tenants' costs over time"). These qualitative themes reinforce the quantitative barrier index results, highlighting **cost, bureaucracy, limited skills and market demand as central obstacles**, which is consistent with the barriers identified in recent studies by Rita et al. (2023), Nooradzhar et al. (2024) and Gottlieb et al. (2023).

The responses to open-ended question on potential improvements and supportive measures indicate several areas that respondents associate with facilitating wider adoption of green building practices. The answers were again reviews and coded into initial categories such as financial support mechanisms, tax incentives, faster permitting, clearer and more stable incentive systems,

communication, demonstration of benefits and market demand, which were grouped into broader themes. Some respondents refer to the importance of financial support mechanisms, including state funding, subsidies and tax incentives, as well as the need for a clear and stable system of financial incentives, for example "*valstybės finansavimas*" ("state funding"), "*Valstybės subsidijos*" ("state subsidies"), "*finansinė paskata, lengvatos*" ("financial incentives, tax reliefs").

Other responses point to administrative aspects, such as faster permitting processes and more flexible regulatory procedures – "*Greitesni projektavimo ir statybos leidimų išdavimo procesai*" ("faster design and building permit procedures"), "*aiški ir stabili finansinė paskatų sistema tvariems pastatams*" ("a clear and stable financial incentive system for sustainable buildings". In addition, several respondents emphasize the importance of demonstrating the real benefits of green building, both for residents and developers, and the role of market demand, for instance "*Naudos įrodymas*" ("proof of benefits"), "*Įrodyta reali nauda gyventojui ir statytojui*" ("proven real benefits for residents and developers").

A smaller number of responses mention communication and cooperation between the public and private sectors as relevant supportive factors, for example "*Valstybės įmonių bendradarbiavimas su privačiu sektoriumi*" ("cooperation between state owned companies and the private sector") and "*Komunikacija*" ("communication"), while others stress thar stronger market demand and lower implementation and operating costs would further support the adoption ("*Rinkos paklausa, statytojai bandytų prisitaikyti, reguliavimas, tikėtina, taptų lankstesnis, medžiagos – pigesnės, nes tiekėjams tektų konkuruoti tarpusavyje*" ("if there were market demand, developers would try to adapt, regulation would likely become more flexible and materials cheaper because suppliers would have to compete"), "*Mažesnė įgyvendinimo ir eksploatavimo kaina*" ("lower implementation and operating costs"), "*Paklausos atsiradimas*" ("emergence of demand"), "*Atsiradusi paklausa ir reali žaliųjų pastatų nauda gyventojams/nuomininkams*" ("emerging demand and real benefits of green buildings for residents/tenants")). Overall, the suggestions for **financial support, clearer regulation, training and knowledge development, and stronger cooperation** are closely related to transition strategies emphasized in the literature review, including coordinated policy incentives, training and stakeholder collaboration described by Falana et al. (2025) and Tetteh et al. (2025).

Most respondents highlighted cost related issues (10 out of 24 answers), followed by market demand and willingness to pay (4 answers) and bureaucratic or support related aspects (4 answers), while only one respondent stated that there were no significant barriers.

Table 19. **Open-ended question's themes**

Theme	**Respondent count**
Costs and initial investment	10
Market demand and willingness to pay	4
Bureaucracy and regulation/access to support	4
Benefits and operational/maintenance complexity	3
No significant barriers perceived	1
Otger	2

Source: compiled by the author based on survey results.

From a practical perspective, the results suggest several strategic implications for real estate developers and other stakeholders. First, companies should prioritize measures that directly reduce perceived barriers by improving cost predictability and transparency for clients, actively communicating the long term financial and other benefits of green buildings, and investing in staff training to strengthen internal competencies related to certification and sustainable design. Second, developers can refine their business strategies by targeting market segments that value sustainability more, experimenting with cost models for certification related expenses, also integrate green features into value propositions for the properties.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions of literature review and empirical research results: This thesis demonstrates that the key factors influencing the adoption of green building practices include various implementation costs, market related barriers, as well as drivers that are mainly based on incentives and stakeholder shaped conditions in the organization, that together determine how widely green building implementation is practiced in Lithuanian real estate sector and what project outcomes they deliver.

Literature review shows the importance on green buildings, highlights barriers and drivers to green practices adoption among real estate developers, as well as dives into regulatory and certification frameworks. The main certification frameworks are discussed and strategies adopted by real estate developers for sustainable development are analyzed. Literature review can be concluded as follows:

1. Green buildings bring various benefits, including economic, environmental, social and organizational/strategic. Authors like Kim, KH et al. (2020), Gültekin and Park (2023) and Tseng et al. (2023) agree that such projects can enhance property value, reduce operating costs and improve occupant wellbeing, while strengthening market positioning and long-term sustainability of real estate companies. These factors are also noticed while conducting empirical research in this study. Collaboration among stakeholders, according to Gomes et al. (2025) is one of the factors that helps to complete green building projects successfully. Lu et al. (2025) agrees that developers, clients and governments may adjust regulations to support green building progress. Thus, leadership and teamwork to support green building adoption among stakeholders in the real estate market also bring benefit to the organizations and stakeholders on an operational and internal levels. Collaboration among stakeholders is also noted in empirical research as one of the important factors that could help the adoption of green building practices in real estate market.
2. However, the green building transition is slowed by number of factors that occur in the real estate market. Authors Rita et al. (2023) and Nooradzhar et al. (2024) emphasizes on high cost of materials, administrative costs for obtaining green certifications, inconsistent occupants' needs and lack of green building knowledge and skills within the organizations. Government constraints are also mentioned as an important barrier to green building adoption. These barriers are supported in empirical research by survey data and analysis. Complexity of the barriers is highlighted as the real struggle, resulting difficulties the stakeholders face when transitioning towards green buildings. These findings support

empirical results of survey in this thesis, as the barriers in Lithuanian real estate market suggest similar barriers.

3. Green building adoption is best understood through socio-technical transition theory and institutional transition theory lens, where new practices meet new regimes in line with technological changes, regulatory frameworks and market dynamics. Hong et al. (2025) emphasize how interactions between niches and regimes pressures shape shifts in construction and energy systems. Tetteh et al. (2025) highlight the role of institutional forces in organizations, Wang et al. (2024) show that relative advantage, complexity and switching costs strongly influence whether actors decide to adopt new solutions. These perspectives compliment Stakeholder Theory and Innovation Adoption Perspective used in the empirical model by showing cost and market related barriers, drivers and stakeholder difficulties identified in the survey.
4. Literature analysis highlights effective transitioning strategies toward green buildings adopted by real estate developers, including financial incentives, clear regulatory frameworks, knowledge and cooperation among shareholders. Studies by Lu *et al.* (2025) and Si *et al.* (2025) show that subsidies and other incentives can shift developer behavior regarding green building adoption over time, especially when aligned with long-term policy goals. These findings from previous studies also to some extent reflect findings identified in this thesis survey.

Findings in empirical research leads to several key conclusions about business strategies for transitions towards green buildings in Lithuanian real estate sector. The following conclusions summarize main results of empirical research.

5. Survey results in this thesis show that the adoption of green building practices among real estate professionals is moderate and uneven, sustainability targets ad certification used more than actual energy performance tracking and energy modelling during project development. This finding may indicate that organizations in Lithuanian real estate sector seek visible elements of green building, rather than adopting practices within organization, thus operational and technical practices remain less developed.
6. The strongest barriers that real estate experts perceive are low client willingness to pay for green properties, high initial implementation costs, certification related bureaucracy and operational complexity, while unclear regulation is not seen as such a strong barrier. This suggests that market and cost constraints, together with administrative and knowledge related issues, play an important role, while regulatory requirements for transitioning are less strong than barriers. This is consistent with Stakeholder Theory as it reflects actors' expectations when it comes to transitioning.

7. One of the relevant drivers is indicated as financial incentives, as they improve the economic viability of green projects. However, administrative complexity can limit the effectiveness of incentives, as respondents indicate that the regulation is unclear and difficult to access. Therefore, organizations remain cautious about implementing green practices even when incentives can be available. This might be different situation, if incentives were easier to access and if they would bring more certainty about project financial results.
8. Higher adoption of green building practices is linked to more favorable project outcomes that real estate professionals perceive. Improved brand reputation, energy cost savings and positive ROI are identified as project outcomes in this study. From real estate experts' point of view, green buildings bring economic, energy saving and reputational advantages in Lithuania, although government incentives are not so easy to access and certification uptake is rather complex.
9. Empirical research analysis confirms all three hypotheses of this study – perceived barriers are negatively related to green building adoption, perceived drivers are positively related to green building adoption, and higher green building adoption is positively related to more favorable project outcomes. These results support the empirical model based on Innovation Adoption Perspective and Stakeholder Theory by showing that organizations' and stakeholders' pressures determine adoption decisions and outcomes, and they are also compatible with broader transition perspectives that are discussed in the literature review.
10. The qualitative respondents' responses compliment quantitative findings by highlighting high costs of green projects implementation, administrative complexity, limited internal skills and knowledge, as well as low client willingness to pay for green certified properties as the main obstacles in green building transition process. However, clearer procedures and stronger cooperation, as well as more reliable proofs on project financial validity are pointed out as key enabler for higher green building adoption in Lithuanian real estate sector. These themes reflect other conducted studies on strategies for overcoming transitioning barriers.

Limitations: This study is conducted in Lithuania with 70 respondents, that are currently involved in real estate development, however, sample size and geographical context may limit generalizability. OLS analysis, cross-sectional and self-reported respondents' data cannot show causality, but only reflects associations and context. Master thesis structure and time constraints may limit the depth of the study in some point. In addition, the available sample size does not

allow for robust group specific analyses, so potential differences between respondent groups remain an open question for future research.

Future research recommendations: Given the complexity of the topic and various stakeholders involvement, more advanced modelling might be sufficient for deeper analysis of transitioning towards green buildings in real estate sector. Comparative and project level studies in various organizations may reflect transitioning process more precisely.

Recommendations for organizations:

1. Reduce internal organizational barriers. Focusing on staff training and education on green building might result in lower struggles of understanding the implementation of complex green projects. Cost management and understanding of regulation policies might soften the barrier of green building adoption among developers and other stakeholders.
2. Use incentives strategically. Active monitoring and planning to apply for available incentives and integrating them into project economic indices may help to lower high initial costs.
3. Leverage reputational benefits. Treating green building practices and certifications as part of brand and market positioning might be a competitive advantage among competitors, therefore the clients and investors would more positively value green certified buildings, which would increase the demand for green certified properties.

Recommendations for public sector:

4. Simplify and stabilize incentives. Simpler application procedures and clear eligibility for green buildings incentives might support developers and reduce the barrier of low accessibility for financial subsidies and other relevant incentives.
5. Support knowledge spread among stakeholders. Financing training programs for organizations involved in real estate development might enhance green building practices adoption within firms, as they would reduce one of key barriers, identified in this study.
6. Promote cooperation and communication. Cohesive dialogue between developers, municipalities, consultants and other relevant stakeholders might help with coordination issues that arise when transitioning towards green building.

BUSINESS STRATEGIES FOR TRANSITIONS TOWARDS GREEN BUILDINGS

GRETA BUTKUTĖ

Master Thesis

Strategic economics

Vilnius University, Faculty of Economics and Business Administration

Supervisor – Assoc. Prof. Dr. Viktorija Cohen

Vilnius, 2026

SUMMARY

49 pages, 19 tables, 7 figures, 55 references

The master thesis analyzes business strategies for transitions towards green buildings in real estate sector with a focus on Lithuanian market. The main purpose of the thesis is to evaluate key factors influencing the adoption of green building practices among professionals involved in real estate development and to determine how these drivers and barriers are related to the adoption of green building practices and how adoption is related to perceived project outcomes. The study consists of three parts – analysis of scientific literature, empirical research and results, followed by conclusions and recommendations.

Literature analysis highlights green building concept and its benefits; explains main certification frameworks used in real estate sector and discusses business strategies adopted by real estate developers and other stakeholders. This chapter includes theoretical frameworks that support the transition toward green buildings and explains how perceived barriers and drivers shape stakeholders' decisions regarding the adoption of green practices.

Empirical study in conducted with survey of 70 experts working in Lithuanian real estate development sector – developers, architects, engineers and sustainability consultants – to identify perceived barriers, drivers, green building adoption level and perceived project outcomes. Results are analyzed using descriptive statistics, OLS regression and correlation analysis to test three hypotheses about relationship between constructs. The results show that adoption of green building practices is uneven and moderate, cost and market concerns are defined as barriers. However, incentive-based drivers contribute positively to green building adoption, barriers contribute negatively to green building adoption, and adoption contribute positively to project outcomes.

In conclusions and recommendations thesis suggest that organizations should be focusing on internal strengths when it comes to green building adoption, incentives should be used strategically, while public sector should simplify and clarify incentive access, as well as promote collaboration and knowledge sharing among stakeholders.

VERSLO STRATEGIJOS PEREINANT PRIE ŽALIŲJŲ PASTATŲ

GRETA BUTKUTĖ

Magistro baigiamasis darbas

Strategijos ekonomika

Vilniaus universiteto Ekonomikos ir verslo administravimo fakultetas

Darbo vadovė – Assoc. Prof. Dr. Viktorija Cohen

Vilnius, 2026

SANTRAUKA

49 puslapiai, 19 lentelių, 7 paveikslėliai, 55 literatūros šaltiniai.

Magistro darbe analizuojamos verslo strategijos, skirtos perėjimui prie žaliųjų pastatų nekilnojamojo turto sektoriuje, daugiausia dėmesio skiriant Lietuvos rinkai. Pagrindinis darbo tikslas – įvertinti pagrindinius veiksnius, lemiančius žaliųjų pastatų praktikos diegimą tarp nekilnojamojo turto plėtros srityje dirbančių specialistų ir nustatyti, kaip šie veiksniai (skatinantys veiksniai ir kliūtys) susiję su žaliųjų praktikos priemonių diegimu bei kaip diegimo lygis susijęs su suvokiamais projekto rezultatais. Darbą sudaro trys dalys – mokslinės literatūros analizė, empirinis tyrimas ir rezultatai, po kurių pateikiamos išvados ir rekomendacijos.

Literatūros analizėje apžvelgiama žaliųjų pastatų samprata ir jų nauda, paaiškinamos pagrindinės nekilnojamojo turto sektoriuje naudojamos sertifikavimo sistemos ir aptariamos verslo strategijos, kurias taiko vystytojai ir kiti suinteresuotieji subjektai. Šiame skyriuje pristatomos teorijos, padedančios paaiškinti perėjimą prie žaliųjų pastatų, ir detalizuojama, kaip suvokiamos kliūtys ir skatinantys veiksniai formuoja suinteresuotųjų šalių sprendimus žaliųjų praktikų diegimo kontekste.

Empirinis tyrimas atliktas apklausiant 70 Lietuvos nekilnojamojo turto plėtros sektoriuje dirbančių ekspertų – vystytojus, architektus, inžinierius ir tvarumo konsultantus – siekiant identifikuoti suvokiamas kliūtis, skatinančiu veiksnius, žaliųjų pastatų diegimo lygį ir suvokiamus projekto rezultatus. Tyrimo rezultatai analizuojami taikant aprašomąją statistiką, OLS regresijos ir koreliacinę analizę siekiant patikrinti tris hipotezes apie ryšius tarp nagrinėjamų konstruktų.

Gauti rezultatai rodo, kad žaliųjų pastatų praktikos diegimas yra netolygus ir vidutinio lygio, o kaštų ir rinkos veiksniai įvardijami kaip pagrindinės kliūtys. Tuo tarpu paskatomis grindžiami skatinantys veiksniai teigiamai veikia žaliųjų pastatų diegimą, kliūtys daro neigiamą poveikį, o didesnis diegimo lygis siejamas su palankesniais projekto rezultatais.

Išvadose ir rekomendacijose siūloma, kad organizacijos, diegdamos žaliųjų pastatų praktikas, daugiau dėmesio skirtų vidinių gebėjimų stiprinimui ir strategiškam paskatų naudojimui, o viešasis sektorius – supaprastintų ir aiškiau reglamentuotų paskatų taikymo sąlygas bei skatintų bendradarbiavimą ir žinių sklaidą tarp suinteresuotųjų šalių.

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ANNEXES

Annex 1. **Questionnaire: Transition toward green buildings in real estate sector**

SECTION 1 – Respondent Screening

(Ensures respondent qualifies for the study)

Q1. In which country do you primarily operate?

▢ Lithuania
▢ Other__ (please specify)

(screening/descriptive)

Q2. What is your professional role? (Select best match)

▢ Real estate developer
▢ Architect
▢ Construction Engineer (HVAC, electrical, water systems)
▢ Sustainability consultant / green certification expert
▢ Other__ (please specify)

(screening/descriptive)

Q3. Have you been professionally involved in new construction or major renovation projects in the past 5 years?

▢ Yes
▢ No → *End survey*

(screening)

SECTION 2.1 – Organization and project profile

(Control variables; descriptive statistics)

Q4. Approximately how many employees does your organization have?

▢ 1–9 ▢ 10–49 ▢ 50–249 ▢ 250+

(control variable: organization size)

Q5. For how many years has your organization been active in real estate/construction market?

▢ 0–5 ▢ 6–10 ▢ 11–20 ▢ 21+

(control variable: firm experience)

Q6. What types of projects does your organization typically work on? (select all that apply):

▢ Residential ▢ Office ▢ Retail ▢ Industrial/logistics
▢ Mixed-use ▢ Public buildings ▢ Other: ___

(descriptive)

Q7. In which markets does your organization operate?

▢ Lithuania only ▢ Baltic region ▢ European Union ▢ Global markets

(control variable: market scope)

Q8. What is the typical scale of your development projects?

▢ Single building ▢ Multi-building ▢ District-scale

(control variable: project scale)

SECTION 2.2 – Sustainability context (descriptive)

(not part of any index)

Q9. Which certifications or frameworks have been used in your projects?
(Select all that apply)

▢ None
▢ BREEAM
▢ LEED
▢ A+/A++ energy efficiency class objectives
▢ DGNB
▢ Other: ___

Q10. Approximately what share of your organization's recent projects included green building measures or certification?

▢ 0% ▢ 1–10% ▢ 11–25% ▢ 26–50% ▢ More than 50%

(descriptive variable)

SECTION 3 – Adoption of green building practices

(Dependent variable: ADOPTION INDEX)

Please evaluate the extent to which your organization currently applies the following green building practices.

Scale: 1=Not applied at all … 5=Fully applied

Q11. Adoption index (green building implementation practices):

(1) We set explicit sustainability & energy targets in projects.
(2) We track energy performance (e.g., EPC class) as a key KPI.
(3) We specify low-carbon or biogenic materials where feasible.
(4) We apply energy modelling or simulation during design.
(5) We pursue independent certification in suitable projects.

(ADOPTION INDEX = mean of these 5 items)

SECTION 4 – Perceived Barriers

(Independent variable: BARRIERS INDEX)

Please indicate how strongly you perceive the following barriers when implementing green building practices.

Scale: 1=Not a barrier … 5=Major barrier

Q12. Barriers index items:

(1) Initial costs of green solutions are too high.
(2) Certification is expensive and bureaucratic.
(3) Operating & maintaining green systems is complex/costly.
(4) Lack of internal skills/training limits implementation.
(5) Limited availability of materials or qualified suppliers.
(6) Clients' willingness to pay for sustainability is low.
(7) Regulatory requirements are unclear/inconsistent

(BARRIERS INDEX = mean of these 7 items)

SECTION 5 – Perceived Drivers

(Independent variable: DRIVERS INDEX)

Please evaluate the extent to which you perceive government incentives as supporting the adoption of green building practices.

Scale: 1=Strongly disagree … 5=Strongly agree

Q13. Drivers index items:

(1) Incentives improve financial viability of green projects.
(2) Incentives are easy to apply for and access.
(3) Our future projects will likely use incentives.

(DRIVERS INDEX = mean of these 3 items)

SECTION 6 – Perceived project outcomes

(Dependent variable in Model 2: OUTCOMES INDEX)

Please evaluate the outcomes your organization has experienced in projects involving green building measures.

Scale: 1=Strongly disagree … 5=Strongly agree
Q14. Outcomes index items:

(1) Our projects achieved energy cost savings.
(2) Green features increased rents, sales prices, or tenant uptake.
(3) Green projects reduced long-term operation and maintenance costs.
(4) Green practices improved our brand reputation and marketability.
(5) Certification improved financing or permitting conditions.
(6) Overall return on investment (ROI) has been positive.

(OUTCOMES INDEX = mean of these 6 items)

SECTION 7 – Open questions, qualitative insights

Q15. What would most accelerate green building adoption in your sector? (Select up to 2)

(1) Clearer regulation.
(2) Stronger financial incentives.
(3) Proven ROI or market demand.
(4) Skills/training availability.
(5) Supply chain development.
(6) Faster permitting processes.
(7) Other: ___

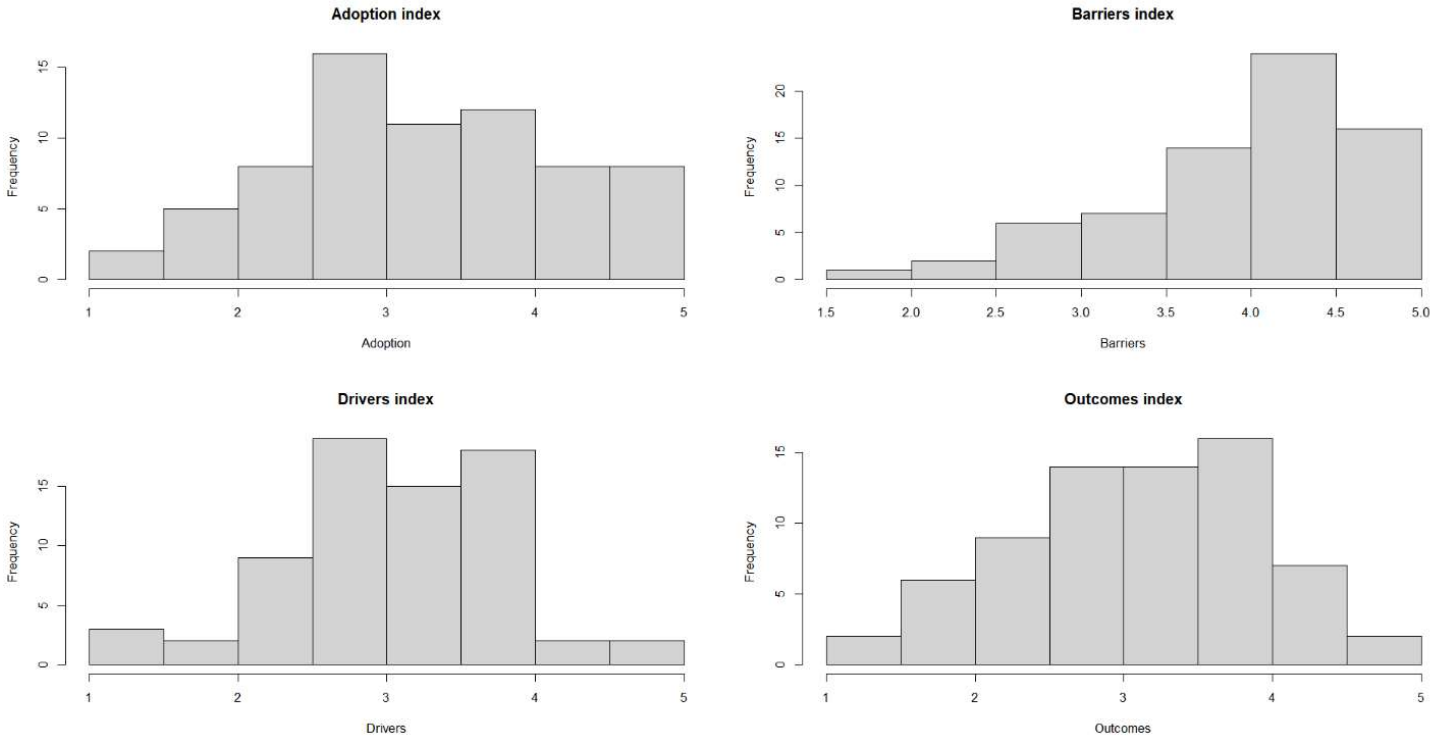
Q16. What is currently the biggest barrier to green building adoption in your projects?

(open text)

Q17. What one change would help the most in increasing green building adoption in Lithuania?

(open text)

Annex 2. **Histograms for assessing OLS linearity assumptions**



Source: compiled by the author based on survey data.