

REPUBLIC OF TÜRKİYE
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING

**ASSESSMENT FRAMEWORK OF ECONOMIC
SUSTAINABILITY FOR CURRENT HOUSING STOCK:
CASE OF TÜRKİYE**

Merve ÇÖVÜT

MASTER OF SCIENCE THESIS

Department of Architecture

Program of Housing Production and Construction Management

Supervisor

Assoc. Prof. Dr. Tuğçe ERCAN

July, 2025

REPUBLIC OF TÜRKİYE
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SCIENCE AND ENGINEERING

**ASSESSMENT FRAMEWORK OF ECONOMIC
SUSTAINABILITY FOR CURRENT HOUSING STOCK: CASE
OF TÜRKİYE**

A thesis submitted by Merve ÇÖVÜT in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** is approved by the committee on 17/07/2025 in Department of Architecture, Program of Housing Production and Construction Management.

Assoc. Prof. Dr. Tuğçe ERCAN
Yildiz Technical University
Supervisor

Approved By the Examining Committee

Assoc. Prof. Dr. Tuğçe ERCAN, Supervisor
Yildiz Technical University

Assoc. Prof. Dr. Almula KÖKSAL IŞIKKAYA, Member
Yildiz Technical University

Assoc. Prof. Dr. Pınar IRLAYICI ÇAKMAK, Member
Istanbul Technical University

I hereby declare that I have obtained the required legal permissions during data collection and exploitation procedures, that I have made the in-text citations and cited the references properly, that I haven't falsified and/or fabricated research data and results of the study and that I have abided by the principles of the scientific research and ethics during my Thesis Study under the title of "Assessment Framework of Economic Sustainability for Current Housing Stock: Case of Türkiye" supervised by my supervisor, Assoc. Prof. Dr. Tuğçe ERCAN. In the case of a discovery of false statement, I am to acknowledge any legal consequence.

Merve ÇÖVÜT

Signature



Dedicated to my family

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my advisor Assoc. Prof. Dr. Tuğçe ERCAN for her trust in me, valuable insights, and guidance throughout this thesis process. Her support played a significant role in keeping me on track and maintaining a positive academic experience. I would also like to thank the valuable experts who contributed to the survey process with their insightful inputs and continuous participation. Finally, I am deeply grateful to my family for their support and presence that has always encouraged my professional development.

Merve ÇÖVÜT

TABLE OF CONTENTS

LIST OF SYMBOLS	vii
LIST OF ABBREVIATIONS	viii
LIST OF FIGURES	x
LIST OF TABLES	xi
ABSTRACT	xii
ÖZET	xiv
1 INTRODUCTION	1
1.1 Problem Statement on Economic Sustainability for Housing Stock.....	3
1.2 Aim of the Study	10
1.3 Scope and Limitations of the Study	11
1.4 Research Design and Method.....	11
2 SUSTAINABLE HOUSING CONCEPT	13
2.1 Definiton of Sustainable Housing	13
2.2 Main Dimensions of Sustainable Housing.....	17
2.2.1 Environmental Sustainability	18
2.2.2 Social Sustainability	20
2.2.3 Economic Sustainability	21
2.3 Sustainable Housing Models in Literature	24
3 ECONOMIC SUSTAINABLE HOSUING CONCEPT AND ASSESSMENT INDICATORS	44
3.1 Economic Sustainability Indicators.....	44

3.2 Thematic Analysis of Economic Sustainability Indicators	49
4 METHODOLOGY OF THE STUDY	53
4.1 Methodological Approach of the Study	53
4.2 Design of the Research Process	55
4.2.1 Selection of Sources	55
4.2.2 Indicator Selection Criteria.....	60
4.2.3 Thematic Analysis	60
4.3 Delphi Method for Predicting the Importance of the Indicators and Developing a Framework for Economic Sustainable Housing Stock in Türkiye	61
4.3.1 Predicting the Delphi Survey Participants.....	63
4.4 Main Findings of the Delphi Analysis	65
4.4.1 First Round of the Survey.....	65
4.4.2 Second Round of the Survey	68
4.4.3 Third Round of the Survey	69
4.4.4 Analysis of the Delphi Study Results	69
4.4.5 Reliability and Validity of the Delphi Survey	72
5 CONCLUSION	75
REFERENCES	81
A 1. DELPHI SURVEY	88
B 2. DELPHI SURVEY	93
C 3. DELPHI SURVEY	96
PUBLICATIONS FROM THE THESIS	98

LIST OF SYMBOLS

$\bar{x}$	Arithmetic Mean
α	Coefficient alpha
Q3-Q1	Interquartile Range
Q1	1 st Quartile
Q2	2 nd Quartile
Q3	3 rd Quartile
σ	Standart Deviation

LIST OF ABBREVIATIONS

ABPRS	Adress Based Popularion Registration System
AHP	Analytic Hierarchy Process
Assoc. Prof.	Associate Professor
BRE	Building Research
BREEAM Method	Building Research Establishment Environmental Assessment Method
BSc	Bachelor of Science
COPRAS	Multiple Criteria Complex Proportional Evaluation
COVID-19	2019 Coronavirus Disease
DANP	Fuzzy DEMATEL-based Analytic Network Process
DGNB	Deutsche Gesellschaft für Nachhaltiges Bauen
EDGE	Excellence in Design for Greater Efficiencies
FSE	Fuzzy Synthetic Evaluation Technique
DEMATEL	Fuzzy Decision-Making Trial and Evaluation Laboratory
GYODER	Real Estate Investors Association
IFC	International Finance Corporation
IQR	Interquartile Range
KSPIs	Key Sustainability Performances
LEED	Leadership in Energy and Environmental Design
MCDM	Multiple Criteria Decision-Making Methods
MSc	Master of Science
OECD	Organization for Economic Co-operation and Development
PhD	Doctor of Philosophy
Prof.	Professor
RAND	American Research and Development Corporation
SDG 11	Sustainable Development Goals 11
TurkStat	Turkish Statistical Institute
UIA	International Union of Architects
UN-Habitat	United Nations Human Settlements Programme

USBGC	United States Green Building Council
VIKOR	ViseKriterijumska Optimizacija I Kompromisno Resenje Method
WELL	WELL Bulding Standard



LIST OF FIGURES

Figure 1.1 Housing prices	4
Figure 1.2 Core inflation index	5
Figure 1.3 House sales by type and state	6
Figure 1.4 Construction cost index of residential buildings	7
Figure 1.5 Population of provinces by years 2000-2023	8
Figure 1.6 Research stages of the study	12
Figure 2.1 Interaction of sustainability factors	14
Figure 2.2 Sustainable design strategies	15
Figure 2.3 Bibliometric analysis of sustainable housing keywords via Vosviewer	17
Figure 2.4 Criteria characterizing sustainable housing	25
Figure 2.5 Hierarchical structure of sustainability indicators and their significances	26
Figure 2.6 Conceptual framework of Sustainable Assessment Model for affordable housing	27
Figure 2.7 A framework for the sustainability performance of affordable housing	28
Figure 2.8 Success criteria for sustainable and affordable housing generated from document content analysis	30
Figure 2.9 Sustainability assessment system of public rental housing communities	32
Figure 2.10 The proposed evaluation framework for social housing toward sustainability	33
Figure 2.11 Criticality of economic, environmental and social success factors ...	35
Figure 2.12 A conceptual framework on barriers to sustainability attainment in affordable housing	38
Figure 2.13 ‘Top down’ and ‘bottom up’ routes to sustainable development	43
Figure 3.1 Thematic analysis	52
Figure 4.1 Research framework for the study	55
Figure 4.2 Execution of the Delphi Study	63

LIST OF TABLES

Table 1.1 Economic outlook (measure: gross domestic product, volume, growth)	2
Table 1.2 Population, annual growth rate of population, number of provinces, districts, towns, villages, and population density	7
Table 1.3 Türkiye housing census data	9
Table 2.1 Description of economic sustainability	22
Table 2.2 A multi-scale framework for sustainable housing policies	42
Table 3.1 Description and references of each indicator	47
Table 4.1 Summerazation of sources	56
Table 4.2 Profile of experts	66
Table 4.3 Answers to open-ended questions	67
Table 4.4 Results of surveys	71
Table 4.5 Overall averages of themes	72

ABSTRACT

Assessment Framework of Economic Sustainability for Current Housing Stock: Case of Türkiye

Merve ÇÖVÜT

Department of Architecture

Master of Science Thesis

Supervisor: Assoc. Prof. Dr. Tuğçe ERCAN

Sustainable development requires a healthy housing stock and market for nations. However, economic conditions pose major obstacles in the housing sector particularly in Türkiye. In order to ensure that sustainability is measurable, use of sustainability indicators and evaluation of their impacts are gaining importance. This study aims to create a framework for economic sustainability in the housing stock, identifying and prioritizing key indicators and creating a database by compiling certain indicators from the literature so that economic sustainability can be measured, particularly in the context of current housing stock and real estate. For the aim developing primary themes and identifying solution categories associated with these themes, and indicating potential areas for addressing the identified issues is crucial. After predicting the problem, first systematic literature review was conducted and selected studies were utilized to compile a comprehensive list of economic sustainability indicators for the housing stock. Secondly, Delphi survey was conducted to rank the economic sustainability indicators, which were compiled through the literature review, according to their importance and priority as assessed by experts, and to statistically analyze their responses. In order to achieve economic sustainability in housing stock, a coordinated approach involving the government, financial institutions, community, real estate market, and private sector is essential.

The government must implement policies that regulate mortgage rates, inflation, and infrastructure development, while financial institutions should provide affordable housing finance options. Community plays a key role in supporting sustainable housing initiatives, and the real estate market must adapt to demand to ensure stability. Private sector can drive innovation, particularly in appropriate technology and housing quality, helping to improve affordability and efficiency. Together, these sectors can foster a stable, sustainable housing market that benefits future generations. However, the results suggest that government, financial institutions and real estate market play critical roles in ensuring economic sustainability.

Keywords: Economic sustainability, housing stock, Delphi technique, economic sustainability indicators, housing market

Mevcut Konut Stoğu için Ekonomik Sürdürülebilirlik Değerlendirme Çerçevesi: Türkiye Örneği

Merve ÇÖVÜT

Mimarlık Anabilim Dalı

Yüksek Lisans Tezi

Danışman: Doç. Dr. Tuğçe ERCAN

Sürdürülebilir kalkınma, uluslar için sağlıklı bir konut stoğu ve piyasası gerektirir. Ancak ekonomik koşullar özellikle Türkiye'de konut sektöründe büyük engeller oluşturmaktadır. Sürdürülebilirliğin ölçülebilir olmasını sağlamak için sürdürülebilirlik göstergelerinin kullanımı ve etkilerinin değerlendirilmesi önem kazanmaktadır. Bu çalışma, konut stoğunda ekonomik sürdürülebilirlik için bir çerçeve oluşturmayı, temel göstergeleri belirlemeyi ve önceliklendirmeyi ve özellikle mevcut konut stoğu ve gayrimenkul bağlamında ekonomik sürdürülebilirliğin ölçülebilmesi için literatürden belirli göstergeleri derleyerek bir veri tabanı oluşturmayı amaçlamaktadır. Bu amaçla birincil temalar geliştirmek ve bu temalarla ilişkili çözüm kategorilerini belirlemek ve belirlenen sorunları ele almak için potansiyel alanları belirtmek çok önemlidir. Sorunu öngördükten sonra, önce sistematik literatür taraması yapılmış ve konut stoğu için kapsamlı bir ekonomik sürdürülebilirlik göstergeleri listesi derlemek için seçilmiş çalışmalardan yararlanılmıştır. İkinci olarak, literatür taraması yoluyla derlenen ekonomik sürdürülebilirlik göstergelerini uzmanlar tarafından değerlendirildiği şekilde önem ve önceliklerine göre sıralamak ve yanıtlarını istatistiksel olarak analiz etmek için Delphi anketi yapılmıştır. Konut stoğunda ekonomik sürdürülebilirliğe ulaşmak için hükümet, finans kuruluşları, topluluk, emlak piyasası ve özel sektörü içeren

koordineli bir yaklaşım esastır. Hükümet ipotek oranlarını, enflasyonu ve altyapı gelişimini düzenleyen politikalar uygulamalı, finans kuruluşları ise uygun fiyatlı konut finansmanı seçenekleri sağlamalıdır. Topluluk, sürdürülebilir konut girişimlerini desteklemede önemli bir rol oynar ve emlak piyasası istikrarı sağlamak için talebe uyum sağlamalıdır. Özel sektör, özellikle uygun teknoloji ve konut kalitesinde inovasyonu teşvik ederek uygunluğu ve verimliliği iyileştirmeye yardımcı olabilir. Bu sektörler birlikte, gelecek nesillere fayda sağlayan istikrarlı ve sürdürülebilir bir konut piyasası yaratabilir. Ancak sonuçlar, hükümetin, finans kuruluşlarının ve emlak piyasasının ekonomik sürdürülebilirliği sağlamada kritik roller oynadığını göstermektedir.

Anahtar Kelimeler: Ekonomik sürdürülebilirlik, konut stoğu, Delphi tekniği, ekonomik sürdürülebilirlik göstergeleri, konut piyasası

1

INTRODUCTION

Sustainability is of great importance in the 21st century where consumption, production, waste and global problems increase. Thus, many studies attach importance to this issue (Ha et al., 2023). For instance, Ha et al. (2023) highlight that in recent decades, sustainable housing development has emerged as a global priority, with nations striving to address environmental challenges while promoting social and economic sustainability. Similarly, Zavadskas et al. (2017) point out in their study that urbanization significantly impacts the environment on both local and global scales. So, continuous expansion of construction, manufacturing, and inefficient energy use leads to deteriorating air quality and accelerated climate change. As a result, there is a growing need for a safer and healthier built environment. Likewise, Gursel et al. (2023) state in their study that buildings cause excessive resource use, waste generation and high emissions. Furthermore, Adabre et al. (2020) stated that, especially the housing sector is the major energy consumer sector compared to other industries. These insights underscore the critical importance of incorporating sustainability principles into housing design, construction, and operation processes.

Sustainability is evaluated through its economic, social, cultural and environmental aspects. In other words, it is necessary to provide these three items to ensure sustainability. One of these, economic sustainability, is not well achieved today. Especially, the year 2020 marked a significant economic contraction for many countries due to the COVID-19 pandemic and it is shown in Table 1.1. This

contraction amounted to -3.03% globally and global growth rates recovered after the pandemic; however, a slowdown is evident in 2023 and 2024.

The Organization for Economic Co-operation and Development (OECD) Economic Outlook presents the OECD's analysis of the major global economic trends and prospects for the next two years. The Outlook puts forward a consistent set of projections for output, employment, government spending, prices and current balances based on a review of each member country and of the induced effect on each of them on international developments (OECD, 2024). Understanding these economic dynamics is crucial for framing sustainability strategies that are not only environmentally sound but also economically viable. As global economies continue to navigate the challenges of recovery, inflation, supply chain disruptions, and geopolitical instability, it becomes increasingly vital to embed sustainability at the core of economic policy and development planning.

Table 1.1 Economic outlook (measure: gross domestic product, volume, growth) (OECD, 2024)

Time period		2018	2019	2020	2021	2022	2023	2024
Reference area	Combined unit of measure							
Canada	Percent per annum, 2012	2,78	1,89	-5,07	5,01	3,44	1,16	0,82
France	Percent per annum, 2014	1,82	1,89	-7,68	6,36	2,53	0,91	0,75
Germany	Percent per annum, 2015	1,00	1,10	-4,20	3,12	1,88	-0,10	0,64
Greece	Percent per annum, 2015	1,67	1,80	-9,02	8,34	6,01	2,36	2,04
Italy	Percent per annum, 2015	0,78	0,48	-9,04	8,29	3,89	0,66	0,66
Japan	Percent per annum, 2015	0,64	-0,40	-4,24	2,23	0,93	1,71	1,04
Korea	Percent per annum, 2015	2,91	2,24	-0,71	4,30	2,61	1,36	2,26
Mexico	Percent per annum, 2018	1,97	-0,28	-8,65	5,84	3,90	3,41	2,53
Norway	Percent per annum, 2019	0,83	1,12	-1,28	3,90	3,28	1,25	0,75
Spain	Percent per annum, 2015	2,28	1,98	-11,17	6,40	5,77	2,41	1,41
Sweden	Percent per annum, 2022	2,03	2,02	-2,34	5,94	2,92	-0,47	0,86
Switzerland	Percent per annum, 2015	2,86	1,16	-2,28	5,39	2,66	0,84	0,89
Türkiye	Percent per annum, 2009	3,01	0,82	1,86	11,44	5,53	4,46	2,90
United Kingdom	Percent per annum, 2018	1,40	1,64	-10,36	8,67	4,35	0,53	0,68
United States	Percent per annum, 2017	2,97	2,47	-2,21	5,80	1,94	2,36	1,54
Euro area (17 countries)	Percent per annum, 2015	1,74	1,59	-6,23	5,85	3,42	0,60	0,88
OECD	Percent per annum	2,36	1,76	-4,20	5,93	2,93	1,66	1,41
China (People's Republic of)	Percent per annum, 2015	6,75	5,95	2,24	8,45	2,99	5,16	4,70
India	Percent per annum, 2011-2012	6,45	3,87	-5,83	9,05	7,24	6,26	6,06
Russia	Percent per annum, 2021	2,78	2,16	-2,61	5,57	-1,95	1,30	1,06
World	Percent per annum, 2015	3,62	2,83	-3,03	6,31	3,31	2,92	2,74
Rest of the world	Percent per annum, 2015	3,65	2,98	-3,44	5,82	2,02	2,30	2,49

Moreover, the economy has massive importance in sustaining human life by meeting basic needs such as food, shelter, healthcare, and education. Among these, housing holds a particularly vital position, not only as a necessity for individual well-being but also as a driving force within broader economic systems. As noted by Adabre et al. (2020), growth in the housing sector positively impacts related industries such as commerce, manufacturing, and finance, stimulating employment

and investment across the economy. This effect demonstrates that sustainable housing is not only a tool for achieving environmental goals or enhancing social equity, but also a strategic component of economic resilience and development. Thus, embedding sustainability into housing development supports both the well-being of individuals and the broader economic system.

1.1 Problem Statement on Economic Sustainability for Housing Stock

The majority of the built environment consists of housing and residential settlements and the built environment is an important resource for environmental, economic and social sustainability (Ashrafian et al., 2016). From an economic perspective, housing can serve as a major source of wealth for both individuals and nations (Adabre et al., 2020). And yet, the existing housing stock is not sustainable enough in terms of sustainability aspects, and especially in recent times economic sustainability cannot be achieved within the existing building stock. However, studies mostly focus on environmental sustainability and yet, according to Jiang et al. (2023), economic sustainability is the core dimension that affects environmental and social sustainability.

There is a global economic stress on countries, especially in the last couple years. As a result of economic problems, inflation rates, housing prices, rent prices, construction costs etc. have increased over time. Among the Organization for Economic Co-operation and Development (OECD) countries with latest available data, Türkiye is the country with the highest nominal housing price index by a large margin in 2023 with over 1.2 ratio, as seen in Figure 1.1 This situation and together with the examination of nominal housing prices of previous years, shows a significant increase. Likewise, the rental market in Türkiye has followed a parallel trajectory, with rent prices showing a sharp increase and a notable divergence from the trends observed in other OECD nations.

This situation highlights the urgent need to address economic sustainability within housing policies and planning frameworks. Without a balanced approach that considers affordability and economic resilience, efforts to promote sustainable housing will remain incomplete. In this light, developing strategies that stabilize housing markets, reduce construction costs, and ensure fair access to housing is

essential not only for economic sustainability but for advancing broader sustainability goals in the built environment.

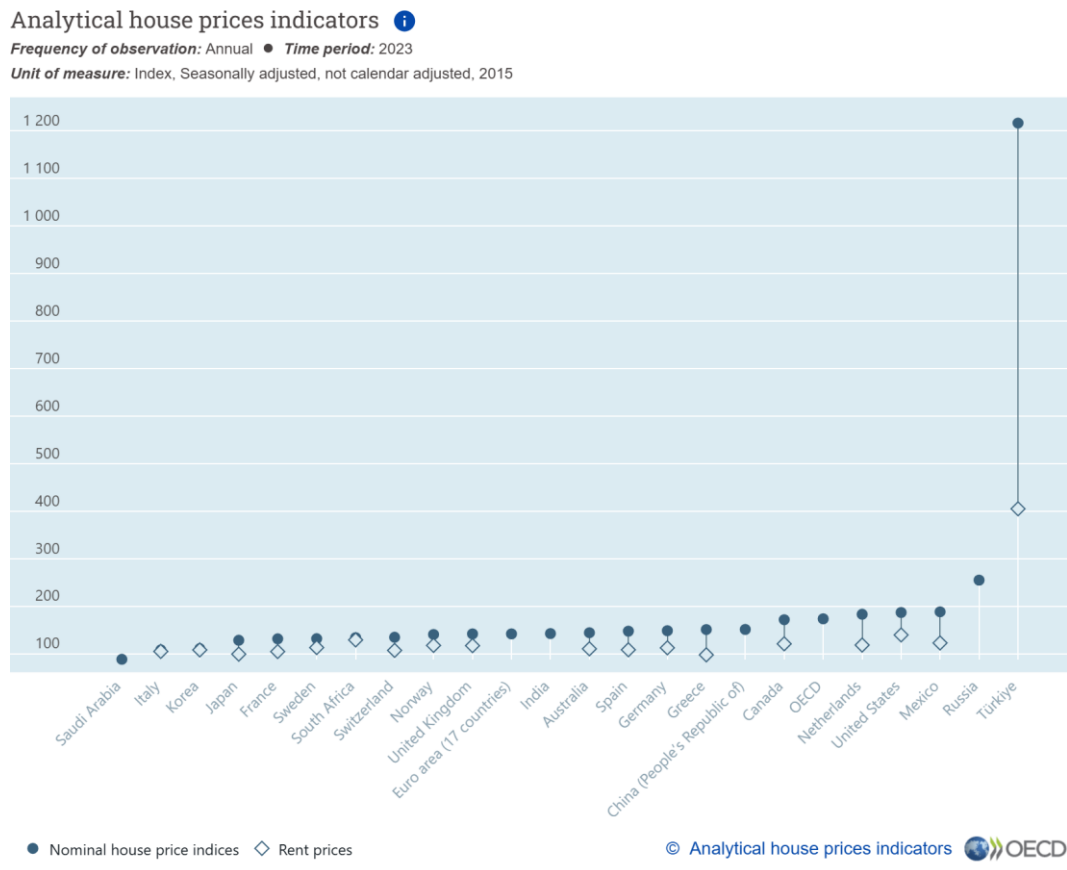


Figure 1.1 Housing prices (OECD, 2024)

In addition to the sharp rise in housing prices and rents, Türkiye is also experiencing a significant increase in inflation, further complicating the country's efforts toward achieving economic sustainability in the housing sector. According to OECD data presented in Figure 1.2, Türkiye recorded the highest inflation index among member countries in 2024, reaching 11.23. This led to problems such as: a decrease in purchasing power, increase in prices, high loan interest rates. Therefore, mortgaged housing sales have decreased over the years (Figure 1.3). These conditions create an environment in which accessing affordable housing becomes increasingly difficult for the average citizen.

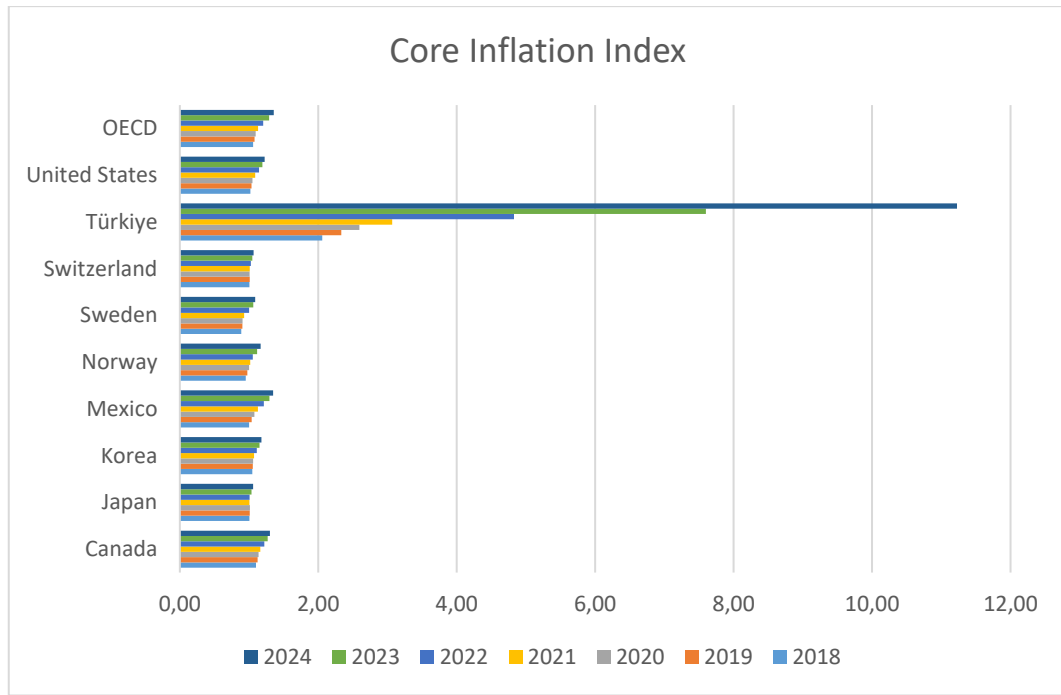


Figure 1.2 Core inflation index (OECD, 2024)

As a direct consequence of these economic challenges, according to the Turkish Statistical Institute (TurkStat) in Figure 1.3, mortgaged housing sales are decreased over the years. The reason is mostly high inflation rate, high interest rates and low credit opportunities in Türkiye.

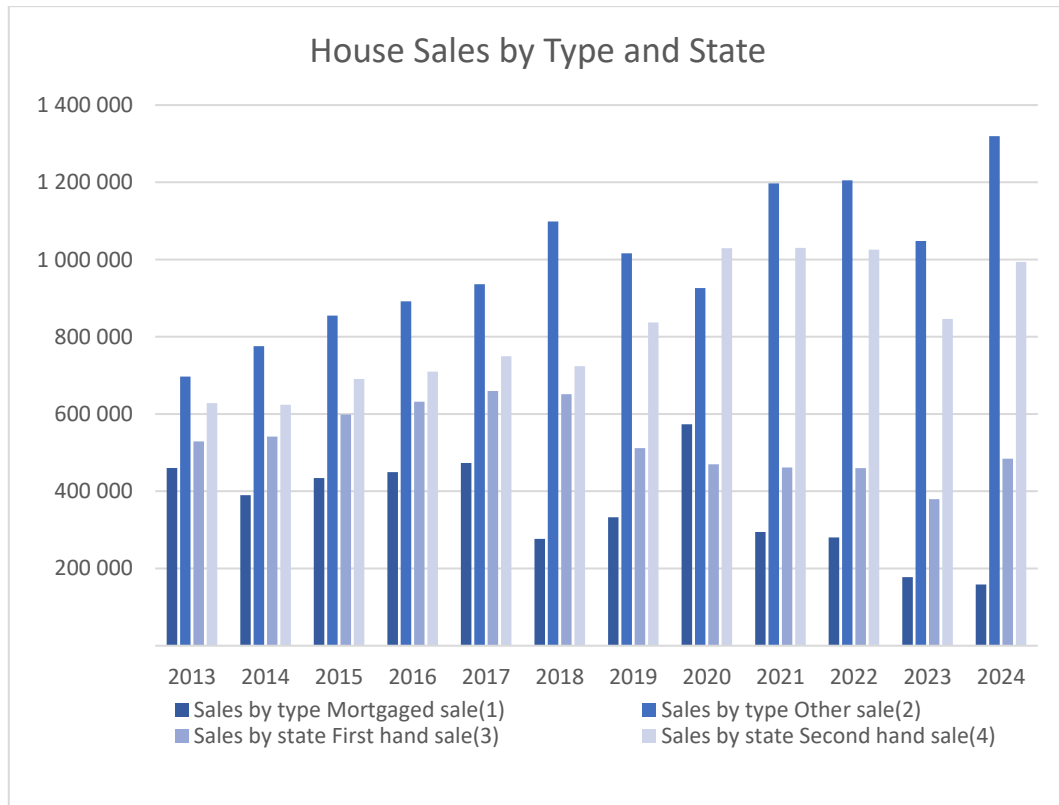


Figure 1.3 House sales by type and state (TurkStat, 2024)

In addition, due to the increasing inflation rates in Türkiye, when Turkish Statistical Institute (TurkStat) data is examined, it is seen that the construction costs of residential buildings (Figure 1.4) and other basic consumption prices have increased accordingly over the years. Construction cost is found by total price of material and labor expenses for residential buildings, both of which have been significantly affected by inflationary pressures. Rising construction costs not only discourage new development but also contribute to higher final sale prices of housing units, intensifying affordability concerns.

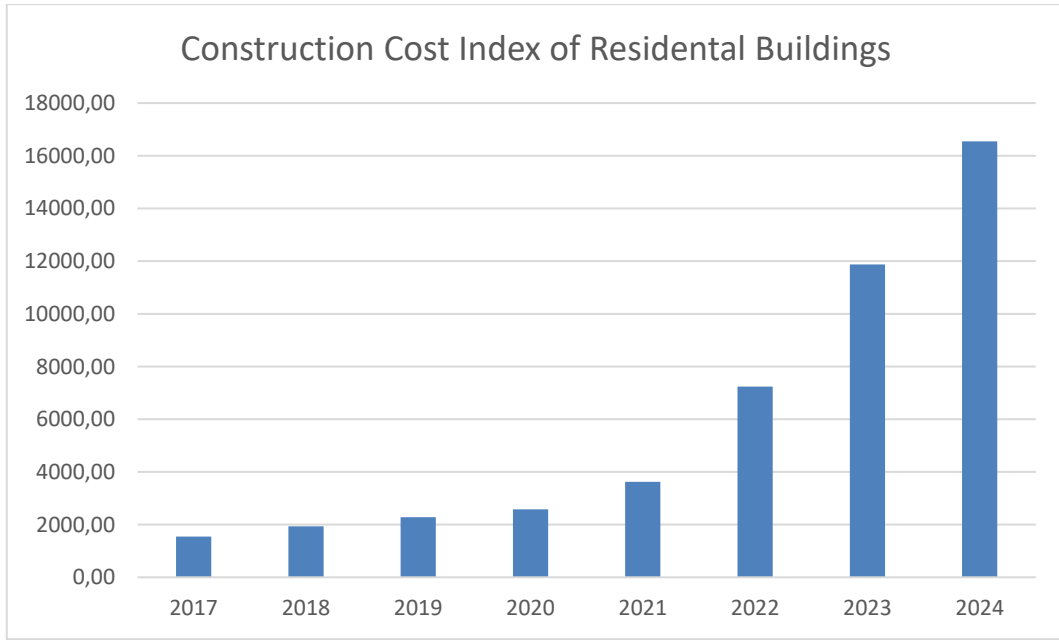


Figure 1.4 Construction cost index of residential buildings (TurkStat, 2024)

Furthermore, the population of cities is increasing day by day (Table 1.2) and the supply and demand balance of the existing building stock is changing. This growth is not evenly distributed across the country; Figure 1.5 illustrates significant disparities in population density among different cities in Türkiye. Uncontrolled migration often results in rapid urbanization that occurs without adequately addressing local needs and surpluses (Wu et al., 2020). This misalignment contributes to issues such as infrastructure strain, informal settlements, and unplanned urban sprawl.

Table 1.2 Population, annual growth rate of population, number of provinces, districts, towns, villages, and population density (TurkStat, the results of Address Based Population Registration System (ABPRS), 2023)

Yıl Year	Nüfus Population	Yıllık nüfus artış hızı Annual growth rate of population (%)	İl sayısı Number of provinces	İlçe sayısı ⁽¹⁾ Number of districts ⁽¹⁾	Belde/ilk kademe belediyesi sayısı Number of towns and submunicipalities	Köy sayısı ⁽²⁾ Number of villages ⁽²⁾	Nüfus yoğunluğu Population density
2015	78 741 053	13,4	81	919	397	18 362	102
2016	79 814 871	13,5	81	919	397	18 373	104
2017	80 810 525	12,4	81	921	396	18 380	105
2018	82 003 882	14,7	81	922	386	18 275	107
2019	83 154 997	13,9	81	922	386	18 280	108
2020	83 614 362	5,5	81	922	386	18 287	109
2021	84 680 273	12,7	81	922	387	18 288	110
2022	85 279 553	7,1	81	922	388	18 293	111
2023	85 372 377	1,1	81	922	390	18 240	111

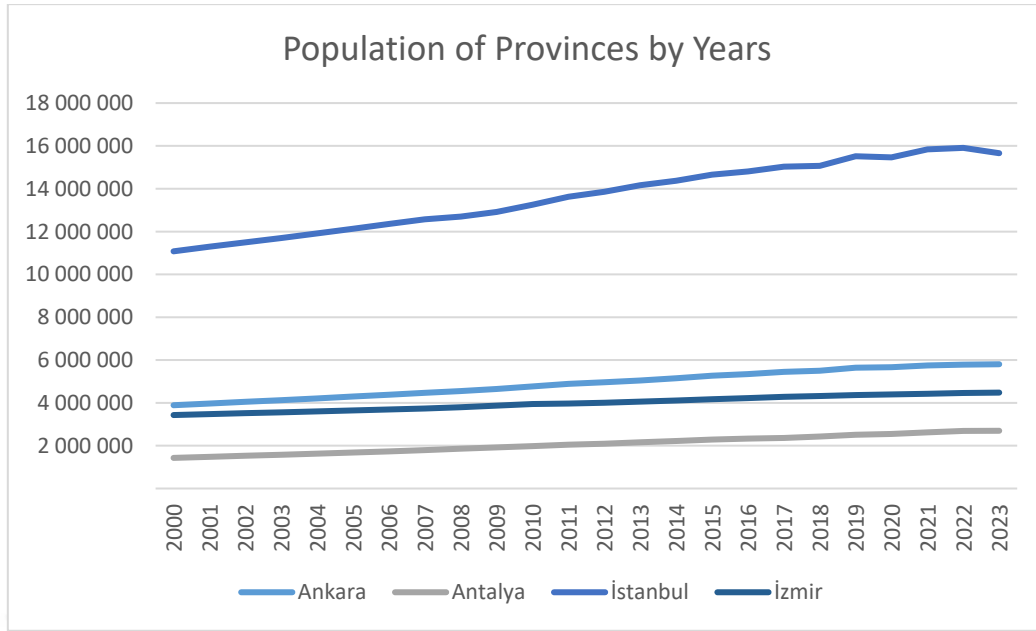


Figure 1.5 Population of provinces by years 2000-2023 (TurkStat, 2024)

While population continues very rapidly, urbanization growth also moves at an equally rapid pace, so, housing demand and pressure in expanding urban areas of economic activities are increasing (Wu et al., 2020). In fact, the pace of migrations and new mass housing construction has made it challenging to monitor this growth effectively. Rapid urban expansion, driven by both necessity and speculative development, often outpaces the ability of local governments and planning authorities to provide adequate services and enforce zoning regulations. According to the Real Estate Investors Association (GYODER) 2023 report, based on the 2021 Building and Housing Qualifications Survey by TurkStat data of population and number of residences, the ratio of total population to number of buildings by housing type decreases year by year. In 2017, 80.810.525 population to 32.802.435 residences ratio was 2,46 and this ratio decreased to approximately 2,10 in 2021 with 84.680.373 population to over 40.200.000 number of residences (GYODER, 2023). This shift suggests that while the number of housing units is increasing, it may not be occurring in tandem with actual population needs or regional demands. In addition, the final and definitive housing numbers for 2021, 2022 and 2023 could not be found due to the lack of up-to-date data. (Table 1.3)

Table 1.3 Türkiye housing census data (TurkStat and GYODER, 2023)

Years	Number of Residences	Population	Ratio of Total Population to Number of Buildings by Housing Type
2015	28.727.506	78.741.053	2,74
2016	29.340.118	79.814.871	2,72
2017	32.802.435	80.810.525	2,46
2018	35.040.843	82 003 882	2,34
2019	38.801.537	83 154 997	2,14
2020	39.307.621	83 614 362	2,12
Q3'21	40.200.000 +	84 680 273	2,10
2022	*	85 279 553	
2023	*	85 372 377	

In summary, based on the statistical data analyzed, the most important obstacles to the economic sustainability of the housing stock in Türkiye are seen as inflation and high prices. Recently, the most fundamental economic sustainability problem of the housing stock in Türkiye, especially encountered in daily life, seems to be the radical increases in rents and house prices and the decrease in affordability in parallel. This affordability crisis reflects a deepening disconnect between income levels and the cost of accessing adequate housing, thereby limiting access to secure and stable living environments for a large portion of the population.

Hereby, according to all this, the problem of the study identifies its core problem as follows: economic sustainability in Türkiye, particularly in the housing stock, has not been effectively achieved in recent years. Many studies have examined the economic sustainability of housing stock across different geographies (Adabre et al., 2020; Ahmad and Thaheem, 2018; Nuuter et al., 2015). However, these studies tend to focus on broader aspects such as the housing market, policies, and transformation strategies. In this sense, the fact that this study aims to develop a holistic evaluation framework for the existing housing stock over Türkiye, a developing country, customizes the research questions. Research questions are as follows:

- What kind of indicators are important and essential for ensuring economic sustainability in housing stock especially in developing countries?
- Which indicator have the most significant impact on the housing sector in Türkiye?
- In what order of priority should these indicators be evaluated in Türkiye?

1.2 Aim of the Study

Economy has a great impact through the country development. Although, most people consider that is not possible to provide sustainability while improving the economy. In contrast to this, Campell (1996) stated the planner has to balance not just two, but at least three competing priorities: promoting economic growth, ensuring this growth is shared equitably, and protecting the environment in the process. This conceptual framework underscores the possibility and indeed the necessity of pursuing economic development within the bounds of sustainability principles.

The question is which criteria should be given priority to help achieve economic sustainability of housing stock in Türkiye. Especially when considered based on the existing housing stocks economic problems. Because the built environment itself has a critical impact and decisive influence (Frederick, 2022). Therefore, the main aim of this study is to predict indicators of economic sustainability based on housing stock and evaluate them in order of priority to a particular country -Türkiye.

The primary objective of this study is to identify and evaluate key indicators of economic sustainability that are directly relevant to the housing stock, and to rank them according to their importance within the socio-economic and spatial context of Türkiye. By doing so, the research aims to provide a tailored framework that can guide housing policies, planning strategies, and investment decisions in the country.

Additionally, while researching the relationship between housing and economic sustainability, it was observed that there is a lack of enough common keywords. This issue was generally examined only under narrower headings, such as affordable housing or public housing. Moreover, most studies have focused on economic sustainability assessments at a smaller scale, such as buildings, housing units, construction, retrofitting, and renovation (Ribas and Cachim, 2017; Angelis et al., 2014). This study seeks to fill this gap by expanding the analytical scope and integrating multiple scales of inquiry. This research contributes to a more comprehensive understanding of the housing sector by considering the housing stock of Türkiye as a whole and identifying economic sustainability indicators in a clear and systematic manner. In this context, with all these problems identified, the main goals of the study are listed below:

- Creating a database by compiling certain indicators from the literature so that economic sustainability can be measured, particularly in the context of housing stock and real estate.
- Developing primary themes and establishing a framework to enhance the economic sustainability of the housing stock, identifying solution categories associated with these themes, and indicating potential areas for addressing the identified issues.

1.3 Scope and Limitations of the Study

Limitations of this study is based on the idea of every country has different circumstances, possibilities, problems about economy and housing. Therefore, each country's priorities and evaluation indicators should be evaluated according to its own conditions. So, the survey participants and evaluation results of this study are limited only to Türkiye.

In addition, this study focused specifically on economic sustainability as one of the key criteria within the broader framework of sustainability. Recognizing the importance of addressing challenges in the housing sector the study sought to explore economic sustainability in a way that highlights specific issues. Particularly in developing country contexts since Türkiye counted as a developing country. Therefore, when identifying and analyzing economic sustainability indicators, the scope was intentionally narrowed to include only those that are directly relevant to the housing domain. By doing so, the study not only maintains thematic focus but also contributes to a more nuanced understanding of how economic sustainability can be meaningfully assessed and improved in the context of housing development.

1.4 Research Design and Method

The research of this study started with identifying the problem and determining the purpose and objectives of the study. Through this process, the obvious perceptibility of the economic problems in Türkiye was a clue to the beginning. Significant economic problems, especially in terms of housing (rent/house prices, cost of living etc.), are increasing. These pressing economic issues pointed to a critical research gap concerning the economic sustainability of the national housing stock. So, to

substantiate and contextualize the problem, statistical data of OECD and TurkStat were used in the beginning of the process. These data sources helped demonstrate the magnitude of the economic pressures faced by the housing sector in Türkiye and served as a factual basis for defining the research problem.

Then, literature research was started in relevant fields using Scopus with the main keywords "economic sustainability, housing stock, housing, sustainable housing" to learn how these topics are addressed in other studies. This process revealed two major gaps in the existing literature: (1) a lack of clearly defined and measurable economic criteria in the assessment of sustainable housing, and (2) a limited number of studies focusing explicitly on the sustainability of the existing housing stock at a broader scale. In response to these gaps, this research emphasized the development of a measurable framework for evaluating the economic sustainability of housing stock.

Hence, an indicator list for the economic sustainability of the housing stock was created using data from the literature. Again, in literature studies, it has been observed that the use of survey methods is prominent in measurement-based research. Especially in such subjects that require knowledge and expertise, expert survey methods such as the Delphi method come to the fore. For this reason, in this study, it was deemed appropriate to use the Delphi technique research method, rank the economic sustainability indicators compiled through literature review by experts in terms of importance and priority, and to statistically analyze these responses. The commonly used Likert scale was used in the surveys, and data such as interquartile range, arithmetic mean, median and standard deviation used in Delphi studies were used in the analyses. After the analysis, the results were compiled and the conclusion section was written with discussions and suggestions. The methodology of the study is explained in more detail in chapter 4. The stages of the research are briefly shown in Figure 1.6.

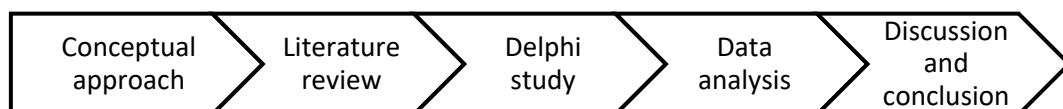


Figure 1.6 Research stages of the study

2

SUSTAINABLE HOUSING CONCEPT

2.1 Definiton of Sustainable Housing

Housing provision has increasingly shifted towards a market-driven approach rather than being guided by comprehensive planning. This shift has led to several adverse consequences, including land shortages for residential development, urban sprawl, imbalances in the housing market, such as shortages in rapidly growing urban areas alongside vacant homes in declining regions, excessive housing segmentation, and a reduction in green spaces (UN-Habitat, 2012). However, housing is a fundamental social determinant that significantly influences individuals' quality of life and overall well-being, as well as the development and vitality of communities. For this reason, sustainable housing is an important issue to consider.

Sustainable housing is being with combined of all sustainability principles and their applications. Every topic of sustainability should be considered when we think of sustainable housing, not only environmental sustainability. Dauda and Ajayi (2022) describe that indication as quality triangle from this interaction between the cores of sustainability (Figure 2.1) and that sustainable system can only be created when all the sustainability factors are properly balanced. The Figure 2.1 illustrates the classical model of sustainable development and at the intersection of the environmental and economic spheres lies the concept of viability, which highlights the need for solutions that are both ecologically responsible and financially feasible. The overlap between economic and social dimensions represents equity, emphasizing the importance of fair economic opportunities and inclusive development. Meanwhile, the intersection of environmental and social aspects is labeled as bearable, referring to the need for environmentally sound practices that are also acceptable and beneficial to society. At the very center, where all three

dimensions converge, the ideal state in which environmental protection, economic growth, and social equity are harmonized.

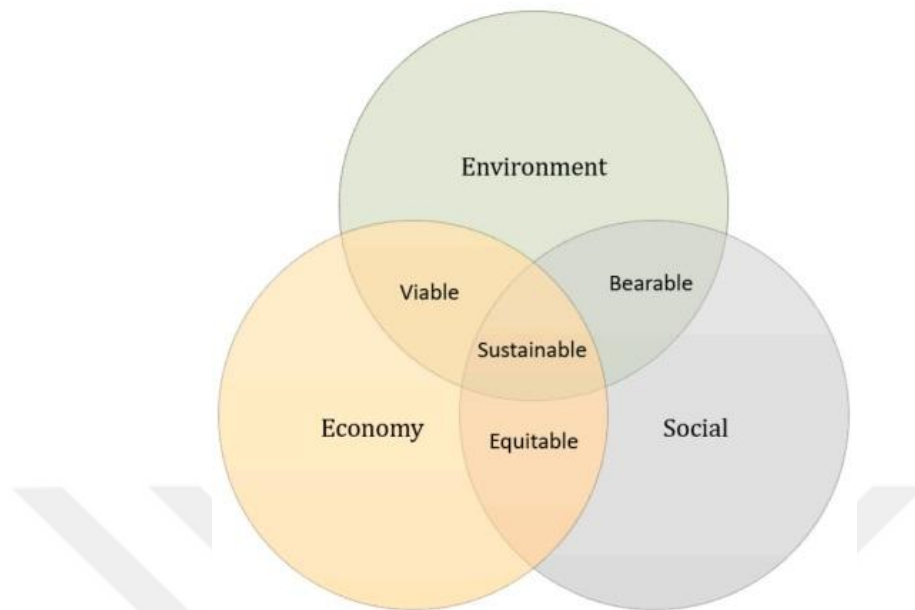


Figure 2.1 Interaction of sustainability factors (Dauda and Ajayi, 2022)

Also, almost full efficiency should be achieved from the life cycle of the building in terms of environmentally, economically and socially.

The diagram (Figure 2.2) from the International Union of Architects (UIA) Open Forum and Student Workshop – Sustainable by Design (2009) effectively visualizes the interdependence of these dimensions and highlights the strategies needed to achieve a truly sustainable design approach.

According to UIA (2009) conference report, from an ecological perspective, sustainable architecture should minimize environmental impact and work in harmony with nature. This includes the use of renewable energies and materials, bioclimatic design, and resource-efficient construction practices, all of which contribute to environmental resilience. Approaches such as biomimicry, which draws inspiration from natural systems, represent innovative ecological solutions for sustainable building (UIA, 2009).

The economic dimension of sustainability emphasizes affordability, efficiency, and long-term viability. Elements such as affordable and low-cost housing, recycling and reuse, and flexibility and multifunctionality are crucial in making sustainable architecture economically accessible and adaptable over time. These strategies also

align with broader goals of reducing operational costs and encouraging sustainable consumption patterns (UIA, 2009).

Social sustainability, on the other hand, is achieved through inclusivity and community-focused design. The UIA framework stresses the importance of public urban spaces, accessible architecture, and housing that supports social interaction and cultural identity. These aspects improve quality of life, promote equity, and strengthen the social fabric of communities (UIA, 2009).

The central convergence of all three pillars - where ecological responsibility, economic feasibility, and social inclusivity meet - defines true sustainability. Concepts like vernacular architecture and revitalization reflect this integration, showcasing solutions that are context-sensitive, community-driven, and environmentally appropriate.

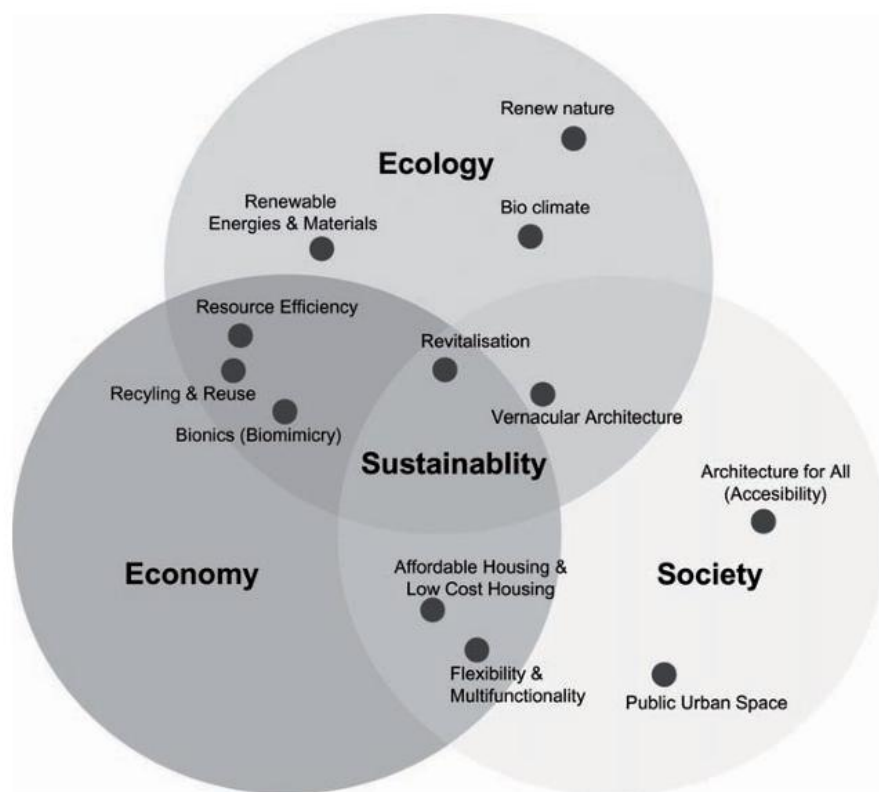


Figure 2.2 Sustainable design strategies (UIA, 2009)

Furthermore, bibliometric analysis was conducted in order to analyze “sustainable housing” term in literature and the keywords which are used by authors in related studies, were visualized using the Vosviewer software, as shown in Figure 2.3. A search on the Scopus database for the term “sustainable housing” yielded 1,040

documents, of which 1,012 were published in English. When the filter “economic” was applied, the number of relevant studies was reduced to 508, indicating that the economic dimension of sustainable housing constitutes a significant research focus within the field. The data visualization makes it easy to see relations between keywords and the relative importance of various concepts related to sustainable housing. In the visualization, the size of each node reflects the frequency of keyword occurrences, while the links between nodes represent co-occurrence relationships. The color scale denotes the average publication year of the terms, with dark blue indicating older studies (circa 2012) and yellow reflecting more recent publications (up to 2020). The keywords “sustainable housing,” “sustainability,” “affordable housing,” and “housing” appear centrally in the network, reflecting their strong presence and interrelation in the literature. Notably, the frequent emphasis on “affordable housing” and “housing development” points to the crucial link between sustainable practices and housing affordability. This connection underscores how efforts to create sustainable living environments must also address broader issues of social equity and economic viability.

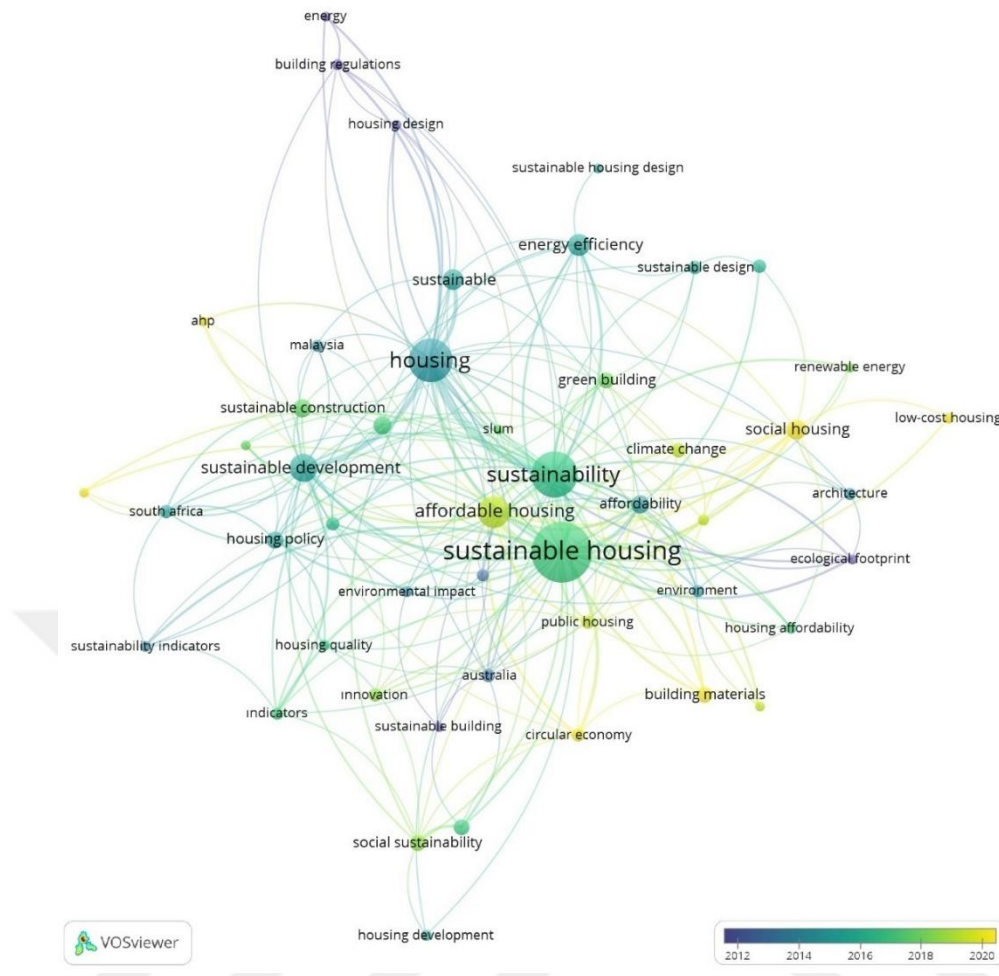


Figure 2.3 Bibliometric analysis of sustainable housing keywords via Vosviewer

In conclusion, sustainable design is a holistic and dynamic process that goes beyond green technology or cost-saving methods. It is about creating synergy between natural systems, economic logic, and human well-being. The UIA's (2009) model reminds architects, planners, and decision-makers that meaningful sustainability can only be achieved through balanced and interdisciplinary design thinking. However, it should be noted that in today's world, economic factors such as initial money spent, profit-loss balance, investment cost are the primary concerns for decision-makers/investors.

2.2 Main Dimensions of Sustainable Housing

Sustainable housing presents diverse opportunities to foster economic growth, protect the environment, enhance living standards, and support social equity. At the same time, it addresses critical challenges such as rapid population growth, urban expansion, informal settlements, poverty, climate change, energy access issues, and

economic instability (UN-Habitat, 2012). Indeed, there are strong interconnections among the various dimensions of sustainability in housing, making it difficult at times to distinctly categorize certain measures (UN-Habitat, 2012). However, together with the basic criteria of sustainability, sustainable housing is shaped on the basis of three main sustainability headings.

2.2.1 Environmental Sustainability

Environmental sustainability refers to the responsible management and use of natural resources in a way that meets current human needs without compromising the ability of future generations to meet their own needs. It involves minimizing environmental impact through practices such as reducing waste and pollution, conserving energy and water, protecting ecosystems, preventing climate change and promoting the use of renewable resources to ensure the long-term health of the planet. In order to make sustainable housing environmentally friendly during design and construction process, it requires attention to material selection, energy use, waste management, use of natural resources, climate adaptation, recycling and vegetation (Maqbool et al., 2023; Saidu & Yeom, 2020). Also, design of sustainable buildings is to reduce the total environmental impact during the production of building materials, during construction and throughout the life cycle of the building (Yıldız, 2018). So, sustainable housing should last long the since after construction completed.

The current energy and environmental crisis are impacting societies around the world simultaneously and a level of widespread disruption that is unprecedented in modern history (UIA, 2009). So, since environmental sustainability is gaining increasing importance, studies are being carried out on measuring the sustainability of buildings. Necessary standards have been established for this building evaluation system so, green building certification systems have been developed and also, renewal efforts in the existing stock are increasing, especially in terms of energy efficiency (Sadıkoğlu, 2016). The most well-known and internationally recognized of these certification systems are LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method). These systems use a performance-based approach, meaning that buildings are evaluated and certified based on how well they meet specific sustainability goals and measurable outcomes (Maqbool et al., 2023).

BREEAM, which was developed by BRE (Building Research Establishment) in 1990, aims to reduce the environmental impact of buildings, promote the use of sustainable practices, and encourage demand for eco-friendly construction. It provides environmental certification to recognize low-impact buildings, raise awareness among stakeholders, and support progress toward environmental goals (Akbulut, 2011). BREEAM provides a holistic sustainability assessment framework for master planning, new construction of infrastructure and buildings, buildings in use, refurbishment of buildings, and its measuring sustainable value in a series of categories and validating this performance with third-party certification. These categories are: Management, water, energy, transport, health & wellbeing, resources, resilience, land use & ecology, pollution, materials, waste, innovation. Each of these categories addresses influential factors, including low impact design and carbon emissions reduction; design durability and resilience; adaption to climate change; and ecological value and biodiversity protection (BREEAM, 2023).

LEED, founded by the U.S. Green Building Council (USGBC) in 1998, was established to implement strategies on the environmental impacts and performances of buildings, to create a sustainable construction industry, to raise awareness about resource consumption and to support environmentally friendly approaches throughout the life cycle (Akbulut, 2011). LEED certification system has developed different evaluation systems for different types of buildings and has been put into practice to create a general standard for buildings: New Buildings and Major Repairs (LEED - New Construction), Existing Buildings (LEED - EB), Public Interiors (LEED - Commercial Interior), Neighborhood Development Projects (LEED - ND), Structural Construction and Exterior Façade (LEED - Core and Shell), Schools (LEED - S), Shopping Malls (LEED - Retail), Hospitals (LEED - Healthcare) and Residences (LEED - Houses) (Akbulut, 2011). The LEED certification system is structured into several main credit categories and these evaluation subcategories are: Location and Transportation (LT), Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (EQ), Innovation (IN), Regional Priority (RP), Integrative Process (IP).

In short, according to all these, in order to extend the life of the modern housing stock, it should be addressed in the context of environmental sustainability, and in

order for the stock to be usable in the future, studies should be carried out to ensure that houses are not in conflict with nature, but rather integrated with nature and in harmony with the city (Sadıkoğlu, 2016).

2.2.2 Social Sustainability

Social sustainability can be linked to civil society and it includes cultural identity, equality, safety, accessibility etc. Social sustainability refers to the ability of a community or society to maintain and improve the well-being, quality of life, and social equity of its members over time. In the context of housing and urban development, it involves creating inclusive, safe, and resilient living environments that promote social interaction, access to services, cultural identity, and opportunities for all residents, regardless of their socioeconomic background. It also emphasizes community participation, long-term livability, and the reduction of social inequalities (Maliene & Malys, 2009). Also, UN-Habitat (2012) described social sustainability in housing, as the development of affordable, high-quality, inclusive, and diverse living environments (featuring a mix of tenure types and income levels) that are safe, healthy, and supportive of strong communities. These housing areas should be well-connected and harmoniously integrated into the broader urban and national socio-spatial frameworks.

In addition, the housing stock, which holds a significant place in the urban memory, can be considered directly linked to cultural sustainability (Sadıkoğlu, 2016). Cultural sustainability involves acknowledging and respecting the cultural beliefs, values, norms, traditions, lifestyles, and behaviors of individuals, communities, and societies, thereby promoting and preserving the dignity of collective life (UN-Habitat, 2012).

Among green building certification systems, WELL building standard places the strongest emphasis on social sustainability, focusing on the health, comfort, and well-being of building users. DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) also treats social aspects as a core category, integrating user experience, cultural compatibility, and community benefits. However, these systems just include social elements more than BREEAM and LEED, so their emphasis on other dimensions still tends to be secondary to environmental and energy performance.

2.2.3 Economic Sustainability

Economic sustainability is the foundation of urban sustainability, requiring not only the expansion of economic growth but also the enhancement of its quality (Yi et al., 2019). Therefore, economic sustainability often becomes a key factor for decision-makers in both public and private sector organizations (Jiang et al., 2023). So, many cities prioritize rapid economic development, often at the cost of harming the surrounding ecological environment (Yi et al., 2019). However, economic sustainability should be considered as providing essential financial resources for supporting both environmental and social sustainability. So, this study seeks to make economic sustainability a part of the solution rather than a priority.

Economic sustainability refers to adopting strategies that optimize the use of resources to achieve a balanced and beneficial outcome that can be sustained over time. Also, economic sustainability does not always mean the cheapest solution, especially in terms of ensuring sustainability (Dauda and Ajayi, 2022). Given the financial inadequacies faced by developing countries in providing housing and related infrastructure, identifying effective financing mechanisms to achieve sustainable housing is essential (UN-Habitat, 2012). Additionally, economic sustainability is important for establishing a solid financial infrastructure for environmental/green housing technology development. So, economic sustainability involves continued functioning profitability over time (Guardigli et al., 2018). For example, this can be achieved by providing financial returns from the investment, by providing energy profitability with appropriate technology, or by creating new job-employee opportunities.

The concept of economic sustainability, particularly within the context of urban housing, encompasses a multi-dimensional framework that integrates financial viability, affordability, resource efficiency, and resilience to economic fluctuations. As Bocken et al. (2014) emphasize, economic sustainability must be pursued without compromising environmental and social systems, highlighting the need for a holistic, long-term perspective. Within urban contexts, this concept expands to include the balancing of economic growth with infrastructure investment and affordability, as outlined by Mohsin et al. (2020), and the incorporation of localized indicators that reflect community needs and priorities (Turcu, 2013).

In the housing sector specifically, economic sustainability is closely linked to maintaining market stability and affordability while ensuring that housing systems are adaptable and resilient to external economic pressures (Nuuter et al., 2015; Winston & Eastaway, 2008). Guardigli et al. (2018) further underscore the importance of optimizing resources and asset utilization to achieve sustained profitability and operational continuity. Collectively, these perspectives underscore that economic sustainability in urban housing is not merely about financial performance but involves a strategic alignment of economic, social, and spatial dimensions to promote inclusive, efficient, and resilient urban development. So, here some perspectives on economic sustainability are expressed in Table 2.1.

Table 2.1 Description of economic sustainability

Economic sustainability definition	Resource
Economic sustainability refers to the capacity of an economy to maintain a certain level of economic activity and growth without causing harm to the environment or society. This concept ensures the long-term financial viability of industries, communities, and nations while minimizing resource depletion and environmental damage.	Bocken et al., 2014
Economic sustainability in the context of urban sustainability involves ensuring long-term financial stability by balancing economic growth, resource efficiency, and affordability. It emphasizes sustainable urban development through cost-effective infrastructure, investment in public services, and resilience to economic fluctuations to support a thriving economy.	Mohsin et al., 2020
Economic sustainability in urban contexts involves creating indicators that reflect local perspectives on financial resilience, equitable resource distribution, and long-term economic growth. It emphasizes integrating community-specific priorities into sustainable development strategies to ensure inclusive and adaptable economic outcomes.	Turcu, 2013
Economic sustainability implies the use of strategies to optimize existing resources in such a way that a beneficial balance can be achieved over the longer term and using the assorted assets of the efficiently to allow it to continue functioning profitability over time.	Guardigli et al., 2018
Economic sustainability in the housing market refers to the long-term financial stability of the sector, ensuring affordability, efficient resource allocation, and resilience to economic fluctuations. It involves evaluating housing market performance through multiple criteria, including cost efficiency, investment potential, and economic resilience to external pressures.	Nuuter et al., 2015
Economic sustainability in the urban housing context is defined as the ability to provide housing that supports economic stability and development. It involves ensuring affordability for residents, maintaining the economic viability of housing markets, and fostering broader economic resilience within urban areas.	Winston and Eastaway, 2008

In this sense, the economic sustainability approach that we find relevant for this study is actually supporting resilience and development against economic fluctuations with investments and financial choices that can ensure profitability throughout the process. It is essential to prevent inflated prices, particularly in the housing sector, and to ensure balanced pricing based on price-performance criteria. This approach contributes to a more stable and transparent housing market, supporting both affordability and long-term economic sustainability.

While many green building certification systems focus heavily on environmental performance, EDGE and DGNB stand out for their emphasis on economic sustainability alongside environmental and social considerations and showing that being eco-friendly doesn't have to come at the expense of cost-efficiency.

EDGE (Excellence in Design for Greater Efficiencies), developed by the International Finance Corporation (IFC), is specifically designed for emerging markets. It promotes affordable, resource-efficient buildings by requiring at least 20% reductions in energy, water, and materials compared to regional baselines. Its software-based tool enables users to assess cost savings and return on investment, making sustainability financially attractive and accessible for developers (IFC, 2023).

Similarly, DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) integrates economic quality as one of its core assessment categories, alongside environmental and sociocultural aspects. The system evaluates life-cycle costs, value retention, and economic efficiency of building projects. By encouraging long-term thinking and investment optimization, DGNB supports a balanced approach to sustainability that aligns ecological goals with financial viability (DGNB, 2022).

Although, even these assessment systems involve economic sustainability more than the other systems they are still mostly focus on environmental sustainability in general. This situation shows that less importance is given to economic and social sustainability (Jiang et al., 2023). However, economic elements have the most impact in terms of basic feasibility, implementation and persuasiveness.

2.3 Sustainable Housing Models in Literature

There are many studies in the literature about sustainability and how to achieve sustainability in housing models. According to Maliene and Malys (2009), sustainable housing could play a key role in revitalizing urban areas, as it is a crucial component of any regeneration plan. Ensuring both affordability and availability in the housing market is essential for these efforts to succeed.

The Figure 2.4 by Maliene and Malys (2009) illustrates sustainable housing as a multifaceted concept encompassing economic, environmental, and social dimensions. Key factors include affordability, market availability, and a sufficient supply of diverse to economically viable for a broad range of households, high-quality green housing. Additionally, sustainable housing must meet criteria related to design and comfort, environmental integration, environmentally responsible through energy efficiency, neighborhood safety, service accessibility, and compliance with technical and hygienic standards. Together, these elements contribute to creating resilient, livable, and inclusive urban environments (Maliene & Malys, 2009).

Crucially, rising demand for housing must not compromise the quality or sustainability of new developments. New housing forms should not intend to replace existing ones but to coexist alongside them. Therefore, the proposed model can be structured into three components: private and social housing, the housing market of existing stock, and a land development framework for new residential construction (Maliene & Malys, 2009).

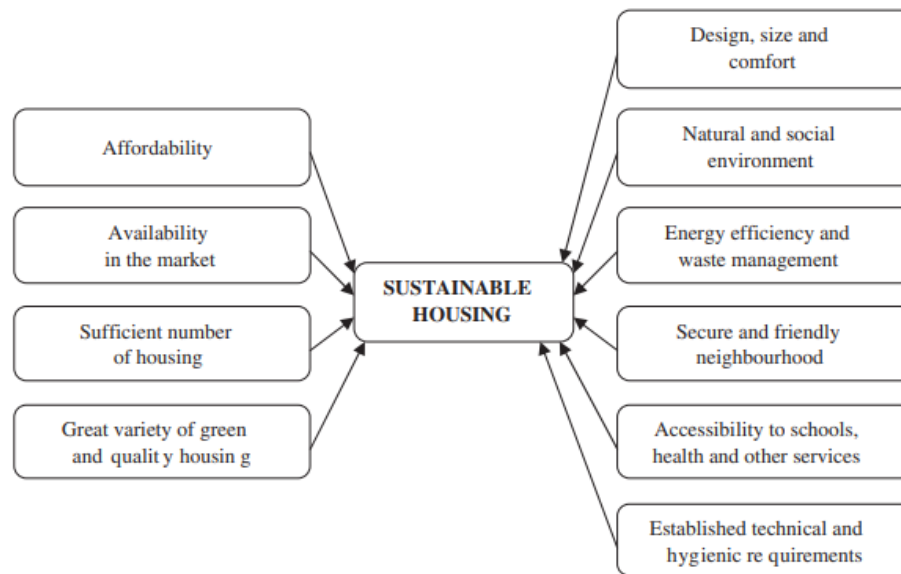


Figure 2.4 Criteria characterizing sustainable housing (Maliene & Malys, 2009)

Tupenaite et al. (2017) presents a structured framework for evaluating the sustainability of new residential projects, specifically within the context of the Baltic States (Figure 2.5). The model categorizes sustainability into three primary dimensions: Environmental, economic, and social, each further divided into detailed sub-indicators with respective weightings. Environmental sustainability, carrying the highest significance, encompasses factors such as energy efficiency, use of renewable resources, greenhouse gas emissions, sustainable material usage, and indoor environmental quality. Economic indicators focus on housing affordability, mortgage interest rates, construction costs, and added value, highlighting the financial feasibility and market viability of housing developments. The social dimension considers accessibility to services and infrastructure, as well as neighborhood-related factors like safety, privacy, and community cohesion. Tupenaite et al. (2017) used expert decision via survey based Analytic Hierarchy Process (AHP) method to determine the weights of these indicators. Experts are from Lithuania, Estonia and Latvia within the Baltic States border. According to the results in this context, environmental sustainability came to the fore and among its indicators, “energy and atmosphere considerations” and “materials and waste management” were listed as the most important. Economic sustainability came in second place and “housing affordability” was determined as the most important indicator. Lastly, in the social dimension, "accessibilities" were regarded as more significant. Within the "accessibilities" category, experts identified "access to

employment opportunities" and "access to public transportation" as the highest-priority indicators. By assigning relative weights to each indicator, the model enables a balanced and data-driven evaluation of housing projects, ensuring alignment with broader sustainability goals.

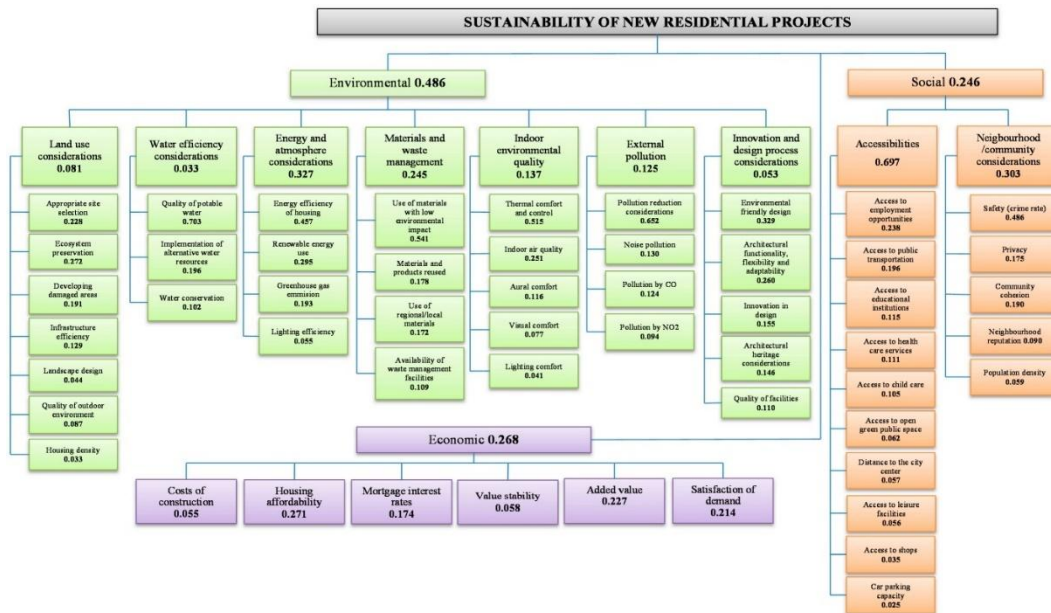


Figure 2.5 Hierarchical structure of sustainability indicators and their significances (Tupenaite et al., 2017)

Adabre and Chan (2020) studied on a sustainable assessment model for affordable housing presented in Figure 2.6 and integrating three core pillars of sustainability: economic, environmental, and social. The model identifies five key assessment criteria: location affordability cost, operation and maintenance cost, household satisfaction, efficient stakeholder management, and quality-related aspects. These criteria are linked to specific indicators, such as housing price-to-income ratio, rental cost, maintainability, energy and water efficiency, safety performance, stakeholder satisfaction, and aesthetic and technical quality. Notably, the framework emphasizes the combined impact of housing and transportation costs as a fundamental economic consideration. As a method they used a questionnaire survey conducted with professionals and analyzed with mean score ranking and the fuzzy synthetic evaluation (FSE) technique. The research showed that while environmental factors like energy efficiency and eco-friendly housing are important, social and economic indicators are rated higher in the context of affordable housing. These include user satisfaction, housing functionality, safety,

quality, and cost (price or rent). Based on these findings, a Sustainability Assessment Model was developed with four main indices: the Housing and Transportation (H+T) index, Household Satisfaction index, Efficient Stakeholder Management index, and Quality-related index. These contribute 25.3%, 26.3%, 23.6%, and 24.9% respectively to overall sustainability. Of these, the Household Satisfaction index had the highest impact on achieving sustainable affordable housing, particularly in the Ghanaian context. By encompassing both user-centric and systemic indicators, the model provides a holistic tool for assessing the long-term viability, livability, and inclusiveness of affordable housing developments.

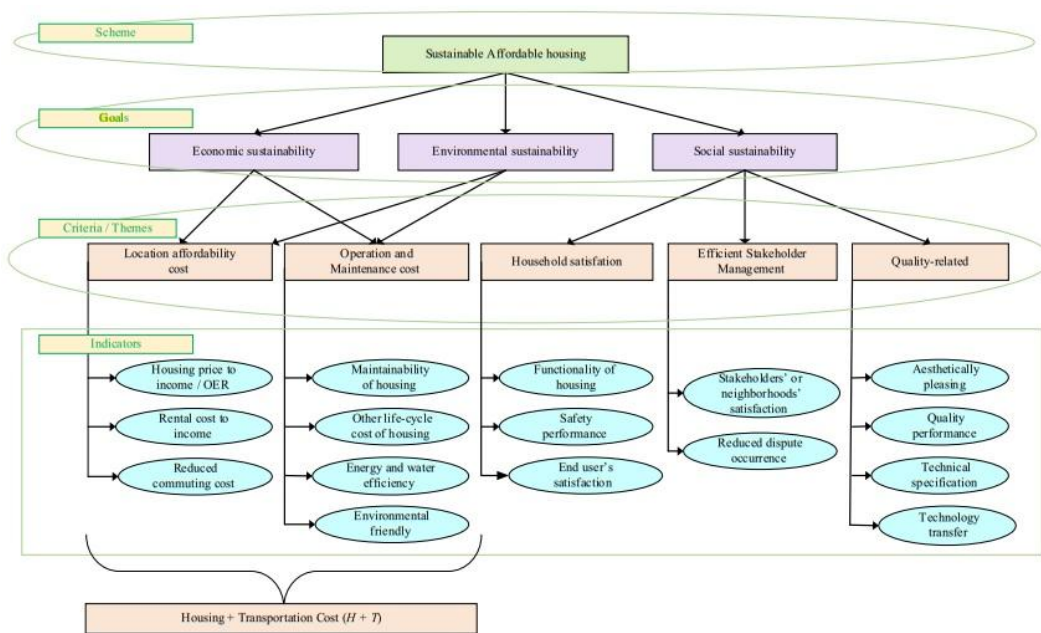


Figure 2.6 Conceptual framework of Sustainable Assessment Model for affordable housing (Adabre and Chan, 2020)

Gan et al. (2017) outline the Key Sustainability Performances (KSPIs) for affordable housing through a tripartite framework encompassing economic, social, and environmental sustainability (Figure 2.7). Economic sustainability indicators include financial viability, cost-effectiveness, affordable pricing, and reduced transportation costs, along with balanced housing markets and cost recovery mechanisms. Social sustainability is characterized by accessibility, equitable distribution, property maintenance, tenure security, social acceptance, and harmonious community relations. Environmental sustainability emphasizes resilience to disasters, efficient land use, high-density planning, energy and water efficiency, and the provision of green spaces, alongside durability and effective

resource use. The questionnaire survey method was used to investigate the importance level of the indicators in the list they created, and the survey was conducted by academics, developers and government related groups. According to their results, financial viability and cost recovery are ranked as first two by the respondents in terms of economic sustainability. Disaster resistance and high housing density are top priorities for environmental sustainability by the respondents from all groups. Tenure security and equitability and fairness of housing distribution are top two indicators in social sustainability. Overall, this framework highlights a holistic, stakeholder informed approach to improving sustainability in affordable housing projects, ensuring long-term viability, social inclusivity, and ecological responsibility.

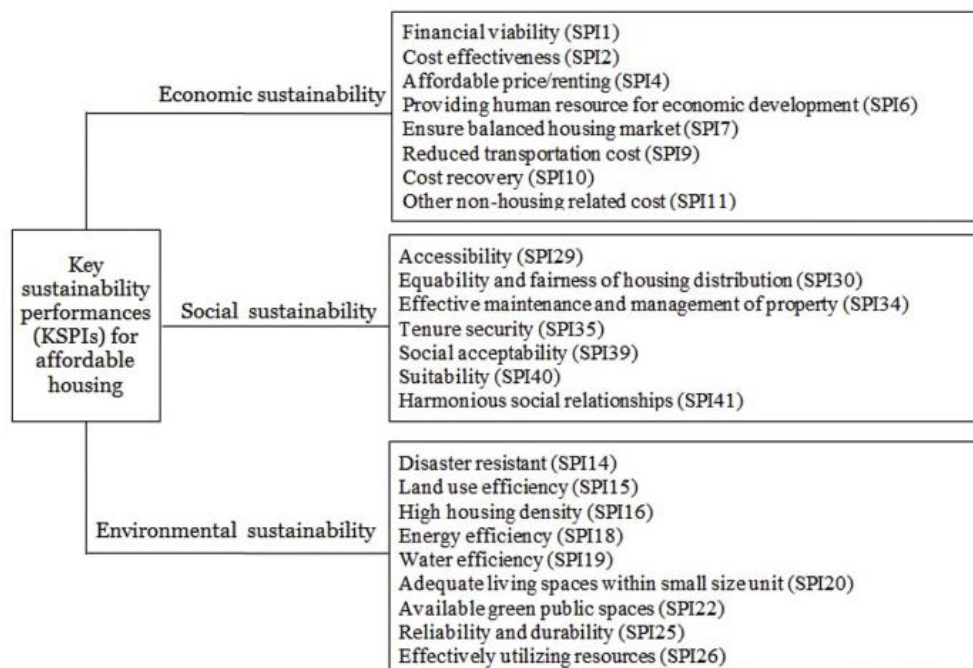


Figure 2.7 A framework for the sustainability performance of affordable housing (Gan et al., 2017)

Saidu and Yeom (2020) worked on the success criteria evaluation for a sustainable and affordable housing and Figure 2.8 presents the distribution of success criteria across three primary sustainability categories (economic, social, and environmental) based on the number of documents referencing each criterion. Since other studies mostly took the perspective of professionals, a survey study was conducted to obtain the opinions of households.

In the economic category, the most frequently cited criteria include house price in relation to income and rental costs in relation to income, each mentioned in seven documents, highlighting affordability as a dominant concern. This is followed by interest rates and mortgage availability, construction cost, and construction time, indicating the importance of both initial investment and financing accessibility. Less frequently mentioned, yet still relevant, are maintenance cost, housing subsidies, adequate funding, employment opportunity, and infrastructure, all of which relate to long-term financial viability and support systems for housing development (Figure 2.8). All these criteria were classified into three groups to form the main evaluation criteria. For the economy, these headings are: affordability, accessibility and technology application.

The social category places the greatest emphasis on security, cited in nine documents, followed by social amenities and building typology and orientation, which reflect the necessity of livable and inclusive urban environments. Accessibility and equity, education, and health comfort also appear as essential considerations, suggesting a comprehensive understanding of well-being beyond physical shelter. Additional criteria such as estate management, quality of housing, aesthetics, and culture and lifestyle further highlight the role of social integration and cultural relevance in sustainable housing (Figure 2.8). All these criteria were classified into three groups and the main evaluation criteria were created for social sustainability: acceptability, community and security.

In the environmental category, energy efficiency is the most referenced criterion (seven documents), emphasizing the growing importance of environmental performance. Renewable energy and environmental protection considerations follow closely, while life cycle cost, appropriate building materials, and waste management and disposal are also recognized, albeit to a lesser extent. These results suggest that while environmental concerns are acknowledged, they are less dominant than economic and social aspects in the literature (Figure 2.8). All these criteria for environmental sustainability are classified into two groups and these titles are: utility, adaptability.

Hereby, this study evaluated key success criteria for sustainable and affordable housing, including security, accessibility, adaptability, utility, technology, community, affordability, and acceptability. Among these, households ranked

security as the most important, likely reflecting increasing concerns related to property safety and secure living environments.

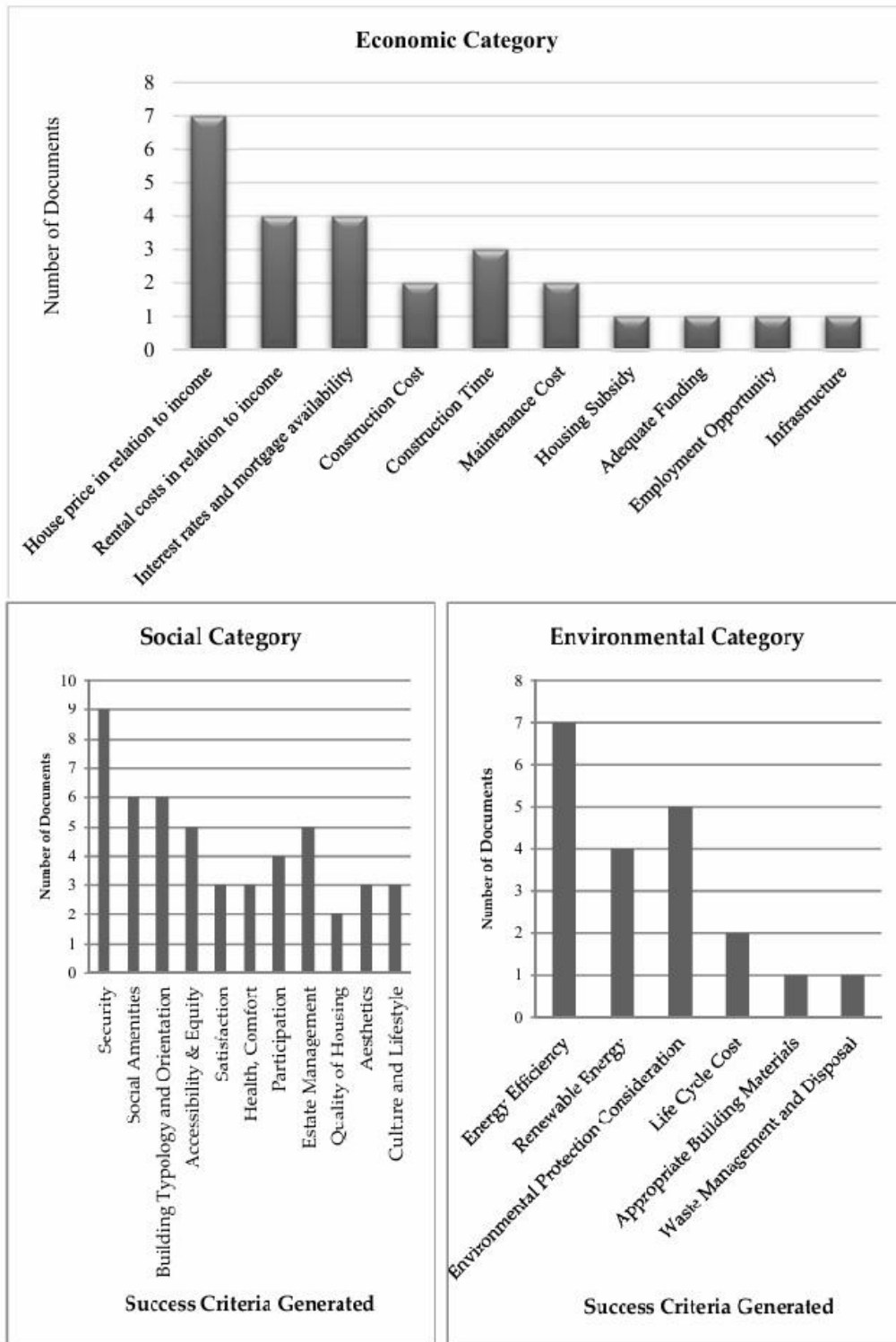


Figure 2.8 Success criteria for sustainable and affordable housing generated from document content analysis (Saidu and Yeom, 2020)

The diagram (Figure 2.9) developed by Wu et al. (2017) presents a comprehensive framework for assessing the sustainability of public rental housing communities through an integrated system that encompasses five key dimensions: environmental, economic, social, institutional, and cultural sustainability. Each dimension is subdivided into specific criteria, reflecting a holistic approach to evaluating sustainability performance in public rental housing. Environmental sustainability includes elements such as ecological planning, energy efficiency, and environmental impact, while economic sustainability highlights affordability, operational and construction costs, business activity, house/rent prices and economic fusion. Social sustainability emphasizes well-being through aspects like employment, safety, health, and social cohesion. Unlike the frameworks in other studies, Wu et al. (2017) also included the concepts of cultural and institutional sustainability in the measurement. Institutional sustainability focuses on governance, including policy support, political participation, and effective management. Finally, cultural sustainability addresses the importance of cultural identity, continuity, and aesthetic value within communities.

Furthermore, they used questionnaires and combined methods to obtain weight are subjective weighting method as AHP and objective weighting method as entropy weight method. The key findings revealed that economic and social sustainability had the higher overall weight among the other dimensions, largely due to the primary goal of public rental housing being to enhance housing affordability and address the housing needs of low- to middle-income populations (Wu et al., 2017). Within economic sustainability category, Housing Affordability (C12) is particularly prominent among the indicators while Employment Conditions (C14) ranking highest among all indicators for social sustainability. Other notable indicators include Environmental Impact (C7), Business Activity (C10), House and Rent Price (C11) and Cultural Fusion (C26).

By combining these dimensions, the framework not only captures the technical and economic components of sustainability but also acknowledges the social and cultural factors essential for fostering long-term resilience and quality of life in housing developments. This multidimensional approach offers a balanced and human-centered method for guiding sustainable housing policy and practice.

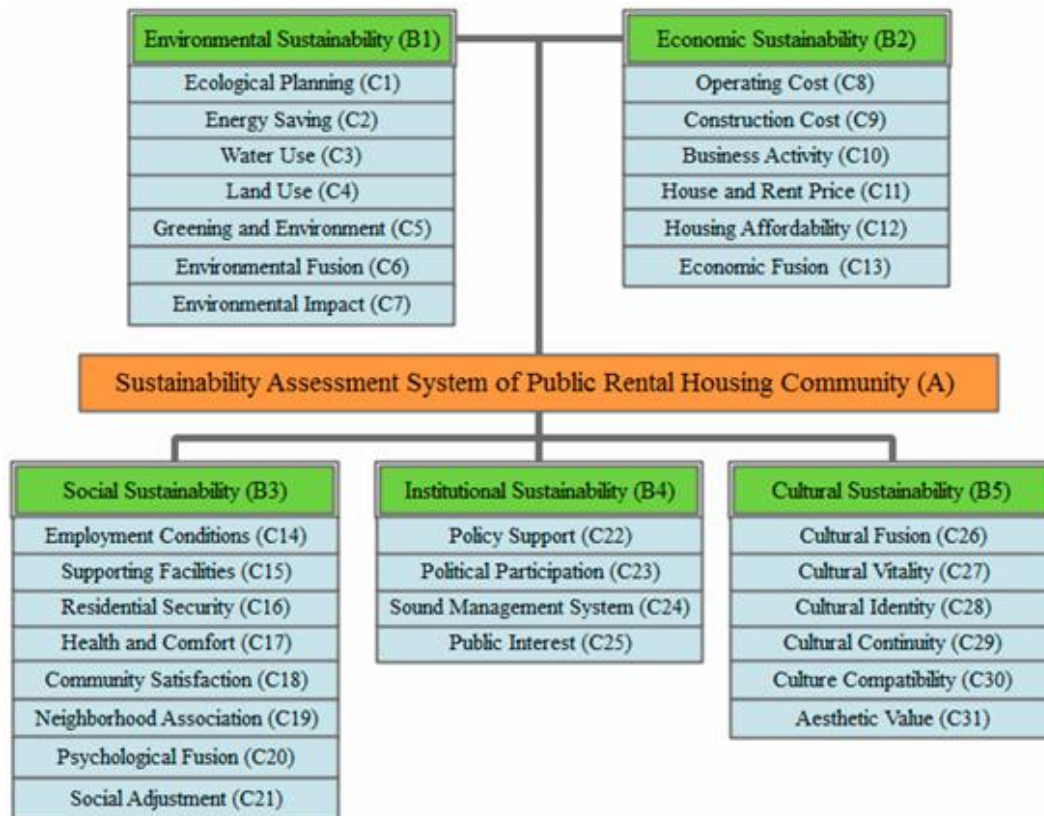


Figure 2.9 Sustainability assessment system of public rental housing communities
(Wu et al., 2017)

The framework proposed by Jiang et al. (2023) outlines a multidimensional approach to promoting sustainable social rental housing by emphasizing economic, social, and environmental sustainability (Figure 2.10). In the economic dimension, sustainability is grounded in securing rent and lease agreements, implementing rational development strategies, and ensuring efficient spatial planning and operational management. These factors are crucial for creating financially viable housing systems that can be maintained over time. Social sustainability, meanwhile, highlights the human-centered aspects of housing, including the provision of essential living services, opportunities for employment and skill development, and efforts to foster social inclusion and cohesion. Additionally, this dimension emphasizes the importance of safe, comfortable living environments and the preservation of cultural identity. On the environmental side, the framework advocates for the adoption of eco-friendly technologies, increased greenery, and harmony with the surrounding landscape.

Furthermore, in order to evaluate the dimensions and their indicators, expert questionnaire and hybrid decision making model which is combination of Fuzzy Decision-Making Trial and Evaluation Laboratory (Fuzzy DEMATEL), Fuzzy DEMATEL-based Analytic Network Process (DANP), VIKOR Method, was used. According to their results economic sustainability is core dimension and affect both other two dimensions. So, core dimension needs to be primarily improved. Moreover, based on the results, indicators that should be prioritized by policymakers are implementing a reasonable development model, ensuring the availability of essential living facilities and services, adopting environmentally friendly technologies and equipment, guaranteeing stable rent and lease arrangements, enhancing opportunities for skill development and employment, and effective space planning and design. Strengthening these areas can significantly contribute to the overall sustainability of the housing initiative (Jiang et al., 2023).

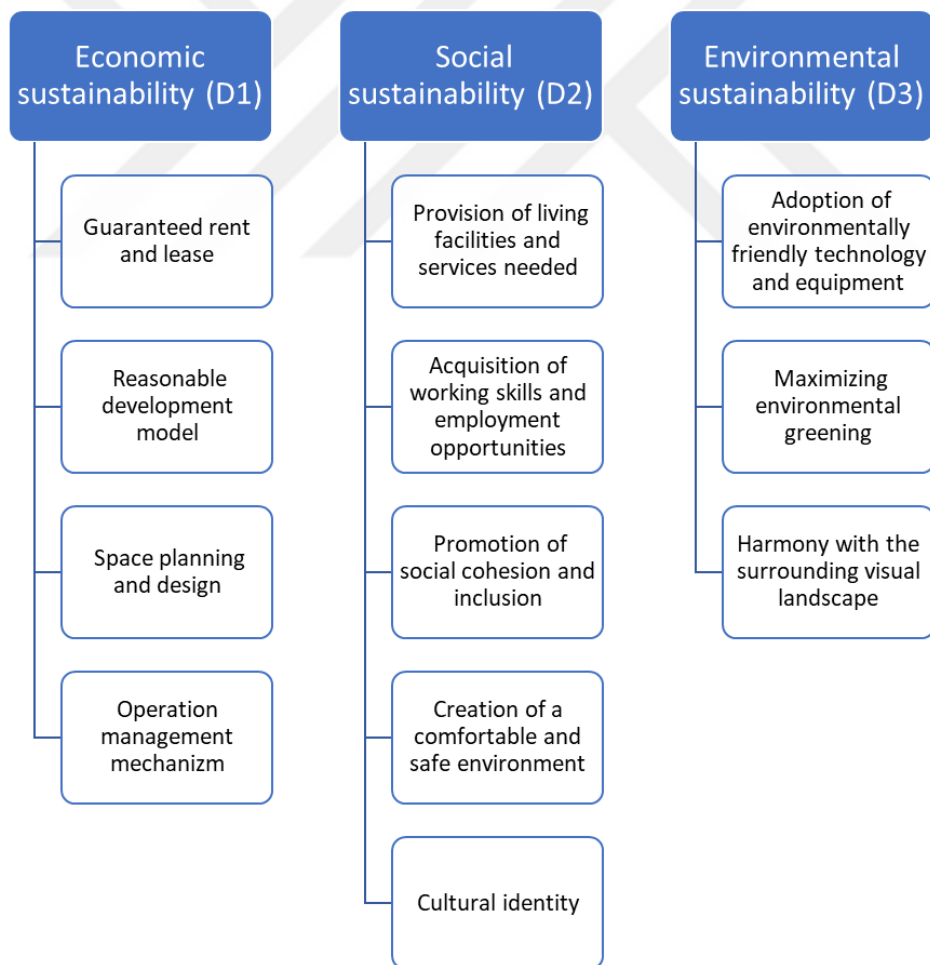


Figure 2.10 The proposed evaluation framework for social housing toward sustainability (Jiang et al., 2023)

The study by Oyebanji et al., (2017) also provides a comprehensive framework for understanding the critical success factors necessary for achieving sustainable social housing. The authors categorize the critical success factors into three main dimensions: economic, environmental, and social. Based on survey data and expert evaluations, economically, factors such as adequate funding and provision, affordability, efficient planning and use of resources, and appropriate technology are identified as essential. Environmentally, the use of appropriate materials, sustainable land use planning and accessibility stand out as vital considerations. Socially, the study highlights the importance of ensuring security, social cohesion, community development and provision of social services, welfare and job opportunities. The research emphasizes that sustainability in social housing cannot be achieved through isolated efforts; rather, it requires integrated strategies that simultaneously address financial, ecological, and social imperatives. Also, they suggest that the economic factors are more crucial because its factors ranked highest and considered more important. Most public and private sector organizations placed greater emphasis on the economic dimension of critical success factors, giving it more priority than the social and environmental aspects (Oyebanji et al., 2017). Ultimately, the findings offer practical insights for policymakers and practitioners, underscoring the need for coordinated policies, inclusive governance, and community empowerment to support the long-term success of sustainable social housing initiatives.

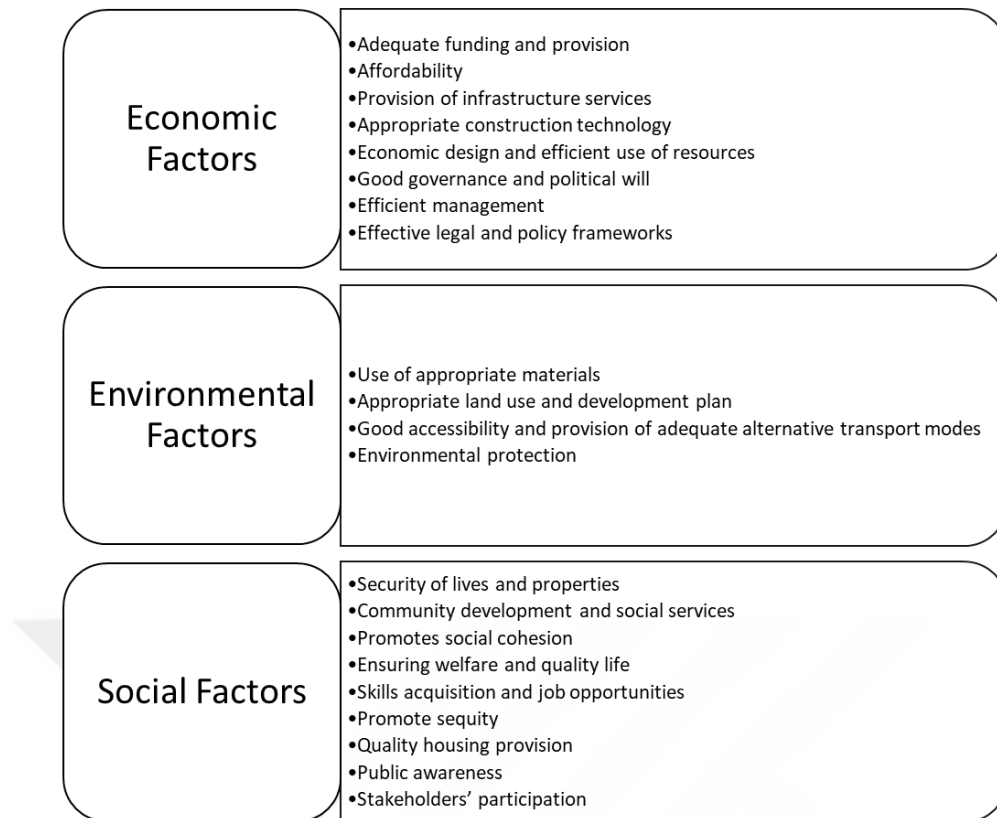


Figure 2.11 Criticality of economic, environmental and social success factors
(Oyebanji et al., 2017)

Adabre and Chan (2019) aimed to identify and prioritize the key factors necessary for achieving sustainable affordable housing, particularly in developing countries. Using a mixed-methods approach, the researchers first conducted a systematic literature review to extract potential critical success factors, and then validated and refined these factors through questionnaire surveys and expert interviews. So, here is the list of success factors of their study:

- Access to low-interest housing loans to developers
- Mixed land development
- Linking commercial development approval to funding for affordable housing
- Stable macro-economic system
- Effective private sector participation
- Incentives for developers to include affordable housing/sustainable designs
- Governments providing guarantees to developers
- Improved supply of low-cost developed land by government
- Political will and commitment to affordable housing

- Stable political system
- Formulation of sound housing policies
- Governments' provision of housing subsidies to households
- Good location for housing projects
- Adequate accessibility to social amenities
- Mandatory inclusion of affordable unit policy in developers' projects
- Adaptable housing design and construction
- Transparency in housing allocation
- Adequate maintenance of existing houses
- Monitoring conditions/performance of completed houses
- High-density affordable housing development
- Increase tax rate to discourage long holding periods of vacant land
- Adequate infrastructure supply by government
- Compliance with quality targets
- Adherence to project schedule
- Compliance with project budget
- Good coordination among project participants
- Sufficient staffing of public housing agencies
- Speculative measures on property sales through taxes
- Taxation on property or capital gains for housing supply
- Time-limited planning approval / bonuses on land development

Hereby, according to the results top six critical success factors are: “political will and commitment to affordable housing”, “formulation of sound housing policies”, “access to low interest housing loans to developers”, “adequate accessibility to social amenities”, “good location for housing projects” and “monitoring condition or performance of completed houses”. Furthermore, the success factors categorized into four key components: developer-enabling, household-demand enabling, mixed land use, and land use planning. These findings aim to guide policymakers in optimizing resource allocation to enhance the effectiveness of the sustainable affordable housing sector.

Unlike other studies, Adabre et al. (2020) also worked on barriers rather than assessment framework and they identify four interconnected categories of barriers

that hinder the attainment of sustainability in affordable housing: social, environmental, institutional, and economic. Social barriers include income inequality, income segregation, poor maintenance practices, infrastructure inadequacies, and cultural resistance to mortgage systems. Environmental challenges largely stem from limited access to land and insufficient development of low-cost housing within urban areas. Institutional obstacles involve delays in government approvals, weak policy enforcement, fragmented governance, and poor management of public housing initiatives. Economically, the sector faces constraints such as inadequate public funding, high costs of land and materials, insufficient investor incentives, and restrictive credit conditions. The Figure 2.12 highlights the interconnected nature of these barriers, indicating that they do not exist in isolation but are mutually reinforcing, thereby complicating efforts to achieve sustainable affordable housing.

The barriers identified in their study were evaluated separately for developed and developing countries. For this evaluation and ranking of barriers, expert surveys, Delphi method and factor analysis with Pearson correlation were used. Hereby, according to their survey results, from perspectives of experts for developing countries, the top five critical barriers: high cost of serviced land, inadequate infrastructure development, income segregation, high interest rates, lack of policies/weak enforcement of policies on land use planning system for housing supply. From the perspective of developed countries: inadequate affordable housing policy, inadequate public funding, income inequality, income segregation, high cost of serviced land are more critical barriers for sustainable affordable housing. These results show that while some barriers are common, such as land cost and income segregation, developing countries face more structural and policy enforcement issues, whereas developed countries struggle with funding and inequality. This highlights the need for context-specific strategies.

In practice, they believed that the research findings can guide policymakers and practitioners in adopting globally pragmatic measures to promote sustainable affordable housing. Furthermore, in light of the identified barriers, the study highlights key actions that international policymakers should consider when addressing sustainable affordable housing challenges (Adabre et al., 2020).

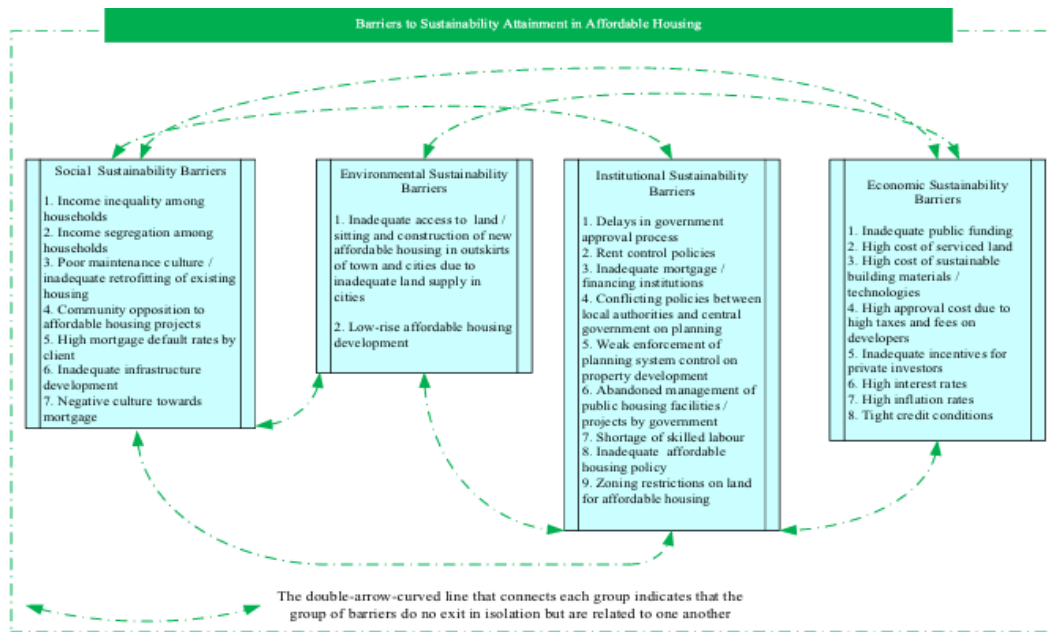


Figure 2.12 A conceptual framework on barriers to sustainability attainment in affordable housing (Adabre et al., 2020)

The collective analysis of the studies and visual models provided throughout this research reveals the multifaceted and interdependent nature of sustainable housing development, particularly within the context of public and affordable housing. As evidenced by the bibliometric analysis above and the conceptual frameworks developed in previous studies, sustainable housing is frequently linked with and examined in the context of affordable housing within the academic literature. Considering the definition of affordable housing, economic sustainability emerges as a critical component of sustainable housing. Because affordable housing initiatives must ensure the economic sustainability of developers/investors to ensure their long-term viability and ongoing implementation (Gan et al., 2017). In addition, housing system should guarantee that all individuals have access to adequate, affordable housing in locations that offer a high quality of life and are desirable to live in (UN-Habitat, 2012).

Although sustainable housing is frequently linked to welfare and high-income groups, true sustainability in housing does not require exclusivity. In fact, genuinely sustainable housing must be inclusive and accessible to individuals across all income levels. Therefore, affordability stands as one of the fundamental prerequisites for achieving sustainable housing. However, affordability alone is insufficient, housing that is labeled as "affordable" cannot be deemed sustainable if

it leads to environmental degradation or weakening social well-being. Consequently, the integration of affordability with broader environmental and social sustainability criteria is essential for a meaningful and transformative approach to sustainable housing (UN-Habitat, 2012).

Measurement systems vary depending on the chosen context. Also based on the research, it could be stated that, the international building certifications tend to focus more on environmental technical performance, while academic housing models focus more on social and economic sustainability criteria. Besides, sustainable building is a part of sustainable housing. In other words, sustainable housing should have the features of sustainable buildings but also provide economic and social sustainability. This shows the difference in scope between them.

Advancing sustainable affordable housing worldwide supports the achievement of Target 11.1 under the United Nations Sustainable Development Goal 11, which emphasizes ensuring access to sustainable and affordable housing for all by the year 2030. Sustainable Development Goal 11 (SDG 11) aims to "make cities and human settlements inclusive, safe, resilient, and sustainable. As urban populations continue to grow rapidly, especially in developing regions, this goal underscores the need for planning, development, and governance that ensures sustainability across economic, social, and environmental dimensions. In order to achieve the targets of Goal 11, especially in the context of sustainable housing, target 11.a, supporting least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials, is important. Also, in the manner of planning, supporting positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning (Target 11.8) is important.

Additionally, in The United Nations Human Settlements Programme (UN-Habitat, 2012) "A policy framework for developing countries" publication, sustainable houses are those that are designed, built and managed as:

- Healthy, durable, safe and secure,
- Affordable for the whole spectrum of incomes,
- Using ecological low-energy and affordable building materials and technology,
- Resilient to sustain potential natural disasters and climatic impacts,

- Connected to decent, safe and affordable energy, water, sanitation and recycling facilities,
- Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities,
- Not polluting the environment and protected from external pollutions,
- Well connected to jobs, shops, health- and child-care, education and other services,
- Properly integrated into, and enhancing, the social, cultural and economic fabric of the local neighborhood and the wider urban areas,
- Properly run and maintained, timely renovated and retrofitted.

When designed and constructed within a comprehensive sustainability framework, housing becomes more attainable for low-income groups, while also addressing their varied social and cultural requirements. This approach yields numerous benefits, including improvements in physical and mental well-being, enhanced safety, and positive impacts on both the economy and the surrounding built and natural environments. Additionally, the long-lasting nature of sustainable housing makes it a wise and enduring investment for governments and other stakeholders (UN-Habitat, 2012).

In addition, UN-Habitat (2012) presents a “A Multi-Scale Framework for Sustainable Housing Policies”, provides a comprehensive and multi-dimensional approach to sustainable housing, structured across three spatial scales: macro (national), meso (regional/city), and micro (neighborhood/household), and four key dimensions of sustainability: environmental, social, cultural, and economic. This matrix structure emphasizes the interconnectedness of policies and practices across governance levels and sustainability domains.

Environmentally, the framework suggests a systemic integration of green policies at the national level, such as energy efficiency and climate mitigation strategies, which cascade down to local interventions like micro-generation and water recycling. Socially, it underscores the importance of securing the right to adequate housing through inclusive policies at all levels, while also fostering community participation, safety, and cohesion in neighborhoods.

The cultural dimension, often underrepresented in housing policy, is notably included and highlights the preservation of heritage, promotion of local traditions, and support for creative and context-sensitive urban design. It advocates for the alignment of housing policies with local cultural norms and practices, fostering identity and resilience.

Economically, the framework promotes institutional strengthening, efficient land use, and housing market regulation at the macro level, while also supporting affordability mechanisms, community financing, and livelihood support systems at the household level.

Overall, this multi-scale framework promotes an integrated and holistic view of sustainable housing policy. It recognizes that effective interventions must be context-sensitive and operate across multiple governance levels to address the complexity of housing challenges in a sustainable and inclusive manner. The framework also reflects a balance between top-down (state-led) and bottom-up (community-driven) approaches, thereby ensuring both strategic alignment and grassroots responsiveness.

Table 2.13 A multi-scale framework for sustainable housing policies (UN-Habitat, 2012)

	MACRO (NATIONAL)	MESO (REGION, CITY)	MICRO (NEIGHBORHOOD, HOUSEHOLD)
Environmental dimension	Housing to support climate mitigation and adaptation efforts. Mainstreaming green housing practices and innovations. Ensuring energy and resource efficiency in the building industry. Integrating national housing and energy systems.	Achieving good location and density for residential areas and access to infrastructure. Serviced land in environmentally safe locations and green areas. Protection of ecosystems and biodiversity. Promoting sustainable and low-carbon urban infrastructure, public transport and non-motorised mobility, energy systems. Waste management and recycling.	Ensuring energy efficiency, micro-generation, water and resource efficiency. Green design, using sustainable local construction and materials. Sanitation, preventing hazardous and polluting materials. Affordable use of resources. Improving resilience and adaptation of homes.
Social dimension	Fulfilling the right to adequate housing and promoting the right to the city. Ensuring affordable, decent and suitable homes for all, including disadvantaged groups. Developing social housing provision. Promoting choice and security of tenure.	Promoting integrated communities and ensuring trust in communities. Providing community facilities, preventing segregation and displacement. Regenerating and reintegrating 'neglected' areas into regional, urban fabric. Ensuring infrastructural integration of housing into wider areas. Upgrading inadequate housing and slum areas.	Empowering people and ensuring public participation. Ensuring health, safety, well-being in residences. Creating a sense of community, 'sense of place', and identity. Meeting specific needs and wants in housing (including those related to gender, age and health). Providing access to infrastructure and public spaces.
Cultural dimension	Promoting links between housing and knowledge-based and cultural economies. Promoting traditional, indigenous and local knowledge (including of relevance to sustainable resource use, energy efficiency and resilient building techniques). Protecting cultural heritage.	Promoting urban creativity, culture, aesthetics, diversity. Shaping values, tradition, norms and behaviours (eg. in relation to energy use, recycling, communal living and place maintenance). Protecting housing heritage and familiarity of city (eg. preventing unnecessary social replacement/ gentrification or complete redevelopment).	Culturally responsive settlements and house planning and design. Improving aesthetics, diversity and cultural sophistication of the built environment and residence. Helping community creativity (i.e. via amenities; affordable sporting, cultural and entertainment facilities). Assisting people's transition from rural and slums areas to decent housing or multifamily housing.
Economic dimension	Institutional capacities for sustainable housing markets and housing development. Articulating housing productivity within national economic systems. Improving housing supply and effective demand, stabilising housing markets. Improving housing finance options. Promoting innovations in housing. Stimulating necessary technological developments for sustainable housing.	Managing economic activities and growth by strengthening housing provision and housing markets. Provision of necessary infrastructure and basic services to housing. Providing serviced land for housing. Strengthening entrepreneurship of communities, local building industry and enterprise. Promoting local and traditional building materials and techniques. Promoting regional and urban regeneration.	Ensuring housing affordability for different social groups. Providing adequate residences to raise labour productivity; ensuring housing is integrated with employment. Supporting domestic economic activities and enterprise. Promoting petty landlordism and self-help housing. Housing management and maintenance. Strengthening resilience and future-proofing of homes.

Furthermore, UN-Habitat (2012) approached sustainable housing in two main ways. The first is a “top-down” (centralized) method, driven by government policies, programs, and international collaborations. The second is a “bottom-up” (decentralized) strategy, based on grassroots initiatives led by individuals,

communities, and private organizations. Both approaches are vital to advancing sustainable housing, though each has its limitations: bottom-up efforts often lack broad impact due to their small scale, while top-down strategies may fail to adequately address the real needs of end users. As illustrated in Figure 2.13, combining both approaches can help direct efforts toward sustainable development. The model suggests that institutional support must be complemented by community participation to ensure both the scalability and longevity of development initiatives. In either case, ensuring longevity, replicability, and scalability is essential (UN-Habitat, 2012).

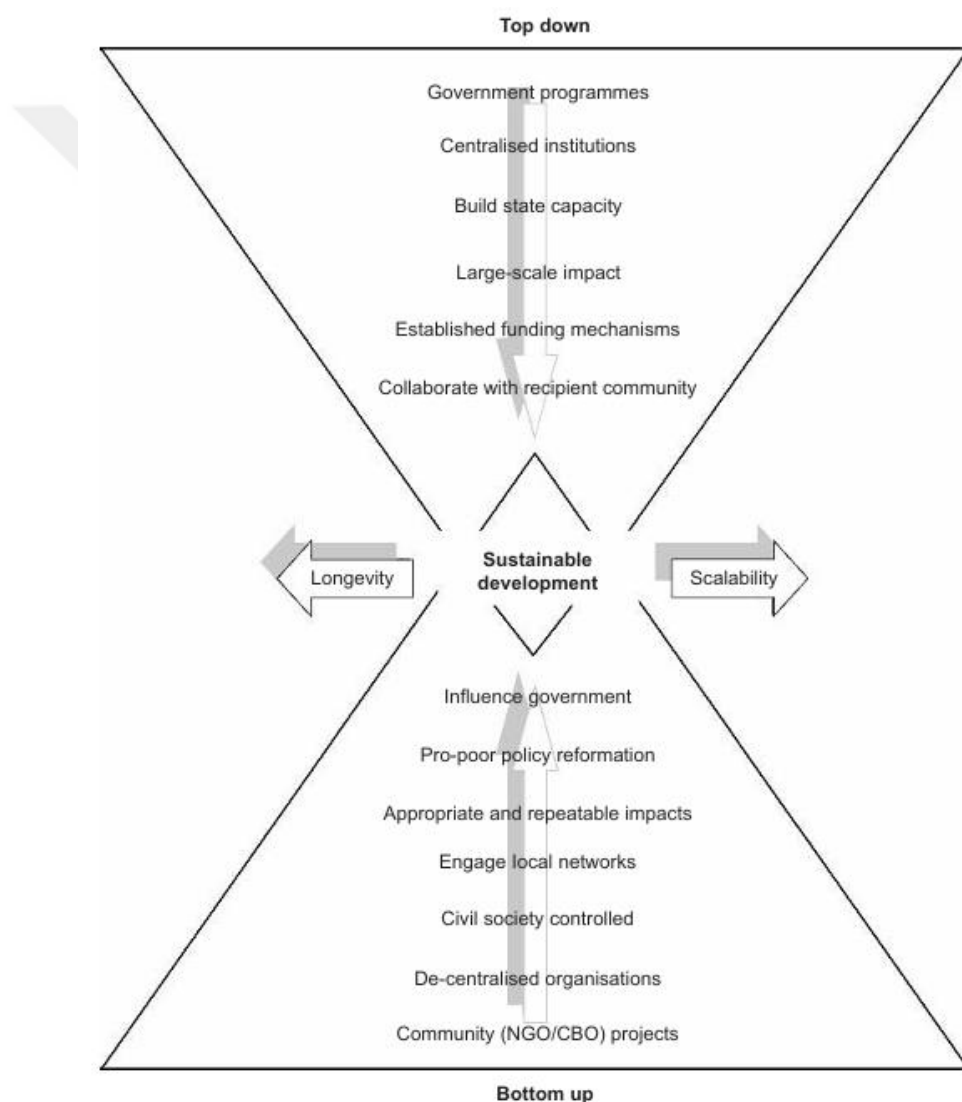


Figure 2.14 ‘Top down’ and ‘bottom up’ routes to sustainable development
(Cronin and Guthrie, 2011; UN-Habitat, 2012)

3

ECONOMIC SUSTAINABLE HOUSING CONCEPT AND ASSESSMENT INDICATORS

Economic sustainability pertains to the development and maintenance of financial resources necessary to achieve environmental and social sustainability (Gilbert et al., 1996). There will be differences when evaluating economic sustainability indicators on a single building dimension and when evaluating them on a building stock basis. For this reason, while creating the indicator list, evaluation criteria at every scale that will affect the general stock were taken into account.

3.1 Economic Sustainability Indicators

The economic sustainability of housing stock is a complex concept that requires careful management of factors such as affordability, availability, operation and maintenance, market dynamics, financial reliability, planning and infrastructure, policy interventions, housing utility and householder satisfaction. When these factors are balanced, housing can provide resilience to economic fluctuations without causing financial distress or economic instability for future generations (Nuuter et al., 2015). Therefore, necessary steps should be taken to make housing stock economically sustainable.

In this sense, in order to determine the indicators, both the barriers and other criteria in the literature should be examined. So, Adabre et al. (2020), listed some economic sustainability barriers for affordable housing in their study. According to their study, economic sustainability barriers are;

- Inadequate public funding
- High cost of serviced land
- High cost of sustainable building materials/technologies

- High approval cost due to high taxes and fees on developers
- Inadequate incentives for private investors
- High interest rates
- High inflation rates
- Tight credit conditions

These barriers are more related to affordable housing but in many studies (Obeyanji et al., 2017; Tupenaite et al., 2017; Wu et al., 2017; Yigitcanlar et al., 2015; Saidu and Yeom, 2020; Gan et al., 2017; Jiang et al., 2023; Zavadskas et al., 2017) economic sustainability contains affordability and detailed contents of references explained later in this section. So, it is important to mention these barriers to identify economic sustainability indicators.

Furthermore, Dauda and Ajayi (2022) have worked on impediments of sustainable structural retrofit and they determined; high costs of materials, high costs of technical skills, insufficient public funding, lack of government and decision makers, high inflation rate, imbalance between initial cost of retrofit and the cost of running, lack of economic viability as potential barriers of economic sustainability. Hence, these barriers lead to these indicators to ensure economic sustainability: the importance of affordability, inflation rates, mortgage availability and interest rates, appropriate technology, adequate funding, effective policy and legal frameworks, cost effectiveness, cost recovery.

Some studies in the literature also mentioned economic sustainability through various criterias, indicators or success factors. Wu et al. (2017) examined the sustainability of public rental housing community and economic sustainability is one of the dimensions. In their study, operating cost, construction cost, business activity, house and rent price, housing affordability and economic fusion are identified indicators for economic sustainability (Wu et al., 2017). Tupenaite et al. (2017) studied on ranking sustainability indicators for new housing developments and highlighted indicators for economic sustainability are costs of construction, housing affordability, mortgage interest rates, value stability, added value and satisfaction of demand. Oyebanji et al. (2017), identified eight success factors for economic sustainability of social housing, including affordability, good governance, adequate funding, economic design and efficient use of resources,

appropriate technology, efficient management, provision of adequate infrastructure services and effective policy and legal frameworks. Jiang et al. (2023) also studied sustainability of social housing and they determined economic sustainability criteria as guaranteed rent and lease, reasonable development model, space planning and design and operation management mechanism. Ibem and Azuh (2011) analyzed the sustainability of public housing in developing countries, identifying economic sustainability dimensions like housing affordability, job creation through home-based enterprises, tenure options, suitability of housing acquisition process, cost of living within the neighborhood and housing adaptability for future needs. Gan et al. (2017) listed economic sustainability indicators for affordable housing, including financial viability, cost-effectiveness, desirability, affordable pricing or renting, reduced life cycle costs, provide human resources for economic development, balanced housing markets, generate job opportunities, cost recovery, integrating related industries of sustainable housing, reduced transportation costs, other non-housing related costs and energy bills. Adabre and Chan (2020) proposed a sustainability assessment model for affordable housing and economic sustainability including housing price and rental cost relative to income, reduced commuting costs, maintainability of housing, other life cycle costs of housing, energy and water efficiency and being environmentally friendly. Yigitcanlar et al. (2015) assesses neighborhood sustainability in a developing country context, using sustainability indicators to evaluate residential developments. They also used the Delphi method to determine the indicators and as a result of expert opinions from the indicators pool, they created, the economic sustainability indicators were finalized as affordability, housing diversity and number of establishment types. Saidu and Yeom (2020) evaluate success criteria for sustainable and affordable housing in Nigerian cities, aiming to improve household welfare through better housing models. Their economic category criterias are house/rent price relation to income, interest rates, mortgage availability, construction cost and time, maintenance cost, housing subsidy, adequate funding, employment opportunity and infrastructure. Zavadskas et al. (2017) focused on developing a practical neighborhood evaluation model that aligns with sustainable development principles and economic factors are housing prices, population density, density of housing types and number of jobs through this evaluation. On a smaller scale, Ahmad and Thaheem (2018) studied economic sustainability assessment for residential

buildings and main parameters are capital cost, life cycle cost, affordability, economic performance, manageability aspects of building, adaptability, and flexibility.

These references were utilized in this study to compile a comprehensive list of economic sustainability indicators for the housing stock. To avoid redundancy, indicators with overlapping meanings were consolidated or redefined. For instance, terms such as “generate job opportunities”, “job creation” and “business activity” were combined into one indicator. Similarly, “reduced energy bills”, “energy-water efficiency” and “reduced life cycle cost” were grouped together, as were “other non-housing related costs” and “cost of living”. Furthermore, indicators like “adaptability”, “flexibility” and “functionality” were merged, as were “capital cost” and “adequate funding”. Additionally, some of the studies mentioned above have worked on affordable housing and proposed its own criteria, however in this study, the indicator of housing affordability was evaluated only based on rent and purchase price. A list of all the finalized indicators, along with their definitions and references, are presented in Table 3.1.

Table 3.1 Description and references of each indicator

Economic Sustainability Indicators	Description/Explanation	Reference
Construction cost	Total construction cost with all expenses (material, workmanship etc.) (Tupenaite et al., 2017).	(Tupenaite et al., 2017; Wu et al., 2017; Banani et al., 2016; Oyeibanji et al., 2017; Bragança et al., 2010; Glaeser & Gyourko, 2018; Alyami et al., 2013; Nilashi et al., 2019; Kang et al., 2016; Zarghami et al., 2019)
Operating Cost	Operating costs refer to the expenses incurred in managing, maintaining, and operating buildings or construction projects.	(Wu et al., 2017; Bragança et al., 2010; Zarghami et al., 2019; Akhanova et al., 2020)
Efficient management	Implementing an efficient management framework during both construction, operational and usage phases help to minimize costs related to management and efficient time use throughout the project's construction (Oyeibanji et al., 2017; Jiang et al., 2023).	(Oyeibanji et al., 2017; Jiang et al., 2023; Bragança et al., 2010; Wu et al., 2017; Banani et al., 2016; Zarghami et al., 2019)
Provision of adequate infrastructure services	Efficient economic planning to ensure the provision of adequate infrastructure services like roads, water, efficient energy, rail services, etc. (Oyeibanji et al., 2017).	(Oyeibanji et al., 2017; Wu et al., 2020; Banani et al., 2016; Golubchikov and Badyina, 2012)
Cost effectiveness	Economic design and efficient use of resources for the provision of mixed development and flexible structures that promotes and minimizes future maintenance and expansion costs (Oyeibanji et al., 2017).	(Gan et al., 2017; Isalou et al., 2014; Oyeibanji et al., 2017; Banani et al., 2016; Zarghami et al., 2019)
Appropriate technology	Appropriate technology to allow for refurbishment, minimize waste, protect the environment, reduce construction cost, reduce construction time, reduce maintenance cost and ensure the construction of housing needs (Oyeibanji et al., 2017; Saidu and Yeom, 2020).	(Oyeibanji et al., 2017; Saidu and Yeom, 2020)

Table 3.1 Description and references of each indicator (continue)

Renovation and reusing	Renovation and reusing are the evaluation of existing buildings and housing stock. It also provides extension of the life of the building.	(Altaf et al., 2023; Roufehaei et al., 2014; Golubchikov and Badyina, 2012)
Reduced life cycle cost	Reducing energy consumption, minimizing future maintenance costs in buildings during their full lifecycle which includes construction and demolition by economic design and efficient use of resources (Golubchikov and Badyina, 2012).	(Roufehaei et al., 2014; Oyebanji et al., 2017; Adabre and Chan, 2020; Gan et al., 2017; Bragança et al., 2010; Banani et al., 2016; Golubchikov and Badyina, 2012; Zarghami et al., 2019; Akhanova et al., 2020; Mohsin et al., 2020)
Economic fusion	This refers to factors that influence housing decisions, such as the dynamics between buying and renting, the intention of local residents to purchase property, etc. These factors significantly affect both market activity and trends, as well as individual housing preferences.	(Wu et al., 2017)
Ensure balanced housing market	A balanced housing market promotes economic stability, alleviates housing shortages, provides affordable housing and prevents speculative price inflation.	(Gan et al., 2017; Golubchikov and Badyina, 2012)
Mortgage interest rates	Interest rates affect the cost of purchasing and amount of payback.	(Tupenaite et al., 2017; Altaf et al., 2023; Saidu and Yeom, 2020; Mulliner et al., 2013; Mulliner et al., 2016; Glaeser & Gyourko, 2018)
Mortgage availability	Mortgage availability refers to the ease with which individuals or businesses can obtain loans to purchase real estate.	(Saidu and Yeom, 2020; Mulliner et al., 2013; Mulliner et al., 2016; Adabre et al., 2020; Zhao et al., 2023)
Cost recovery	Cost recovery refers to the process of recouping the investment made in constructing or maintaining a property or infrastructure over time.	(Gan et al., 2017; Isalou et al., 2014)
Value stability	The amount of change in the financial value of the house over time is minimal. Functioning profitability (Guardigli et al., 2018).	(Tupenaite et al., 2017; Alwaer and Clements-Croome, 2010; Bragança et al., 2010; Alyami et al. 2013)
Inflation rate	Inflation rate refers to the percentage increase in the overall price and affects costs and prices (Altaf et al., 2023).	(Altaf et al., 2023; Saidu and Yeom, 2020; Adabre et al., 2020; Zou and Chau, 2015)
Added value	Value added refers to the increase in the price of a house or the increase in the return on money over time, relative to the initial cost. It means that its value increases in the eyes of consumers or stakeholders (Tupenaite et al., 2017).	(Tupenaite et al., 2017; Zavadskas et al., 2017; Turcu, 2013; Kang et al., 2016; Shen et al., 2010)
Housing affordability	House rent and purchase price concerning income compared with the general level (Saidu and Yeom, 2020; Wu et al., 2017).	(Oyebanji et al., 2017; Tupenaite et al., 2017; Wu et al., 2017; Ibem and Azuh, 2011; Yiğitcanlar et al., 2015; Saidu and Yeom, 2020; Gan et al., 2017; Winston and Eastaway, 2008; Turcu, 2013; Jiang et al., 2023; Zavadskas et al., 2017; Glaeser & Gyourko, 2018; Alwaer and Clements-Croome, 2010; Mulliner et al., 2013; Mulliner et al., 2016; Roufehaei et al., 2014; Adabre and Chan, 2020; Adabre and Chan, 2019; Isalou et al., 2014; Golubchikov and Badyina, 2012; Zarghami et al., 2019; Akhanova et al., 2020)
Good governance	Good governance for promoting economic growth that allows for the provision of adequate Sustainable Social Housing that meets housing needs (Oyebanji et al., 2017).	(Oyebanji et al., 2017)
Financial viability	The designed structure must be applicable in every sense such as financial, temporal, technical etc. and developers can adopt cost reduction strategies (such as the use of regionally available materials and techniques) (Gan et al., 2017).	(Gan et al., 2017; Zhao et al., 2023; Zarghami et al., 2019)
Adequate funding	Ensure adequate funding to enable the public and private sectors to provide adequate sustainable social housing for meeting housing needs of every household (Oyebanji et al., 2017).	(Oyebanji et al., 2017; Saidu and Yeom, 2020)
Effective policy and legal frameworks	Effective policy and legal frameworks for enhancing efficient implementation and control of social housing provision activities like procurements, award of contracts and distribution (Oyebanji et al., 2017).	(Oyebanji et al., 2017; Roufehaei et al., 2014)

Table 3.1 Description and references of each indicator (continue)

Reasonable development model	Through reasonable development models, such as self-construction by the government, the joint construction of sub-houses or setting superficies, sufficient funds are allocated to support its operation and maintenance to make its overall financial viability (Jiang et al., 2023).	(Jiang et al., 2023; Gan et al., 2017; Wu et al., 2017)
Cost of living	Other non/housing and housing (bills etc.) related costs within the neighbourhood (Gan et al., 2017).	(Gan et al., 2017; Ibem and Azuh, 2011; Isalou et al., 2014)
Business activity	Business activities within and around the community (Wu et al., 2017). Job and employment opportunities (Saidu and Yeom, 2020).	(Wu et al., 2017; Turcu, 2013; Saidu and Yeom, 2020; Mohsin et al., 2020; Zarghami et al., 2019; Zhao et al., 2023)
Occupancy	The general occupancy rate of the property and the rate of filling frequency of the dwelling when it is vacant.	(Altaf et al., 2023; Zhao et al., 2023)
Satisfaction of demand	Meeting the demands and satisfaction of those who buy or rent a house is the way to ensure that they retain their house.	(Tupenaite et al., 2017; Adabre and Chan, 2020; Higham and Stephenson, 2014; Nilashi et al., 2019; Kang et al., 2016; Shen et al., 2010; Wu et al., 2020; Gan et al., 2019)
Desirability	The desirability of a home refers to how well it meets consumers' expectations and how eagerly and enthusiastically it is desired. This is determined by how willing people are to buy or rent the home (Pullen et al., 2010).	(Pullen et al., 2010; Gan et al., 2017; Golubchikov and Badyina, 2012)
Functionality	Space planning and design (Jiang et al., 2023) according to needs and providing flexibility for any future use.	(Adabre and Chan, 2020; Jiang et al., 2023; Adabre and Chan, 2019; Tupenaite et al., 2017; Ibem and Azuh, 2011)
Quality performance of housing facility	Quality of indoor and outdoor environment; quality of materials or workmanship (Adabre and Chan, 2020).	(Adabre and Chan, 2020; Adabre and Chan, 2019; Tupenaite et al., 2017; Saidu and Yeom, 2020; Banani et al., 2016)
Safety	Safe indoor and outdoor environment; number of crimes (burglary and robbery cases) recorded in housing facilities (Adabre and Chan, 2020).	(Adabre and Chan, 2020; Adabre and Chan, 2019; Tupenaite et al., 2017)
Supply and demand	A healthy balance between the supply of and demand for housing is essential to avoid price volatility. Economic sustainability is at risk when housing markets experience bubbles or significant declines (Glaeser, 2011).	(Glaeser & Gyourko, 2018; Glaeser, 2011; Golubchikov and Badyina, 2012; Wang et al., 2021)

Economic sustainability does not always mean the cheapest solution, especially in terms of ensuring sustainability (Dauda and Ajayi, 2022). For example, investing in advanced, expensive and appropriate technology to benefit renewable energy sources could reduce long term expenses and energy consumptions ultimately leading to lower life cycle costs. Reduced life cycle cost and affordability also lead to low living costs. This approach could also facilitate cost recovery of initial cost and can even create added value over time. In addition, some other indicators are interconnected, but they do not express the same meaning. For instance, desirability of housing affects occupancy of housing. Also, satisfaction of demand after the house is rented also affects the occupancy in the long term.

3.2 Thematic Analysis of Economic Sustainability Indicators

A thematic analysis was created by determining relevant and common categories to address the solution within the content of each theme, as seen in Figure 3.1. These common themes were developed to classify the economic sustainability indicators

identified through the literature and these categories were created by considering those who play an active role and direct impact like stakeholders, policymakers, funders, realtors, contractors etc. Common theme headings were created by using the contents of studies such as Adabre and Chan (2020), Saidu and Yeom (2020), and also by using artificial intelligence for some indicator groupings. To explain the meanings of these titles in order;

1. **Affordability and Availability:** Housing should be priced so that it is accessible to people across a wide range of incomes. This includes ensuring that costs such as rent or mortgage payments, utilities, and basic living costs remain within a manageable portion of household income (Glaeser & Gyourko, 2018). It also includes the availability of opportunities such as granting housing loans for home ownership and access to these opportunities. Lastly, indicators of this theme are; housing affordability, mortgage interest rates, mortgage availability and cost of living.
2. **Operation and Maintenance:** Housing should be constructed and maintained at a quality level that guarantees durability, longevity, health, and comfort, preventing deterioration that could lead to higher repair or replacement costs (International Code Council, 2021). In addition, this title also includes low energy bills and maintenance expenses during the use of the building or includes reasonable investments and expenses. Indicators of this theme are; appropriate technology, operating cost, efficient management, cost effectiveness, construction cost and reduced life cycle cost.
3. **Financial Reliability:** Housing should contribute positively to the overall economic health of a community by retaining or increasing in value over time, supporting local economies through jobs in construction and maintenance, and helping to stabilize neighborhoods (National Association of Home Builders, 2022). In terms of individual investment, it includes getting the return on initial investment and making logical investments. Indicators of this theme are; Inflation rate, value stability, cost recovery, ensure balanced housing market, added value, adequate funding, financial viability and economic fusion.
4. **Planning and Infrastructure Quality:** There should be a sufficient supply of housing options to meet the needs of the population, including diverse types of

housing (such as single-family homes and apartments) and various sizes to accommodate different household structures (UN-Habitat, 2020). At the urban scale, comprehensive planning efforts should encompass the distribution, quantity, and spatial organization of housing settlements. This includes not only determining the appropriate number of housing units to meet current and projected demands, but also strategically managing their spatial spread to ensure sustainable urban growth, efficient land use, and equitable access to infrastructure and services. Effective urban planning in this context is essential to address issues such as urban sprawl, socio-spatial segregation, and environmental impacts, thereby promoting more resilient and inclusive urban environments. Indicators of this theme are; Supply and demand, good governance, reasonable development model, effective policy and legal frameworks, renovation and reusing, provision of adequate infrastructure services.

5. Housing Utility and Householder Satisfaction: Economic sustainability in housing also means ensuring fair access to housing, preventing displacement, and making sure that all community members, regardless of their background, have access to safe, quality, affordable homes (Urban Institute, 2019). While ensuring quality and satisfaction for basic living needs, it is also important to ensure continuity and increase in job opportunities. Indicators of this theme are; Quality performance of housing facility, business activity, safety, functionality, satisfaction of demand, desirability, occupancy.

The government primarily assumes responsibility for themes such as affordability, financial reliability, and planning and infrastructure quality. Financial institutions (e.g., central banks, commercial banks) and real estate markets play critical roles in ensuring affordability, availability, and financial reliability. The private sector focuses on operations, management, financial reliability, housing utility and homeowner satisfaction. Lastly, the community plays a significant role in indicators associated with housing quality and household satisfaction. All these written relations are illustrated in Figure 3.1.

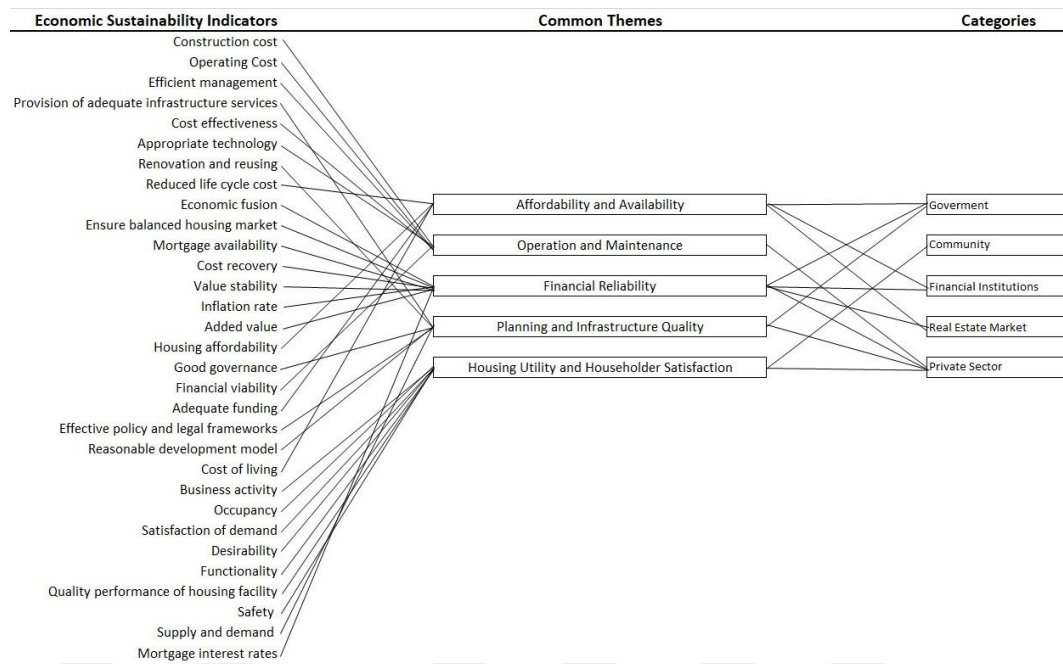


Figure 3.1 Thematic analysis

Overall, based on the weight of citations in the literature, economic sustainability in housing stock depends on ensuring housing affordability and is affected by addressing key barriers like inadequate financing, high costs, and inflation. It is achieved by through effective policies, affordability measures, and sustainable management practices. A well-maintained housing supply could support the long-term economic resilience.

METHODOLOGY OF THE STUDY

In this chapter of the thesis, the research methodology used to conduct the study is explained. The methodological framework was shaped in response to the increasing problems observed in Türkiye in recent years regarding the use, purchase, production, and repair of the existing housing stock. These issues, which have gained prominence especially under the influence of dynamic and often challenging socio-economic conditions, reflect broader concerns related to the sustainability and resilience of the housing sector. Among the various factors contributing to these challenges, the economic dimension emerged as the most significant and overarching issue. Therefore, within the scope of this study, economy was identified as the primary determinant influencing the current state and future prospects of the housing stock.

As part of the methodological approach, particular emphasis was placed on the concept of economic sustainability and the measurability of the economy in terms of housing stock was discussed. In this sense, expert opinions were sought to determine the priorities and effects of the indicators in the framework created on the measurability of economic sustainability in the housing stock, which is one of the aims of the thesis. This methodological process not only grounds the research in empirical evidence but also enhances the practical applicability of the findings in urban and housing policy development.

4.1 Methodological Approach of the Study

At the very beginning of this process, first, statistical data were analyzed to detect and support the research problem which is economic sustainability of housing stock in Türkiye. Turkstat and OECD data platforms were used for statistical data. Economic data such as price changes in the housing market, inflation, and

comparative graphs of Türkiye and other countries were used. Simultaneously, a literature review was conducted to identify any deficiencies or gather existing information on economic sustainability. Many studies in the literature measure environmental sustainability or the three pillars of sustainability; however, their content lacks detailed analysis (Zavadskas et al., 2017; Turcu et al., 2013). As a result of these, a problem identification was made and the aims of the study were determined. So, it was decided to create a framework to measure the economic sustainability of the housing stock. Then, the Delphi method was deemed appropriate for this study and necessary limitations were discussed along with the method. Hereby, the Delphi method aimed to determine the most effective indicators in line with the economic sustainability problem of the existing housing stock in Türkiye.

In order to determine the suitable indicators for economic sustainability in housing stock, firstly a comprehensive review of the literature on indicators, success factors and criteria was conducted. The literature was collected from articles indexed in Scopus and its sub-sources. These criteria were compiled into a table, and after necessary refinements, a list of 31 potential indicators of economic sustainability in housing was finalized. Then, proceeded to the Delphi method stage, as outlined in the research design. In short, during this process, the prepared survey was conducted with selected experts from Türkiye via Google Surveys. In the analysis of the survey results, arithmetic mean, standard deviation, median, and interquartile range data were utilized. The level of consensus at the end of each survey round was determined by examining the interquartile range (IQR) which is difference between the first and third quartiles (Belton et al., 2019). As the IQR value increases, it is seen that agreement cannot be achieved. Most Delphi studies use the criterion $IQR \leq 1.5$ to consider consensus as achieved (Diamond et al., 2014). However, in order to make a more precise measurement, the value of 1.2 suggested by Zelif and Heldenbrand (1993) was determined as consensus limit. For the analysis of the degree of impact, the arithmetic mean of the experts' responses was used, as it provides insights into the overall trend (Diamond et al., 2014). The Delphi process and the results of the analyses are explained in more detail in the following sections. The stages and methodology of the study are shown in Figure 4.1.

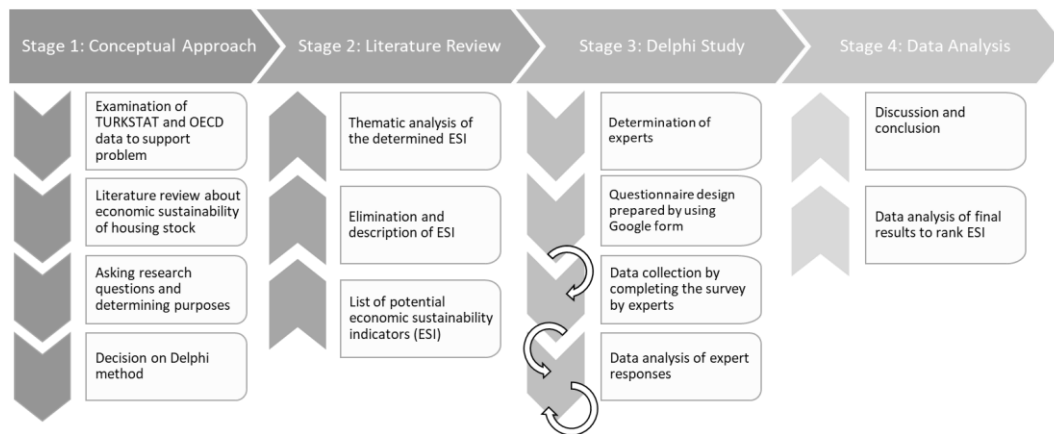


Figure 4.1 Research framework for the study

4.2 Design of the Research Process

In order to predict economic sustainability indicators within the scope of this research, a qualitative content analysis was conducted on a range of academic publications, policy documents, and strategic reports related to sustainable development, sustainable housing, housing stock and urban economics. The aim is to identify recurring themes, indicators and criteria that are consistently referenced in the literature and practice.

4.2.1 Selection of Sources

The concept of economic sustainability has a multidimensional structure in the literature and can be defined in different ways in different disciplines. Therefore, instead of defining these indicators based on a single source, a large number of academic studies, international reports and policy documents were examined and an evaluation was made in line with the common indicators derived from these documents. Qualitative content analysis was preferred because it is an effective method in revealing conceptual similarities.

In the beginning of this process, firstly, article research was conducted using keywords via Scopus. Keywords used in different combinations: "economic sustainability", "housing", "housing stock", "sustainable housing". Only for economic sustainability, there are 6.445 English resources. If this is filtered with housing, there are only 503 sources remain. When the "economic sustainability"; "housing" using together, 159 English sources emerged. By reviewing the abstracts of studies in related fields such as environmental science, social sciences, and

engineering, approximately 60 articles were obtained for use. Nearly 80 studies were examined along with their sub-resources. Additionally, strategic plans, policy approaches and sustainability reports of international organizations such as UIA and UN-Habitat were examined. The indicators determined by the examined sources for economic sustainability from the sustainability models were tabulated one by one by writing them on a Microsoft Excel table together with their sources and meanings. This is how the first draft of the indicators list was created. Here is summarization of some sources that was used for the framework, with their methodology and results in Table 4.1.

Table 4.1 Summerazation of sources

Reference	Subject	Methodology	Economic Measures	Economy Based Results
Zarghami et al. (2019)	Develop a sustainability rating system for multi-family residential buildings in Iran	Expert Questionnaire, Analytic Hierarchy Process (AHP), Delphi method	Domestic production (local material choice) Life cycle cost Environmental costs Local business (Job opportunities) Capital costs Residential affordability Low-cost maintenance and operation costs	Domestic production (local material choice) Life cycle cost
Mohsin et al. (2020)	Develop an urban sustainability framework for Iraqi cities	Delphi method	Promote investment Develop the tourism sector Employment Foreign experience Promote use of local materials Diversity of economic activities instead of single economy (oil) Cooperating between public and private sector Commercial awareness's programs on site	Diversity of economic activities and employment
Oyebanji et al. (2017)	Identifies Critical Success Factors for achieving Sustainable Social Housing	Expert questionnaires	Affordability (purchase, rent and mortgage loan rates) Good governance Ensure adequate funding to enable the public and private sectors Economic design and efficient use of resources Efficient management Efficient economic planning to ensure the provision of adequate infrastructure services Effective policy and legal frameworks	Adequate funding and provision Affordability Provision of adequate infrastructure services.

Table 4.1 Summerazation of sources (continue)

Adabre et al. (2020)	Identify the critical barriers preventing the attainment of sustainability in affordable housing projects	Expert questionnaires , Delphi method and factor analysis	Inadequate public funding High cost of serviced land High cost of sustainable building materials/ technologies High approval cost due to high taxes and fees on developers Inadequate incentives for private investors High interest rates High inflation rates Tight credit conditions	The top barriers for developing countries: High cost of serviced land High interest rates Tight credit conditions. In developed countries: Inadequate public funding High cost of serviced land.
Adabre & Chan (2020)	Develop a sustainability assessment model for affordable housing in Ghana	Expert questionnaires and fuzzy synthetic evaluation (FSE) technique	Housing price to income Rental cost to income Reduced commuting cost Maintainability of housing Other life-cycle cost of housing Energy and water efficiency Environmentally friendly	Price/rental cost of housing facilities are rated higher concerning affordable housing.
Adabre & Chan (2019)	Identify Critical Success Factors for sustainable affordable housing	Expert questionnaires , Delphi method	Access to low-interest housing loans to developers, Linking commercial development approval to funding for affordable housing, Stable macro-economic system, Incentives for developers to include affordable housing/sustainable designs, Governments providing guarantees to developers, Improved supply of low-cost developed land by government, Political will and commitment to affordable housing, Formulation of sound housing policies, Governments' provision of housing subsidies to households, Increase tax rate to discourage long holding periods of vacant land, Speculative measures on property sales through taxes, Taxation on property or capital gains for housing supply, Time-limited planning approval, Compliance with project budget, Good coordination among project participants	Political will and commitment to affordable housing, formulation of sound housing policies, access to low interest housing loans to developers and monitoring condition/performance of completed houses.
Alyami et al. (2013)	Develop a sustainable building assessment scheme	Delphi method	Construction cost Life-cycle cost Operating and maintenance cost Affordable rental Life costing mechanism in building choice Recognition of lower running cost in rental levels	Operating and maintenance cost Overall life cycle costs of buildings

Table 4.1 Summerazation of sources (continue)

Yigitcanlar et al. (2015)	Assesses the sustainability of residential developments in a developing country context	Delphi method	Housing jobs proximity Jobs/housed worker balance Local food production Conforming employment density Affordable housing Non-conforming employment density Housing option diversity Employment proximity to transit Housing proximity to employment center Locations with reduces automobile dependence Employment opportunity	Affordable housing Commercial establishment types Housing option diversity (Outcome of the Delphi Process)
Saidu & Yeom (2020)	Evaluates success criteria for sustainable and affordable housing	Household survey and factor analysis to rank	House/rent price relation to income Interest rates and mortgage availability Construction cost and time Maintenance cost Housing subsidy Adequate funding Employment opportunity and infrastructure	House price concerning income ranks on top, Rental costs concerning income and Interest rates and mortgage availability both rank second on the list.
Tupenaite et al. (2017)	Ranks sustainability indicators for assessing new housing development projects in the Baltic States	Expert questionnaires , AHP	Costs of construction Housing affordability (price in relation to income) Mortgage interest rates Value stability Added value Satisfaction of demand	Housing affordability Added value Satisfaction of housing demand Mortgage interest rates Value stability Cost of construction (ranking order)
Nuuter et al. (2015)	Compare housing market sustainability across European countries	Multiple Criteria Complex Proportional Evaluation (COPRAS)	Housing affordability Household income levels Construction costs Housing supply and demand Inflation rate Unemployment rate Total dwelling stock Nominal house prices Total outstanding residential loans Interest rates of loans Housing cost and disposable income	The most sustainable housing market was found in Denmark, followed by Germany and Sweden.
Zavadskas et al. (2017)	Healthy and safe built environments in urban neighborhoods	Expert questionnaires , Multiple criteria decision-making methods (MCDM)	Housing prices Population density Density of single-family and two-family houses Density of blocks of flats Number of jobs.	Housing prices

Table 4.1 Summerazation of sources (continue)

Wu et al. (2017)	Develops an integrated sustainability assessment model for public rental housing	Expert questionnaires , AHP and entropy weight method	Operating cost Construction cost Business activity House and rent price Housing affordability Economic fusion	Housing affordability Business activity Housing and rent price are top three.
Gan et al. (2017)	Investigates how affordable housing can be made more sustainable through a stakeholder-based approach	Expert questionnaire (government, developers and academics)	Financial viability Cost effectiveness Desirability Affordable price/renting Reduced life cycle cost Provide human resource for economic development Ensure balanced housing market Generate job opportunities Reduced transportation cost Cost recovery Other non-housing related costs Reduced energy bills Integrate related industries of sustainable housing	Financial viability and Cost recovery
Jiang et al. (2023)	Proposes a hybrid decision-making model for promoting sustainable social rental housing	Expert questionnaire, Fuzzy DEMATEL, DANP, VIKOR	Guaranteed rent and lease Reasonable development model Space planning and design Operation management mechanism	Reasonable development model Guaranteed rent and lease Space planning and design (Cause position indicators)
Ahmad & Thaheem (2018)	Develop a dedicated framework for assessing economic sustainability of residential buildings	Expert questionnaire, case study analysis	Capital cost Lifecycle cost Affordability and economic performance Manageability aspects of building Adaptability and flexibility	Lifecycle cost
Dauda & Ajayi (2022)	Identify and analyze the barriers to sustainable structural retrofitting of buildings in the UK	Expert questionnaire, Factor analysis	High costs of materials High costs of technical skills Insufficient public funding Lack of government and decisionmakers policies High inflation rate Imbalance between initial cost and cost of running Lack of economic viability	High inflation rate High costs of materials
Ibem and Azuh (2011)	Propose a framework for evaluating public housing sustainability in developing countries	Case study analysis	Housing affordability Job creation in the form of home-based enterprise Tenure options Suitability of housing acquisition process Cost of living within the neighborhood Adaptability of housing units for future needs	Findings: Many public housing programs fail due to poor planning, lack of financing, and inadequate policy implementation

Table 4.1 Summerazation of sources (continue)

Zhao et al. (2023)	Develops indicators for urban regeneration	Delphi method and AHP	Financial support Attracting investors Job opportunities Housing vacancy rate Local compatibility Traditional business development Training and skills.	Financial support and attracting investors
--------------------	--	-----------------------	---	--

4.2.2 Indicator Selection Criteria

After the first draft of indicators list a detailed elimination process was carried out to refine the list of indicators. This process involved a careful review of the tabulated indicators and indicators were eliminated one by one based on the similarities in their meanings and their relations to housing and housing stock. Indicators that overlapped in meaning or lacked a clear connection to the specific context of housing were systematically excluded. This approach was adopted to avoid redundancy and ensure that the final set of indicators was both focused and meaningful within the scope of the study.

In addition, while the meanings of the indicators were reviewed through a process of elimination, an attempt was made to facilitate easier tracking by grouping them according to certain themes. In this sense, the indicators were evaluated in contexts such as financial contents, urban scale effects, direct relationship of housing with people, and social problems. Hereby, nearly 45 indicators were reduced to 31 through the elimination method. This selective approach ensured that the final indicator set could serve as a strong foundation for evaluating economic sustainability in housing while maintaining analytical depth and clarity.

4.2.3 Thematic Analysis

Thematic analysis was created throughout the process from the beginning of the elimination process. This approach ensured that the emerging themes were grounded in both the data and the contextual relevance of the study. For appropriate and suitable names for the themes, inspiration was drawn from previous literature such as the thematic titles created by Adabre and Chan (2020), Chan and Adabre (2019), Saidu and Yeom (2020) and Tupenaite et al. (2017) and the names suggested by the artificial intelligence based on to the list of indicators grouping were used. As a result, six core themes were identified: Affordability and

Availability, Operation and Maintenance, Financial Reliability, Planning and Infrastructure Quality, Housing Utility, and Householder Satisfaction. Each of these themes captures a critical dimension of economic sustainability in the housing sector. To deepen the analysis, according to the top down and bottom-up approach (UN-Habitat, 2012), certain solution and impact groups of these themes were considered. Thus, with the shaping of these indicators and themes, Government, Community, Financial Institutions, Real Estate Market, Private Sector were seen as the five primary impact and solution categories.

In the top-down framework, government institutions play a central role by establishing regulatory frameworks, policies, and fiscal incentives to facilitate sustainable housing development. Financial institutions, often aligned with governmental priorities, provide essential capital and mechanisms for risk mitigation, while the real estate market acts as a bridge between state directives and large-scale housing provision. Conversely, the bottom-up approach emphasizes the agency of communities and the private sector, particularly small and medium-sized enterprises and local developers, whose grassroots initiatives and innovations often respond more directly to local needs. While top-down mechanisms ensure strategic oversight and scalability, bottom-up actors contribute localized knowledge and adaptability, making both approaches complementary. A balanced integration of these actors is vital for the successful implementation and sustainability of housing interventions.

By mapping the thematic indicators to these actor groups, the study not only identified critical areas of concern but also emphasized the shared responsibility and multi-level collaboration required for promoting economic sustainability in the housing sector. This thematic structure forms the backbone of the analysis and provides a clear pathway for policy recommendations and practical interventions.

4.3 Delphi Method for Predicting the Importance of the Indicators and Developing a Framework for Economic Sustainable Housing Stock in Türkiye

The Delphi technique was developed in the 1950s by two researchers named Olaf Helmer and Norman Dalkey while working at the RAND Corporation in the United

States (Schmalz et al., 2021; Şahin, 2001). Its name comes from a place called Delphi in Ancient Greece, where a famous Greek oracle lived who made prophecies about the future (Şahin, 2001). The purpose of the Delphi technique is to bring together expert opinions and achieve consensus on a particular topic (Chellappa et al., 2024; Şahin, 2001). The Delphi method is defined by four main characteristics: anonymity, repetition through multiple rounds, controlled feedback, and a statistically derived group response (Schmalz et al., 2021). This technique can also address current challenges by helping to rank and prioritize topics, support and inform policy-making, generate ideas, establish facts, and serve various other research purposes (Schmalz et al., 2021). In this study, the Delphi technique was considered an appropriate research method to rank the economic sustainability indicators, compiled through a literature review, based on their importance and priority, as evaluated by experts, and to statistically analyze their responses.

Various recommendations have been made regarding the number of expert panelists required, and these numbers may vary depending on the content of the study (Belton et al., 2019). Empirical studies indicate that the minimum values within these ranges may be sufficient (Belton et al., 2019) and the heterogeneity of the expert panel is regarded as essential for a Delphi study (Toma and Picioreanu, 2016). So, due to the significance of heterogeneous distribution in this study, selecting a panel of 5 to 20 experts, as recommended by Belton et al. (2019), was considered appropriate. The selection and criteria of experts is explained in more detail under a separate heading.

In the surveys prepared for this method, several open-ended questions and 6-point Likert scale was deemed suitable. There are several commonly used Likert scales, such as 5, 7, and 9-point scales; however, in this study, scales with a midpoint were not utilized, as respondents were required to choose a definitive stance (Belton et al., 2019). Also, having more response options allows for a more precise measurement; however, an excessive number of options may lead to increased random error, as respondents might struggle to distinguish subtle differences in meaning between choices (Belton et al., 2019). For these reasons, a 6-point scale was selected to enhance measurement precision while minimizing respondent ambiguity. In the Delphi method, surveys are conducted iteratively until consensus is reached based on the analysis of the Likert scale data provided by the experts. In

the study, following the stages of problem definition, indicator determination, and expert selection, a Delphi questionnaire was prepared and distributed to the selected experts. The first survey responses were tabulated and analyzed, and it was seen that no consensus could be reached. Then, a second survey was prepared, and the process was repeated. Since no consensus could be reached in the second survey results, a third round was conducted and finally consensus was reached. The results of each survey round are explained in detail under separate headings below. The execution process of the Delphi study is illustrated in Figure 4.2.

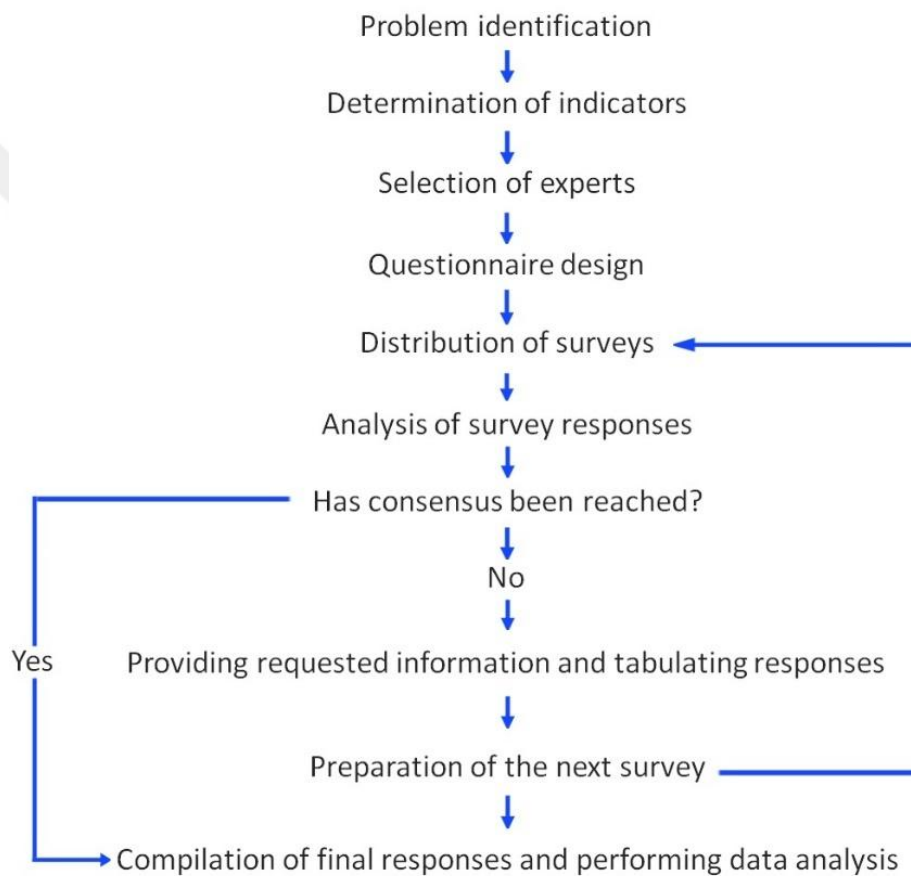


Figure 4.2 Execution of the Delphi Study

4.3.1 Predicting the Delphi Survey Participants

In order for the Delphi technique to be successful, it is important that the required expertise is well defined and that the expert panel members are knowledgeable about the research topic and willing to conduct this research. Experts were selected from various professional backgrounds within the fields of civil engineering and architecture. Their academic qualifications, professional expertise, and industry engagement were also considered during the selection process (Chellappa et al.,

2024). It was also taken into consideration that they were from different regions of Türkiye, considering the differences in living conditions and housing markets (Belton et al., 2019). These individuals should have had expertise in areas such as urban design, housing, real estate, and sustainability, and were either actively working in the market or familiar with the housing market and economy. Expert panelists were required to fulfill at least four of the following eight criteria relevant to the field under study (Chellappa et al., 2024; Hallowell and Gambatese, 2010).

1. Expert panelists were required to meet at least five years of professional experience in the construction and housing industry.
2. Advanced degree in the field of architecture and civil engineering institution of higher learning minimum of a Bachelor of Science (B.Sc.).
3. Faculty member at an institution of higher learning with a research or teaching focus on housing, housing production, urban design, sustainability or construction management.
4. Engaged in professional work or consultancy within the private sector related to housing production and sales, demonstrating expertise in the housing market.
5. Member or chair of a chamber of architects and chamber of civil engineers in a nationally recognized organization.
6. Working in the municipality, government organizations or a well-known real estate agency.
7. Having publications on housing, sustainability and economy in reliable resources.
8. Delivering speeches at symposiums, panels, television programs, and conferences on housing, sustainability, and economics.

So, leveraging through references from academic staff of universities, the Chamber of Architects, professional acquaintances and our personal networks, 29 potential candidates contacted via email. The email provided an overview of the study's objectives, the type of the data to be collected, and the implementation of the Delphi method. Also, it was stated that participation in each round was necessary for the consistency of the survey results, and only 10 experts reported that they could participate continuously. So, based on the responses received, 10 participants were finalized. The process of identifying experts, establishing contact and determining

participants took approximately 6 weeks. Subsequently, the prepared survey was distributed to the experts via Google Surveys.

4.4 Main Findings of the Delphi Analysis

4.4.1 First Round of the Survey

The most critical of the Delphi surveys is the first survey, as it will directly shape the subsequent surveys. In this sense, the first Delphi survey was designed to be as open-ended as possible, allowing researchers to think deeply and generate new ideas, allowing the research to be conducted more comprehensively.

In the survey process of the research, firstly, the I. Delphi Survey was sent to the expert participants determined for the Delphi surveys via e-mail. The process of implementing and analyzing the I. Delphi survey took four weeks. At the beginning of the survey, firstly, the definition of economic sustainability along with general information and then the participants were asked to answer questions about their personal information (profession, educational background, sector experience). The answers of 10 experts are shown respectively in Table 4.2. Then, 4 open-ended questions were asked in order to get their first thoughts based on their experiences and observations on the subject. Their answers are shown in Table 4.3. Questions are in the following order:

1. What is the most important factor for the economic sustainability of the housing stock?
2. What is the most important obstacle to the economic sustainability of the housing stock in Türkiye?
3. In your opinion, what is the most fundamental economic sustainability problem of the housing stock in Türkiye, especially in recent times?
4. The "housing economic sustainability indicators" obtained from the literature have been classified and added as a list below. If there is an item you would like to add or remove from this list, which one(s) would it be? (It is not mandatory to answer)

The first three questions mentioned above were included in the first part of the survey and were answered without showing the determined indicators. The fourth question was presented in the second part, along with a list of the specified

indicators. Then, the participants were asked to evaluate the importance and impact of 31 indicators determined through the literature research in ensuring economic sustainability in the housing stock, using a 6-point Likert scale.

Table 4.2 Profile of experts

	Education Status	Years of Experience	Profession	Institutions/Organizations
E1	B.Sc.	21-30	Architect	Chamber of Architects
E2	PhD	21-30	Architect/Academician (Assoc. Prof.)	Yildiz Technical University
E3	B.Sc.	21-30	Architect	Chamber of Architects
E4	M.Sc.	0-10	Architect	Chamber of Architects
E5	B.Sc.	21-30	Architect	Chamber of Architects
E6	B.Sc.	0-10	Architect	Municipality
E7	PhD	31+	Architect/Academician (Prof.)	Marmara University
E8	PhD	31+	Architect/Academician (Prof.)	Istanbul Technical University
E9	B.Sc.	21-30	Civil engineer/Real estate consultant	Coldwell Banker Türkiye
E10	PhD	31+	Architect/Academician (Prof.)	Eskisehir Technical University

After the I. Delphi survey responses were collected, the written answers of experts were shown in Table 4.3. To summarize, according to the experts, the several critical indicators for economic sustainability mentioned multiple times were “planning”, “quality production”, “purchasing power”, “financing” and “requirements”, underscoring the multifaceted nature of economic stability in housing provision. For question 2, which addressed as the most significant obstacles, the frequently mentioned challenges are “income and wealth equality”, “purchasing power”, “high costs and prices”, “lack of planning” in Türkiye. These insights point to structural challenges that hinder the affordability and availability of housing. Regarding question 3, the fundamental problems were identified as “purchasing power”, “high costs”, “affordability” and “inflation” particularly relevant in recent times. All of this reflect the financial pressures faced by both individuals and developers. Finally, here are some additional indicators recommended by experts for future consideration including “building repair and retrofit”, “price stability”, “purchasing power”, “income and wealth equality”, “urban planning” and “social relations”, suggesting more integrated view of economic sustainability that links financial, technical, and social aspects. This feedback not only enriches the indicator set but also provides valuable direction for policy and planning strategies aimed at enhancing sustainable housing practices.

Table 4.3 Answers to open-ended questions

	Question 1 (most important factor)	Question 2 (most important obstacle)	Question 3 (fundamental problem)	Question 4 (review on indicator set)
E1	Planning	Lack of planning	Affordability	-
E2	Price stability, purchasing power, income and wealth equality	Price stability, purchasing power, income and wealth equality	Price stability, purchasing power, income and wealth equality	Price stability, purchasing power, income and wealth equality (add)
E3	Right planning, right project and right implementation	Lack of planning	Illegal construction	-
E4	Long-lasting and high-quality production is essential for a stable economy. Cheap production techniques should not be preferred as their short-term failures will reduce the quality of life and cause additional economic difficulties.	Low quality and standard production for financial gain	Since houses have become investment instruments in society, human-structure interaction is ignored and reduced to the structure-monetary relationship.	Urban planning and social relations (add)
E5	Correct determination of needs	Ownership	Disturbed price balances	Desirability (out)
E6	It is not only considered in terms of the density of construction and financial arrangements, but also the improvement of environmental and social opportunities in a way that is suitable for all age and income groups, focusing on the individual and society.	The welfare level of the family is not taken into account when evaluating whether the house to be purchased is affordable only according to the household budget.	The household budget is not sufficient to cover housing expenses in areas that can meet transportation, shelter, security, social etc. needs.	-
E7	Robust, quality production	Lack of maintenance and repair	Cheap production, no consideration of life cycle cost	Building repair and retrofit (add)
E8	Financing	Financing	Economic crisis	-
E9	Parallelism between cost and purchasing power	Decline in purchasing power	Purchasing power	-
E10	The requirements and meeting these requirements under appropriate conditions. Appropriate financing conditions will increase demand, while the opposite will cause stagnation. However, while environmental conditions affect long-term economic sustainability, changes in demographic structure and population movements, economic development and growth, and urban development and improvements are also important factors for sustainability.	High urban production costs, high housing prices and limited affordability of these prices.	With increasing inflation, high interest rates, increased construction costs, decreased purchasing power, and rent increases	-

Subsequently, the data from the 6-point Likert scale of the I. Delphi Survey were analyzed. The arithmetic means, median, standard deviation, 1st, 2nd and 3rd quartile values and interquartile range (3rd quartile - 1st quartile) of the responses given for the impact levels (1 lowest-6 highest) of each risk item asked in the survey were calculated. The interquartile range (IQR) provides insight into the level of agreement among participants' responses. Among various metrics, the IQR (Q3 – Q1) is a widely used measure of consensus in applied Delphi research (Schmalz et al., 2021). According to Zeliff and Heldenbrand (1993), when the interquartile range is greater than 1,2, it means that agreement has not been reached. So, based on the results of the first survey, consensus was reached on 12 indicators, while no agreement was achieved for the remaining 19 indicators (Table 4.3). The items on which agreement was most evident were under the theme "housing utility and householder satisfaction". These indicators are as follows: Quality performance of housing facility, Desirability, Functionality, Occupancy, Satisfaction of demand. Among the all indicators, the indicator that attracted the most attention was mortgage interest rates, because it was the indicator that was agreed upon in the first round and had the highest impact (5,5). A consensus was reached in the first round of Delphi survey for the inflation rate, which has the second level of impact (5,4). Consensus was also reached in the first round for the supply and demand indicator, which is another high impact (5,3) indicator. The remaining indicators on which agreement has been reached are as follows: Operating cost, Provision of adequate infrastructure services, Cost effectiveness, Adequate funding. All indicators are listed with their values in Table 4.4.

4.4.2 Second Round of the Survey

After the first-round results, a second survey was prepared for the 19 indicators on which consensus had not been reached. In the new survey, the averages of the indicators from the previous round were provided, and participants were asked to reconsider their decisions. The second Delphi survey and analysis of the survey results took three weeks. As a result of the second survey, consensus was reached on 11 indicators, while no consensus was reached on 8 indicators (Table 4.4). The indicators that have been reached consensus are as follows: Efficient management, Appropriate technology, Renovation and reusing, Economic fusion, Ensure

balanced housing market, Mortgage availability, Added value, Housing affordability, Financial viability, Reasonable development model, Cost of living.

4.4.3 Third Round of the Survey

In the third round, a new survey was conducted, like the previous one, for the remaining 8 indicators and these indicators were: Construction cost, Reduced life cycle cost, Cost recovery, Value stability, Good governance, Effective policy and legal frameworks, Business activity, Safety. The last Delphi survey and analysis of the survey results took three weeks. As a result, consensus was reached for all indicators except for one, cost recovery. It is generally considered appropriate for Delphi surveys to last three rounds, and since consensus could not be reached on only one indicator, the survey study was concluded at the end of the third round (Table 4.4).

4.4.4 Analysis of the Delphi Study Results

This calculation and analysis process was carried out with using Microsoft Excel. In the final results of the surveys, the impact levels were determined based on arithmetic means, with the final round average values of each indicator being considered. Mortgage interest rates had the highest average, at 5.5, followed closely by inflation rates with an average of 5.4. Consensus was reached for these two indicators in the first round. Supply and demand was the third most significant indicator, with an average of 5.3, and agreement was also achieved in the first round. On the other hand, occupancy, which was agreed upon in the first round, had the lowest impact level, with an average of 3.4. Additionally, it is worth noting the cost recovery indicator, which, despite not reaching agreement in the third round, still maintained a moderate impact level with an average of 5.2. The value stability indicator also had the same average, with consensus being reached in the third round.

The indicators that stand out within the four main themes identified in this study are as follows (Table 4.5): "Appropriate technology" has the highest impact, with an average of 4.6, under the "operation and maintenance" theme. For the "affordability and availability" theme, the "mortgage interest rates" indicator, as previously mentioned, was identified as the most impactful. Similarly, the "inflation rate" indicator, discussed earlier, ranked first under the "financial reliability" theme,

while "supply and demand" ranked first under the "planning and infrastructure quality" theme. Lastly, for the "housing utility and householder satisfaction" theme, the "quality performance of the housing facility" indicator emerged as the most significant, with an average score of 4.6. In further detail, the arithmetic mean, median, standard deviation, and interquartile range values for each of the 31 indicators are provided in Table 4.4 for each round they were assessed.



Table 4.4 Results of surveys

	Economic Sustainability Indicators	Impact Lvl.	Arithmetic Mean (Impact Level) - $\bar{x}$			Median			Standard Deviation - σ			Interquartile Range (Q3-Q1)		
			1.Round	2.Round	3.Round	1.Round	2.Round	3.Round	1.Round	2.Round	3.Round	1.Round	2.Round	3.Round
ESI1	Construction cost	7	5,2	4,9	4	6	5	5	1,032	1,059	0,788	2	1,75	1
ESI2	Operating Cost	5	4,5	-	-	4	-	-	0,971	-	-	1	-	-
ESI3	Efficient management	6	3,9	4,2	-	4	4	-	1,663	0,699	-	2	0	-
ESI4	Provision of adequate infrastructure services	7	3,9	-	-	4	-	-	1,286	-	-	1	-	-
ESI5	Cost effectiveness	7	4	-	-	4	-	-	1,247	-	-	0,75	-	-
ESI6	Appropriate technology	5	4	4,6	-	4,5	5	-	1,567	0,966	-	2,5	1	-
ESI7	Renovation and reusing	6	4,1	4,3	-	4	4,5	-	1,852	1,505	-	3,75	1	-
ESI8	Reduced life cycle cost	7	3,6	4,4	4	3	4	4	1,955	1,505	0,942	3,75	2,75	0,75
ESI9	Economic fusion	7	4	4,1	-	4	4	-	1,49	0,875	-	2	0	-
ESI10	Ensure balanced housing market	4	3,9	4,8	-	4	5	-	1,595	1,505	-	2,75	1	-
ESI11	Mortgage interest rates	1	5,5	-	-	6	-	-	1,08	-	-	0	-	-
ESI12	Mortgage availability	5	4,7	4,6	-	5	5	-	1,159	1,173	-	1,75	1	-
ESI13	Cost recovery	2	4,2	4,9	5,2	4	5	5	1,316	0,699	1,494	1,75	2	1,5
ESI14	Value stability	2	3,9	4,2	5,2	4	4,5	4	1,595	0,875	0,707	1,5	2	1
ESI15	Inflation rate	1	5,4	-	-	6	-	-	1,074	-	-	0,75	-	-
ESI16	Added value	4	3,9	4,7	-	3	5	-	1,449	0,966	-	2	1	-
ESI17	Housing affordability	4	4,2	4,7	-	4,5	5	-	1,475	0,823	-	1,75	0,75	-
ESI18	Good governance	4	4	4,7	4,7	4	4,5	5	1,414	1,059	0,483	1,5	1,75	0,75
ESI19	Financial viability	6	4,2	4,3	-	3,5	4	-	1,398	0,674	-	2,75	1	-
ESI20	Adequate funding	5	4,4	-	-	4	-	-	1,074	-	-	1	-	-
ESI21	Effective policy and legal frameworks	6	3,8	4,5	4,3	4	4,5	4	1,619	1,509	0,823	1,75	2,75	0,75
ESI22	Reasonable development model	5	3,8	4,4	-	4	4	-	1,475	0,966	-	1,5	0,75	-
ESI23	Cost of living	5	4,3	4,6	-	4,5	4,5	-	1,636	0,699	-	2,5	1	-
ESI24	Business activity	5	3,6	4	4,5	3,5	4	4,5	1,646	0,843	1,286	2,75	1,5	1
ESI25	Occupancy	8	3,7	-	-	4	-	-	1,059	-	-	0,75	-	-
ESI26	Satisfaction of demand	7	4,1	-	-	4	-	-	0,737	-	-	0	-	-
ESI27	Desirability	7	3,9	-	-	4	-	-	0,994	-	-	1	-	-
ESI28	Functionality	6	4,3	-	-	4	-	-	0,823	-	-	0,75	-	-
ESI29	Quality performance of housing facility	5	4,6	-	-	4,5	-	-	0,966	-	-	1	-	-
ESI30	Safety	5	3,9	4	4,5	4	5	4	1,595	0,699	1,101	1,5	2	0,75
ESI31	Supply and demand	2	5,3	-	-	6	-	-	1,059	-	-	1	-	-
Average Impact Rating:			5,5	5,25	5	4,75	4,5	4,25	4	3,75	3,5			

The average values of each indicator were aggregated under their respective themes, and overall averages were calculated. As a result, affordability and availability had the greatest impact, with an average score of 4.9. This was followed by financial reliability, with an average of 4.8. Planning and infrastructure quality ranked third, with an average of 4.5. Finally, operation and management and housing utility and householder satisfaction both had the same impact, each with an average of 4.2. The final values of the indicators which have a consensus by all experts and themes are presented in Table 4.5.

Table 4.5 Overall averages of themes

Affordability and Availability		Operation and Maintenance		Financial Reliability		Planning and Infrastructure Quality		Housing Utility and Householder Satisfaction	
Indicator	$\bar{x}$	Indicator	$\bar{x}$	Indicator	$\bar{x}$	Indicator	$\bar{x}$	Indicator	$\bar{x}$
ESI11_Mortgage interest rates	5,5	ESI6_Appropriate technology	4,6	ESI15_Inflation rate	5,4	ESI31_Supply and demand	5,3	ESI29_Quality performance of housing facility	4,6
ESI17_Housing affordability	4,7	ESI2_Operating cost	4,5	ESI14_Value stability	5,2	ESI18_Good governance	4,7	ESI24_Business activity	4,5
ESI23_Cost of living	4,6	ESI3_Efficient management	4,2	ESI13_Cost recovery	5,2	ESI22_Reasonable development model	4,4	ESI30_Safety	4,5
ESI12_Mortgage availability	4,6	ESI5_Cost effectiveness	4	ESI10_Ensure balanced housing market	4,8	ESI21_Effective policy and legal frameworks	4,3	ESI28_Functionality	4,3
		ESI1_Construction cost	4	ESI16_Added value	4,7	ESI7_Renovation and reusing	4,3	ESI26_Satisfaction of demand	4,1
		ESI8_Reduced life cycle cost	4	ESI20_Adequate funding	4,4	ESI4_Provision of adequate infrastructure services	3,9	ESI27_Desirability	3,9
				ESI19_Financial viability	4,3			ESI25_Occupancy	3,7
				ESI9_Economic fusion	4,1				
Mean value:	4,9		4,2		4,8		4,5		4,2

4.4.5 Reliability and Validity of the Delphi Survey

Throughout the design, implementation, and reporting of a Delphi study, it is essential to ensure the study's reliability and validity to enhance research rigor and credibility (Belton et al., 2019). Reliability, in particular, pertains to the degree to which a study consistently yields similar results when repeated under similar conditions. In Delphi studies, where data is largely dependent on expert opinions and subjective judgments, this aspect becomes even more crucial. Given that the process involves interpretation by decision-makers, the subjectivity inherent in

expert evaluations must be carefully addressed to ensure consistent and trustworthy results (Belton et al., 2019; Akhanova et al., 2020).

Therefore, it is important to check its internal consistency when evaluating the questionnaire to assess reliability. So, Cronbach's alpha was used to evaluate the internal consistency coefficient of the questionnaire, which is an important component of its reliability. This statistical measure is commonly used to assess the degree of internal agreement among a set of items in a scale or questionnaire. The alpha value ranges between 0 and 1, where higher values indicate greater reliability. Typically, a value above 0.7 is considered acceptable for ensuring the reliability of research survey (Akhanova et al., 2020; Adabre et al., 2020; Adabre and Chan, 2019). Accordingly, Coefficient alpha (α) was calculated using SPSS software and the reliability statistics for each Delphi round in this study were as follows: In the first round, the Cronbach's alpha value was calculated as 0.852 for a total of 31 items, demonstrating a high level of internal consistency. In the second round, which included 19 items based on re-evaluation, the alpha value was 0.775, still within acceptable limits. In the final round, with a further narrowed set of 8 items, the value was 0.802, which once again confirmed the internal reliability of the questionnaire used.

For external validation of the study best guideline is the extent to which aspects of the developed framework matches an existing theoretical model on same topic (Hair et al. 2006). In this regard, several studies offer comparative insights. For instance, Yigitcanlar et al. (2015) uses Delphi method outputs to assess the sustainability of housing developments in a developing country context and with the results in the economic category aligning with affordability. Similarly, Adabre et al. (2020) identified critical barriers to sustainability in affordable housing projects and determined through expert survey results, that high interest rates are a significant concern for developing countries.

These parallels with earlier research suggest that the results of this study are not only internally reliable but also externally valid. The consistency of findings with other research conducted in different settings and using similar or complementary methodologies reinforces the credibility of the developed framework. These comparisons are further explored in the further section, where similarities in

economic sustainability assessments help ground the study's conclusions and emphasize their broader relevance and applicability.



5 CONCLUSION

This study proposes an assessment framework aimed at fostering a more sustainable economy in the context of housing stock, particularly considering economic challenges. According to the survey results, mortgage interest rates, categorized under the theme of "affordability and availability," emerged as a critical indicator of the economic sustainability of housing stock in Türkiye. This finding aligns with the study by Adabre and Chan (2019), which highlighted the significance of mortgage interest rates as a key factor in affordable housing criteria. Also, when Saidu and Yeom (2020) listed the success criteria for sustainable and affordable housing, interest rates ranked second after housing price affordability in the results of the household survey. Similar results were obtained in the results of Mulliner et al. (2016) based on an expert survey. Oyebanji et al. (2017) collected survey data from housing authorities (public) and private non-profit social housing organizations, results revealing that affordability, which is cost of provision, purchase, rent and mortgage loan rates, and adequate funding are important for sustainable social housing. It should be noted that it will be considered more important in countries like Türkiye where home ownership is important. Mortgage interest rates will be less essential in countries where to acquire a house as property is not considered a priority.

Inflation rates indicator, which is under the "financial reliability" title, is the second most important indicator by a small margin. Zou and Chau (2015) study argued that a decline in the inflation rate could stabilize housing prices. This discourse is also a criterion that supports affordable housing. Also, it is seen in Adabre et al., (2020) inflation rate is one of the critical barriers for affordable housing in developing countries. In addition, according to the averages of these indicators' two topics, "affordability and availability" and "financial reliability" are more decisive than

other themes in this order. The third key indicator is supply and demand, categorized under the "planning and infrastructure quality" theme, which ranks third among the thematic priorities. In Türkiye, a developing country, housing is preferred not only to meet the need for shelter but also as an investment tool, and the importance of the housing sector is increasing day by day. Therefore, ensuring the economic sustainability of the existing housing stock and determining which data affects housing supply and demand are of great importance. Wang et al. (2021) argued that if the conflict between housing supply and demand is not addressed, there could be serious housing problems. Within other themes, quality performance of housing facilities and appropriate technology demonstrated the highest impact in the "housing utility and householder satisfaction" and "operation and maintenance" categories, respectively.

In short, answers of the research questions;

- What kind of indicators are important and essential for ensuring economic sustainability in housing stock especially in developing countries?: 31 indicators were identified for this framework, which are listed in the section above.
- Which indicator have the most significant impact on the housing sector in Türkiye?: Mortgage interest rates
- In what order of priority should these indicators be evaluated in Türkiye?: Here are the top six indicators: "mortgage interest rates", "inflation rates", "supply and demand", "value stability", "cost recovery", "ensure balanced housing market".

Additionally, considering the different results of other studies that have conducted sustainability assessments, Turcu (2013) found that for three different local areas, local jobs, business activity and house prices are the most important indicators of economic sustainability for local urban perspectives. Similarly, Mohsin et al. (2020) identified the diversity of economic activities and employment as the two most critical factors for urban sustainability. Supporting this, Zarghami et al. (2019) emphasized the importance of domestic production and local material choice for residential projects. According to Tupenaite et al. (2017) for achieving sustainability of the new residential development projects, "housing affordability" indicator was ranked as the most significant, which is also found important for

building sustainability in Akhanova et al. (2020), followed by added value of the project, satisfaction of housing demand and mortgage interest rates in the economic dimension. Also, in the study for key performance for affordable housing by Gan et al. (2017), financial viability and cost recovery were listed as the top two criteria. In this sense, even if developers can implement cost-saving measures such as using locally sourced materials and construction methods, consistent and reliable financial incentives are required to ensure their financial viability (Pullen et al., 2009). Likewise, for sustainable urban regeneration, Zhao et al. (2023) state that the financial support is a key indicator of economic aspects. Although, it has been shown that there are similarities and differences in the categories and results of economic indicators included in the proposed framework, yet many of them are results that support “financial reliability”. This is reasonable since each evaluation tool is originally developed within a particular regional context and various scale, and assessment priorities differ across countries (Akhanova et al., 2020).

Also, while different results are mentioned, surprisingly, in the survey result, construction cost ratios were lower than expected on average, and even when looking at the statistical data presented in the introduction, it stands out as one of the areas with the highest cost increases. One reason for this may be the difference in perspectives stemming from the lower number of civil engineers compared to the number of architects. Similarly, while mortgage interest rates are found to be important, the fact that the mean of mortgage availability is low is another notable difference in the results. Because, especially in Türkiye, availability is as important as interest rates, and these two indicators are closely interrelated, each reinforcing the effectiveness of the other. Future studies could explore this issue by conducting a survey with different groups of experts.

These survey results underline the centrality of economic factors, particularly mortgage interest rates and inflation, in ensuring the sustainability of housing stock. The emphasis on affordability and financial reliability highlights the necessity of targeted policy measures to address economic vulnerabilities and stabilize housing markets in Türkiye. Moreover, with regard to the “supply and demand” indicator, Adabre and Chan (2019) analyzed the relative effectiveness of supply-side and demand-side policies. Their findings suggest that supply-side policies are more

effective in promoting economic sustainability due to their ability to curb inflationary pressures in housing markets (Adabre and Chan, 2019).

Additionally, it is crucial to recognize that, as Zeijl-Rozema and Martens (2010) emphasize, “It is only by relating a particular indicator to other measures and evaluating its importance within the system that we can make a meaningful sustainability assessment.” For instance, inflation rates influence not only interest rates but also all other cost-related indicators, highlighting their interconnected nature. In this context, “value stability” plays a pivotal role in maintaining investor confidence and mitigating market volatility, which in turn supports long-term economic sustainability. Similarly, “cost recovery” ensures the financial viability of housing projects by balancing construction and operational expenses with revenues, thus contributing to the overall financial reliability of housing systems. “Ensuring a balanced housing market” is crucial for pricing houses in line with their true value and preventing excessive price fluctuations, which also contributes to affordability, by considering supply-demand dynamics. Securing the housing market is one of the important tasks that a country must undertake to achieve sustainable development goals (Ha et al., 2023).

Furthermore, “quality performance of housing facilities” significantly impacts household satisfaction and long-term utility, directly influencing the overall sustainability of housing stock. High-quality facilities not only enhance livability but also reduce maintenance costs over time. Finally, “appropriate technology” is critical for improving the efficiency and sustainability of housing operations. By integrating innovative construction techniques and energy-efficient solutions, this indicator supports environmental and economic objectives while aligning with broader sustainability goals.

This study has certain limitations that should be acknowledged. The data were collected exclusively from participants who work in or have conducted research related to housing and the housing market in Türkiye. Consequently, the impact levels of the indicators identified in the results may not be generalizable to other countries. However, this assessment framework is universally applicable, as it is developed based on a comprehensive framework synthesized from diverse literature and studies across various scales in both developed and developing countries.

Furthermore, the study does not incorporate the perspectives of the general public regarding housing opportunities and the broader economy.

The economy plays a vital role in a country's development, and given that housing stock constitutes a significant proportion, it serves as a valuable tool for identifying problems and solutions. For this reason, every indicator in this assessment framework holds importance, and this study aims to prioritize the indicators of economic sustainability, which encompasses numerous criteria. These indicators are valuable not only for ranking conditions but also for diagnosing issues, setting sustainability objectives, and formulating effective management strategies. Consequently, this study is significant in highlighting the roles of the categories associated with these indicators in addressing challenges.

Affordability and availability, which are also given importance in the literature, was the prominent theme in this study. In the sub-indicators of the theme, mortgage interest rates come to the fore, and the work of financial institutions and the state are effective in this regard. The government must implement policies that regulate mortgage interest rates, inflation, and infrastructure development, while financial institutions should provide affordable housing finance options. If the loans provided by financial institutions are insufficient and the margin of the cost-payment balance is wide, the government may establish financial support mechanisms within its own structure. Additionally, it should not be forgotten that the inflation rate is a factor that affects interest rates, and in this study, it was the second-ranked indicator. In this regard, it is important for the government to adopt policies that will reduce inflation. In addition, even if the government cannot provide social housing etc. in the sense of affordable housing, it would be beneficial for it to provide supervision and controls to prevent the emergence of exorbitant prices to keep the housing market in balance and the real estate market must adapt to demand to ensure stability. Especially, mechanisms should be established to control excessive rent increases through incentives and monitoring. To balance housing supply and demand, which stands out as the third indicator, in Türkiye, several measures can be implemented. Reducing construction costs through tax incentives and streamlining zoning processes can accelerate housing production and making it more feasible for developers to increase supply. Moreover, financial support for urban renewal projects can facilitate the renovation of old and unsafe buildings,

contributing to an increase in available housing units. On the demand side, regulating mortgage interest rates, reevaluating and restricting foreign property ownership policies can help maintain affordability. Strengthening rental market regulations and promoting alternative housing models, such as co-housing and cooperative projects, can also ease market pressure. Implementing these measures can contribute to a more sustainable and balanced housing sector in Türkiye.

To achieve economic sustainability in housing stock, a coordinated approach involving the government, financial institutions, community, real estate market, and the private sector is essential. The community plays a more passive role compared to others through its choices and individual investments in supporting a sustainable housing stock. The private sector can drive innovation, particularly in appropriate technology and housing quality, helping to improve affordability and efficiency. Together, these sectors can foster a stable, sustainable housing market that benefits future generations. However, the results suggest that government, financial institutions and the real estate market play critical roles in ensuring economic sustainability in housing stock. Practically this economic sustainability assessment framework can be used as a decision support system in the development of national housing policies and long-term strategies regarding the existing housing stock by governments and local legislators.

Last of all, since the prioritization of economic sustainability indicators of housing stock may vary across countries and the range of expert opinions is limited, future research could involve comparative analyses with various expert groups, between countries with strong and weak economic sustainability in their housing sectors, examining the effectiveness of the identified indicators in different countries.

REFERENCES

- Adabre, M. A., & Chan, A. P. C. (2020). Towards a sustainability assessment model for affordable housing projects: The perspective of professionals in Ghana. *Engineering, Construction and Architectural Management*, Vol. 27 No. 9, pp. 2523-2551. <https://doi.org/10.1108/ECAM-08-2019-0432>
- Adabre, M. A., Chan, A. P. C., Darko, A., Osei-Kyei, R., Abidoye, R., & Adjei-Kumi, T. (2020). Critical barriers to sustainability attainment in affordable housing: International construction professionals' perspective. *Journal of Cleaner Production*, 253, 119995. <https://doi.org/10.1016/j.jclepro.2020.119995>
- Adabre, M.A. and Chan, A.P. (2019), "Critical success factors (CSFs) for sustainable affordable housing", *Building and Environment*, Vol. 156, pp. 203-214. <https://doi.org/10.1016/j.buildenv.2019.04.030>
- Ahmad, T., & Thaheem, M. J. (2018). Economic sustainability assessment of residential buildings: A dedicated assessment framework and implications for BIM. *Sustainable Cities and Society*, 38, 476–491. <https://doi.org/10.1016/j.scs.2018.01.035>
- Akbulut, H. (2011). Mevcut yapılarda sürdürülebilirlik amaçlı iyileştirmelerin yapı sistemi açısından analizi (Yüksek lisans tezi, Mimar Sinan Güzel Sanatlar Üniversitesi, Fen Bilimleri Enstitüsü).
- Akhanova, G., Nadeem, A., Kim, J. R., & Azhar, S. (2020). A multi-criteria decision-making framework for building sustainability assessment in Kazakhstan. *Sustainable Cities and Society*, 52, 101842. <https://doi.org/10.1016/j.scs.2019.101842>
- Altaf, M., Alaloul, W. S., Musarat, M. A., & Qureshi, A. H. (2023). Life cycle cost analysis (LCCA) of construction projects: Sustainability perspective. *Environment, Development and Sustainability*, 25, 12071–12118. <https://doi.org/10.1007/s10668-022-02579-x>
- Alwaer, H.; Clements-Croome, D.J. (2010). Key performance indicators (KPIs) and priority setting in using the multi-attribute approach for assessing sustainable intelligent buildings. *J. Build. Environ.* 2010, 45, 799–807. <https://doi.org/10.1016/j.buildenv.2009.08.019>
- Alyami, S.H.; Rezgui, Y.; Kwan, A. (2013). Developing sustainable building assessment scheme for Saudi Arabia: Delphi consultation approach. *Renew. Sustain. Energy Rev.* 2013, 27, 43–54. <https://doi.org/10.1016/j.rser.2013.06.011>

- Ashrafian T., Yilmaz A. Z., Corgnati S. P., Moazzen Z. (2016). Methodology to define cost-optimal level of architectural measures for energy efficient retrofits of existing detached residential buildings in Turkey, *Energy and Buildings* 120, pg. 58–77. <http://dx.doi.org/10.1016/j.enbuild.2016.03.074>
- Banani, R., Vahdati, M. M., Shahrestani, M., & Clements-Croome, D. (2016). The development of building assessment criteria framework for sustainable non-residential buildings in Saudi Arabia. *Sustainable Cities and Society*, 26, 289–305. <https://doi.org/10.1016/j.scs.2016.07.007>
- Belton, I., MacDonald, A., Wright, G., & Hamlin, I. (2019). Improving the practical application of the Delphi method in group-based judgment: A six-step prescription for a well-founded and defensible process. *Technological Forecasting & Social Change*, 147, 72–82. <https://doi.org/10.1016/j.techfore.2019.07.002>
- Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, 65, 42–56. <https://doi.org/10.1016/j.jclepro.2013.11.039>
- Bragança, L., Mateus, R., & Koukkari, H. (2010). Building sustainability assessment. *Sustainability*, 2(7), 2010–2023. <https://doi.org/10.3390/su2072010>
- Campbell, S. (1996). Green cities, growing cities, just cities?: Urban planning and the contradictions of sustainable development. *J. Am. Plan. Assoc.*, 62, 296–312. <https://doi.org/10.1080/01944369608975696>
- Chellappa, V., Li, R. Y. M., & Al-Bayati, A. J. (2024). Essential qualifications for safety personnel in the Indian construction industry: Delphi approach. *Journal of Structural Design and Construction Practice*, 30(2), 04024120. <https://doi.org/10.1061/JSDCCC.SCENG-1679>
- Cronin, V. and Guthrie, P. (2011) ‘Alternative approaches to slum upgrading in Kibera, Nairobi’, *Urban Design and Planning*, 164 (DP2): 129-139.
- Dauda J. A., Ajayi S. O. (2022). Understanding the impediments to sustainable structural retrofit of existing buildings in the UK, *Journal of Building Engineering* 60, 105168, <https://doi.org/10.1016/j.jobbe.2022.105168>
- Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M., & Wales, P. W. (2014). Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. *Journal of Clinical Epidemiology*, 67(4), 401-409. <https://doi.org/10.1016/j.jclinepi.2013.12.002>
- Frederick, C. (2022). Economic Sustainability and ‘Missing Middle Housing’: Associations between Housing Stock Diversity and Unemployment in Mid-Size U.S. Cities. *Sustainability*, 14, 6817. <https://doi.org/10.3390/su14116817>
- Gan, X., Zuo, J., Wu, P., Wang, J., Chang, R., & Wen, T. (2017). How affordable housing becomes more sustainable? A stakeholder study. *Journal of Cleaner Production*, 162, 427–437. <https://doi.org/10.1016/j.jclepro.2017.06.055>

- Gilbert, R., Stevenson, D., Girardet, H., & Stren, R. (1996). *Making cities work: The role of local authorities in the urban environment*. Earthscan, Energy and Infrastructure, Volume 8. <https://doi.org/10.4324/9781315066431>
- Glaeser, E. L. (2011). *Triumph of the city: How our greatest invention makes us richer, smarter, greener, healthier, and happier*. Penguin Press.
- Glaeser, E. L., & Gyourko, J. (2018). *Rethinking federal housing policy: How to make housing plentiful and affordable*. American Enterprise Institute Press.
- Golubchikov, O., Badyina, A., (2012). In: French, M. (Ed.), *Sustainable Housing for Sustainable Cities: a Policy Framework for Developing Countries*. United Nations Human Settlements Programme (UN-Habitat), Nairobi. <https://www.unhabitat.org>
- Guardigli L., Bragadin M. A., Fornace F. D., Mazzoli C., Prati D. (2018). Energy retrofit alternatives and cost-optimal analysis for large public housing stocks, *Energy & Buildings*, vol. 166, pp. 48–59, <https://doi.org/10.1016/j.enbuild.2018.02.003>
- Gursel A. P., Shehabi A., Horvath A. (2023). What are the energy and greenhouse gas benefits of repurposing non-residential buildings into apartments?, *Resources, Conservation & Recycling* 198, 107143, <https://doi.org/10.1016/j.resconrec.2023.107143>
- Ha T. V., Thuat P. T., Van H. T. K., Arimura M. (2023). Housing development policies toward sustainability in Japan and Vietnam, *E3S Web of Conferences* 403, 01013, ESCP-2023, <https://doi.org/10.1051/e3sconf/202340301013>
- Hair, J., W. Black, B. Babin, R. Anderson, and R. Tatham. (2006). *Multivariate data analysis*. 6th ed. Upper Saddle River, NJ: Pearson Prentice Hall.
- Hallowell, M. R., and J. A. Gambatese. (2010). “Population and initial validation of a formal model for construction safety risk management.” *J. Constr. Eng. Manage.* 136 (9): 981–990. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000204](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000204).
- Higham, A. & Stephenson, P., (2014). Identifying project success criteria for UK social housing asset management schemes. In *Proceedings of the 30th Annual ARCOM Conference, Association of Researchers in Construction Management*, Portsmouth, UK, 1–3 September 2014, pp. 33–42.
- Ibem, E. O., & Azuh, D. E. (2011). Framework for evaluating the sustainability of public housing programmes in developing countries. *Journal of Sustainable Development and Environmental Protection*, 1(3), 24–39.
- International Code Council. (2021). *International building code*.
- Isalou, A.A., Litman, T., Shahmoradi, B., (2014). Testing the housing and transportation affordability index in a developing world context: a sustainability comparison of central and suburban districts in Qom, Iran. *Transp. Policy* 33, 33e39. <https://doi.org/10.1016/j.tranpol.2014.02.006>
- Jiang, W., Qiu, W. L., Lin, S. H., Lv, H., Zhao, X., & Cong, H. (2023). A new hybrid decision-making model for promoting sustainable social rental housing. *Sustainability*, 15(8), 6420. <https://doi.org/10.3390/su15086420>

- Kang, H., Lee, Y., Kim, S. (2016). Sustainable building assessment tool for project decision makers and its development process. *Environ. Impact Assess. Rev.* 2016, 58, 34–47. <https://doi.org/10.1016/j.eiar.2016.02.003>
- Maliene, V. & Malys, N. (2009). High-Quality Housing: A Key Issue in Delivering Sustainable Communities. *Building and Environment*, 44, 426-430.
- Maqbool, R., Thompson, C., & Ashfaq, S. (2023). LEED and BREEAM green building certification systems as possible game changers in attaining low-cost energy-efficient urban housing projects. *Journal of Urban Planning and Development*, 149(3), 04023024. <https://doi.org/10.1061/JUPDDM.UPENG-4292>
- Mateus, R. and Braganca, L. (2011). Sustainability assessment and rating of buildings: Developing the methodology SBToolPT—H. *Build. Environ.* 2011, 46, 1962–1971. <https://doi.org/10.1016/j.buildenv.2011.04.023>
- Mohsin, M. M., Beach, T., & Kwan, A. (2020). Consensus-based urban sustainability framework for Iraqi cities: A case study in Baghdad. *Heliyon*, 6(12), e05348. <https://doi.org/10.1016/j.heliyon.2020.e05348>
- Mulliner, E., Malys, N., Maliene, V. (2016). Comparative analysis of MCDM methods for the assessment of sustainable housing affordability. *Omega* 2016, 59, 146–156. <https://doi.org/10.1016/j.omega.2015.05.013>
- Mulliner, E., Smallbone, K., Maliene, V. (2013) An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega* 2013, 41, 270–279. <https://doi.org/10.1016/j.omega.2012.05.002>
- National Association of Home Builders. (2022). Housing market index.
- Nilashi, M., Zakaria, R., Ibrahim, O., Majid, M.Z.A., Zin, R.M., Chughtai, M.W., Abidin, N.I.Z.; Sahamir, S.R., Yakubu, D.A. (2015) A knowledge-based expert system for assessing the performance level of green buildings. *Knowl.-Based Syst.* 2015, 86, 194–209. <https://doi.org/10.1016/j.knosys.2015.06.009>
- Nuuter, T., Lill, I., & Tupenaite, L. (2015). Comparison of housing market sustainability in European countries based on multiple criteria assessment. *Land Use Policy*, 42, 642–651. <https://doi.org/10.1016/j.landusepol.2014.09.002>
- Oyebanji, A. O., Liyanage, C., & Akintoye, A. (2017). Critical success factors (CSFs) for achieving sustainable social housing (SSH). *International Journal of Sustainable Built Environment*, 6(2), 216–227. <https://doi.org/10.1016/j.ijbsbe.2017.03.006>
- Pullen, S., Zillante, G., Arman, M., Wilson, L., Zuo, J., Chileshe, N., (2009). Ecocents Living: Affordable and Sustainable Housing for South Australia University of South Australia.
- Pullen, S., Arman, M., Zillante, G., Zuo, J., Chileshe, N., & Wilson, L. (2010). Developing an assessment framework for affordable and sustainable housing. *Australasian Journal of Construction Economics and Building*, 10(1/2), 48–64. <https://doi.org/10.5130/AJCEB.v10i1/2.1594>
- Roufechaei, K.M., Bakar, A.H.A. and Tabassi, A.A. (2014), “Energy-efficient design for sustainable housing development”, *Journal of Cleaner*

- Sadıkoğlu, H. (2016). Mevcut konut stokunda yenileme uygulamaları: 1930-1970 dönemi modern konut buluşmalarına yönelik bir model (Doktora tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Mimari Tasarım Programı).
- Saidu, A. I., & Yeom, C. (2020). Success criteria evaluation for a sustainable and affordable housing model: A case for improving household welfare in Nigerian cities. *Sustainability*, 12(2), 656. <https://doi.org/10.3390/su12020656>
- Schmalz, U., Spinler, S., & Ringbeck, J. (2021). Lessons learned from a two-round Delphi-based scenario study. *MethodsX*, 8, 101179. <https://doi.org/10.1016/j.mex.2020.101179>
- Shen, L.Y., Tam, V.W.Y., Tam, L., Ji, Y. (2010). Project feasibility study: The key to successful implementation of sustainable and socially responsible construction management practice. *J. Clean. Prod.* 2010, 18, 254–259. <https://doi.org/10.1016/j.jclepro.2009.10.014>
- Toma, C., Picioreanu, I. (2016). The Delphi technique: methodological considerations and the need for reporting guidelines in medical journals. *International Journal of Public Health Research* 4 (6), 47–59.
- Tupenaite, L., Lill, I., Geipele, I., & Naimaviciene, J. (2017). Ranking of sustainability indicators for assessment of the new housing development projects: case of the Baltic States, *Resources*, 2017, Vol. 6 No. 4, p. 55. <https://doi.org/10.3390/resources6040055>
- Turcu, C. (2013). Re-thinking sustainability indicators: Local perspectives of urban sustainability. *Journal of Environmental Planning and Management*, 56(5), 695–719. <https://doi.org/10.1080/09640568.2012.698984>
- UIA, (2009). International Union of Architects, Copenhagen Declaration, Sustainable by Design, Copenhagen.
- UN-Habitat (2012). Sustainable Housing for Sustainable Cities: A Policy Framework for Developing Countries. United Nations Human Settlements Programme. French, M. (Ed.), Nairobi: UN-Habitat.
- UN-Habitat (2020). World cities report 2020: The value of sustainable urbanization. United Nations Human Settlements Programme.
- Urban Institute. (2019). The affordable housing crisis: Challenges and solutions.
- Wang, H., Zhao, Y., Gao, X., & Gao, B. (2021). Collaborative decision-making for urban regeneration: A literature review and bibliometric analysis. *Land use policy*, 107, Article 105479. <https://doi.org/10.1016/j.landusepol.2021.105479>
- Winston, N., & Eastaway, M. P. (2008). Sustainable housing in the urban context: International sustainable development indicator sets and housing. *Social Indicators Research*, 87(2), 211–221. <https://doi.org/10.1007/s11205-007-9165-8>

- Wu, G., Duan, K., Zuo, J., Zhao, X., & Tang, D. (2017). Integrated sustainability assessment of public rental housing community based on a hybrid method of AHP-entropy weight and cloud model. *Sustainability*, 9(4), 593. <https://doi.org/10.3390/su9040593>
- Yıldız, S. (2018). Sürdürülebilir kentsel dönüşüm değerlendirme modeli oluşturulması.
- Yi, P., Dong, Q., & Li, W. (2019). Evaluation of city sustainability using the deviation maximization method. *Sustainable Cities and Society*, 50, 101529. <https://doi.org/10.1016/j.scs.2019.101529>
- Yigitcanlar, T., Kamruzzaman, M., & Teriman, S. (2015). Neighborhood sustainability assessment: Evaluating residential development sustainability in a developing country context. *Sustainability*, 7(3), 2570–2602. <https://doi.org/10.3390/su7032570>
- Zarghami, E., Fatourehchi, D., & Karamloo, M. (2019). Establishing a region-based rating system for multi-family residential buildings in Iran: A holistic approach to sustainability. *Sustainable Cities and Society*, 50, 101631. <https://doi.org/10.1016/j.scs.2019.101631>
- Zavadskas, E. K., Cavallaro, F., Podvezko, V., Ubarte, I., & Kaklauskas, A. (2017). MCDM assessment of a healthy and safe built environment according to sustainable development principles: A practical neighborhood approach in Vilnius. *Sustainability*, 9(4), 702. <https://doi.org/10.3390/su9040702>
- Zeijl-Rozema, A. & Martens, P. (2010). An adaptive indicator framework for monitoring regional sustainable development: a case study of the INSURE project in Limburg, The Netherlands. *Sustainability: Science, Practice & Policy*, 6, 6-17.
- Zeliff N. D. and Heldenbrand S. S. (1993). "What has being done in the international business curriculum?". *Business Education Forum*, vol. 48, issue 1, pg. 23-25.
- Zhao, P., Ali, Z. M., & Ahmad, Y. (2023). Developing indicators for sustainable urban regeneration in historic urban areas: Delphi method and Analytic Hierarchy Process (AHP). *Sustainable Cities and Society*, 99, 104990. <https://doi.org/10.1016/j.scs.2023.104990>
- Zou, G. L., & Chau, K. W. (2015). Determinants and sustainability of house prices: The case of Shanghai, China. *Sustainability*, 7(4), 4524–4548. <https://doi.org/10.3390/su7044524>

Online Resources

- Building Research Establishment (BRE). (2023). BREEAM – The world’s leading science-based suite of validation and certification systems for a sustainable built environment. Retrieved from <https://breeam.com> (accessed 17 April 2025)
- DGNB. (2022). The DGNB System. Deutsche Gesellschaft für Nachhaltiges Bauen. Retrieved from <https://www.dgnb-system.de/en> (accessed 17 April 2025)

- International Finance Corporation (IFC). (2023). EDGE Buildings: A Global Green Building Certification System. Retrieved from <https://edgebuildings.com> (accessed 17 April 2025)
- GYODER. (2023). *Türkiye gayrimenkul sektörü 2023 4. çeyrek raporu - sayı: 35*. Real Estate Investors Association, Türkiye, available at: <https://www.gyoder.org.tr/yayinlar/gyoder-gosterge> (accessed 12 May 2024)
- Organisation for Economic Co-operation and Development (OECD). (n.d.). Economic outlook. *OECD Data Explorer*, available at: [https://data-explorer.oecd.org/vis?pg=0&fs\[0\]=Topic%2C1%7CEconomy%23ECO%23%7CEconomic%20outlook%23ECO_OUT%23&fc=Topic&snb=1&bp=true&vw=tb&df\[ds\]=dsDisseminateFinalDMZ&df\[id\]=DSD_EO%40DF_EO&df\[ag\]=OECD.ECO.MAD&df\[vs\]=1.0&pd=2018%2C2025&dq=IND%2BESP%2BITA%2BFRA%2BCAN%2BGRC%2BDEU%2BKOR%2BJPN%2BMEX%2BNOR%2BCHE%2BSWE%2BTUR%2BGBR%2BUSA%2BEA17%2BOECD%2BCHN%2BRUS%2BW%2BWXD.GDPV_ANNPCT.A&to\[TIME_PERIOD\]=false](https://data-explorer.oecd.org/vis?pg=0&fs[0]=Topic%2C1%7CEconomy%23ECO%23%7CEconomic%20outlook%23ECO_OUT%23&fc=Topic&snb=1&bp=true&vw=tb&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_EO%40DF_EO&df[ag]=OECD.ECO.MAD&df[vs]=1.0&pd=2018%2C2025&dq=IND%2BESP%2BITA%2BFRA%2BCAN%2BGRC%2BDEU%2BKOR%2BJPN%2BMEX%2BNOR%2BCHE%2BSWE%2BTUR%2BGBR%2BUSA%2BEA17%2BOECD%2BCHN%2BRUS%2BW%2BWXD.GDPV_ANNPCT.A&to[TIME_PERIOD]=false) (accessed 5 April 2024)
- Organisation for Economic Co-operation and Development (OECD). (n.d.). Housing prices. *OECD Data Explorer*, available at: [https://data-explorer.oecd.org/vis?tm=housing%20prices&pg=0&snb=32&df\[ds\]=dsDisseminateFinalDMZ&df\[id\]=DSD_AN_HOUSE_PRICES%40DF_HOUSE_PRICES&df\[ag\]=OECD.ECO.MPD&df\[vs\]=1.0&pd=2023%2C2023&dq=AUS%2BNLD%2BZAF%2BCHN%2BSAU%2BIND%2BFRA%2BITA%2BDEU%2BGRC%2BKOR%2BJPN%2BNOR%2BSWE%2BESP%2BCHE%2BTUR%2BUSA%2BGBR%2BW%2BWXXOECD%2BEA17%2BRUS.A.HPI%2BRPI.&to\[TIME_PERIOD\]=false&vw=vs](https://data-explorer.oecd.org/vis?tm=housing%20prices&pg=0&snb=32&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_AN_HOUSE_PRICES%40DF_HOUSE_PRICES&df[ag]=OECD.ECO.MPD&df[vs]=1.0&pd=2023%2C2023&dq=AUS%2BNLD%2BZAF%2BCHN%2BSAU%2BIND%2BFRA%2BITA%2BDEU%2BGRC%2BKOR%2BJPN%2BNOR%2BSWE%2BESP%2BCHE%2BTUR%2BUSA%2BGBR%2BW%2BWXXOECD%2BEA17%2BRUS.A.HPI%2BRPI.&to[TIME_PERIOD]=false&vw=vs) (accessed 18 April 2024)
- Turkish Statistical Institute (TurkStat). (n.d.). Population and demographics, construction and housing, inflation and price. *TÜİK Veri Portalı*, available at: <https://data.tuik.gov.tr/> (accessed 11 May 2024)
- U.S. Green Building Council (USGBC). (2023). LEED Rating System. Retrieved from <https://www.usgbc.org/leed> (accessed 17 April 2025)
- Sustainable Development Goal 11 (SDG 11). (n.d.), available at: <https://www.globalgoals.org/goals/11-sustainable-cities-and-communities/> (accessed 30 May 2025)

1. DELPHI SURVEY

1. Ad/Soyad:

2. E-Mail:

3. Eğitim durumu:

☐Doktora ☐Yüksek lisans ☐Lisans ☐Ön Lisans ☐Lise

4. Deneyim yılı:

☐0-10 ☐11-20 ☐21-30 ☐31+

5. Mesleğiniz:

6. Çalıştığınız veya bağlı olduğunuz kurum/kuruluşlar:

7. Konut stokunun ekonomik sürdürülebilirliği için en önemli faktör nedir?:

8. Türkiye'de konut stokunun ekonomik sürdürülebilirliği için en önemli engel nedir?:

9. Sizce Türkiye'deki konut stokunun özellikle son zamanlardaki en temel ekonomik sürdürülebilirlik problemi nedir?:

Ekonomik Sürdürülebilirlik Göstergeleri

10. Literatürden elde edilen "konut ekonomik sürdürülebilirlik göstergeleri" sınıflandırılarak aşağıya liste olarak eklenmiştir. Bu liste içerisinde eklemek veya çıkarmak istediğiniz bir madde varsa, hangisi veya hangileridir?:

Affordability and Availability	Operation and Maintenance	Financial Reliability	Planning and Infrastructure Quality	Housing Utility and Householder Satisfaction
Housing affordability	Reduced life cycle cost	Value stability	Effective policy and legal frameworks	Desirability
Mortgage availability	Cost effectiveness	Added value	Reasonable development model	Satisfaction of demand
Cost of living	Operating cost	Cost recovery	Renovation and reusing	Functionality
Mortgage interest rates	Construction cost	Ensure balanced housing market	Provision of adequate infrastructure services	Occupancy
	Appropriate technology	Economic fusion	Good governance	Business activity
	Efficient management	Inflation rate	Supply and demand	Quality performance of housing facility
		Financial viability		Safety
		Adequate funding		

11. Housing affordability: Affordable price rent/purchase) (Konutun maddi erişilebilirliği: Uygun fiyatlı kira/satın alma) (1: en az etkili, 6: en yüksek etkili):

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

12. Mortgage availability (İpotek ve kredi uygunluğu) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

13. Financial viability (Finansal uygulanabilirlik: Tasarlanan yapının finansal, zamansal, teknik vb. her anlamda uygulanabilir olması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

14. Adequate funding (Yeterli finansman: Yapım sürecinde, sponsorlukta, sosyal konut desteğinde başlangıçta ilgili kişi veya kurumun yeterli finansmanı sağlaması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

15. Effective policy and legal frameworks (Etkili politika ve yasal çerçeveler: Özellikle sosyal konut sağlama faaliyetlerinin (tedarik, sözleşme ve dağıtım) etkin bir şekilde uygulanmasını ve kontrolünü artırmak için etkili politika ve yasal çerçeveler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

16. Good governance (İyi yönetim: Konut ihtiyaçlarını karşılayan yeterli Sürdürülebilir Sosyal Konut sağlanmasına olanak tanıyan ekonomik büyümeyi teşvik etmeye yönelik iyi yönetim.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

17. Reasonable development model (Makul kalkınma modeli: Hükümet tarafından kendi kendini inşa etme, alt konutların ortak inşası veya üst yapı alanları oluşturulması gibi makul kalkınma modelleri benimsenirse, genel mali sürdürülebilirliğini sağlamak için işletme ve bakımını destekleyecek yeterli fon ayrılır.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

18. Cost of living (Yaşam maliyeti: Konutta yaşayan kişi veya kişilerin konutla doğrudan alakalı toplam gider maliyeti.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

19. Reduced life cycle cost (Azaltılmış yaşam döngüsü maliyeti: Karma geliştirme ve esnek yapıların sağlanması için ekonomik tasarım ve kaynakların verimli kullanımı, gelecekteki bakım ve genişleme maliyetlerini teşvik eder ve en aza indirir.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

20. Construction cost (İnşaat maliyeti: Yapılacak olan veya yapılan inşaatın maliyeti) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

21. Operating cost (İşletme maliyeti: İnşaatın veya binanın yönetme maliyeti) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

22. Cost effectiveness (Maliyet etkinliği/verimliliği: Karma geliştirme ve esnek yapıların sağlanması için ekonomik tasarım ve kaynakların verimli kullanımı, gelecekteki bakım ve genişleme maliyetlerini teşvik eder ve en aza indirir.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

23. Appropriate technology (uygun teknoloji: Yenilemeye olanak sağlayan, atığı en aza indiren, konut ihtiyaçlarını karşılayan, inşaat maliyetini azaltan, inşaat süresini azaltan, bakım maliyetini azaltan uygun teknoloji.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

24. Efficient management (Verimli yönetim: Tüm yaşam döngüsü boyunca yönetim, bakım ve müteakip genişleme maliyetlerini en aza indirmek için inşaat ve işletme aşamasında etkili bir yönetim mekanizmasının benimsenmesi.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

25. Provision of adequate infrastructure services (Yeterli altyapı hizmetlerinin sağlanması: Yol, su, verimli enerji, demir yolu hizmetleri gibi yeterli altyapı hizmetlerinin sağlanmasını garanti altına almak için etkin ekonomik planlama.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

26. Renovation and reusing (Yenileme ve yeniden kullanım: Evlerin yaşanabilir ve verimli kalması için düzenli bakıma ve ara sıra güncellemelere ihtiyacı vardır. Konut stokunun ekonomik sürdürülebilirliği, sahiplerinin ve hükümetlerin bu devam eden maliyetleri karşılayıp karşılayamayacağına bağlıdır) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

27. Value stability (Değer istikrarı: Konutun mali değerinin zaman içindeki değişim miktarının minimum olması, işleyen karlılık.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

28. Added value (Katlanmış değer: Satın alınan konutun fiyatının zaman içinde artması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

29. Cost recovery (Maliyet kurtarma: Yapımda harcanan maliyetin veya yatırım amaçla alınan konut maliyetinin daha sonradan kendi kendine harcanan maliyetini çıkarması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

30. Ensure balanced housing market (Dengeli bir konut piyasası: Fiyat, tutarlılık, uygunluk vb. açısından dengeli bir piyasa sağlanması) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

31. Economic fusion (Ekonomik füzyon: Satın alma ve kiralama durumu, yerel satın alma niyetleri, piyasadaki hareketlilik vb.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

32. Inflation rate (Enflasyon oranı) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

33. Mortgage interest rates (İpotek ve kredi faiz oranları) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

34. Desirability (Arzu edilebilirlik: Konutun beğeni ve istenme durumu.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

35. Occupancy (Konut doluluğu: Konutun boş kalma durumundaki dolma hızı ve sirkülasyon sıklığı.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

36. Satisfaction of demand (Taleplerin karşılanması: Konutu alan ya da kiralayan kişilerin taleplerinin karşılanması ve memnuniyet durumu.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

37. Functionality (İşlevsellik: Konut tesisinin, konutun hanelerin ve kişilerin zamanla değişen ihtiyaçlarını karşılama yeteneği) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

38. Business activity (İş faaliyeti/İstihdam fırsatı: Topluluk içinde ve çevresinde ticari faaliyetler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

39. Quality performance of housing facility (Konutun kalite performansı: İç ve dış ortam kalitesi; malzeme veya işçilik kalitesi) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

40. Safety (Konut çevresi güvenliği) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

41. Supply and Demand (Arz ve Talep: Fiyat oynaklığını önlemek için konut arzı ve talebi arasında sağlıklı bir denge esastır. Konut piyasaları balonlar veya önemli düşüşler yaşadığında ekonomik sürdürülebilirlik risk altındadır.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

2. DELPHI SURVEY

Adınız:

1. Housing affordability: Affordable price rent/purchase) (Konutun maddi erişilebilirliği: Uygun fiyatlı kira/satın alma) (1: en az etkili, 6: en yüksek etkili):

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

2. Mortgage availability (İpotek ve kredi uygunluğu) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

3. Financial viability (Finansal uygulanabilirlik: Tasarlanan yapının finansal, zamansal, teknik vb. her anlamda uygulanabilir olması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

4. Effective policy and legal frameworks (Etkili politika ve yasal çerçeveler: Özellikle sosyal konut sağlama faaliyetlerinin (tedarik, sözleşme ve dağıtım) etkin bir şekilde uygulanmasını ve kontrolünü artırmak için etkili politika ve yasal çerçeveler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

5. Good governance (İyi yönetim: Konut ihtiyaçlarını karşılayan yeterli Sürdürülebilir Sosyal Konut sağlanmasına olanak tanıyan ekonomik büyümeyi teşvik etmeye yönelik iyi yönetim.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

6. Reasonable development model (Makul kalkınma modeli: Hükümet tarafından kendi kendini inşa etme, alt konutların ortak inşası veya üst yapı alanları oluşturulması gibi makul kalkınma modelleri benimsenirse, genel mali sürdürülebilirliğini sağlamak için işletme ve bakımını destekleyecek yeterli fon ayrılır.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

7. Cost of living (Yaşam maliyeti: Konutta yaşıyan kişi veya kişilerin konutla doğrudan alakalı toplam gider maliyeti.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

8. Reduced life cycle cost (Azaltılmış yaşam döngüsü maliyeti: Karma geliştirme ve esnek yapıların sağlanması için ekonomik tasarım ve kaynakların verimli kullanımı, gelecekteki bakım ve genişleme maliyetlerini teşvik eder ve en aza indirir.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

9. Construction cost (İnşaat maliyeti: Yapılacak olan veya yapılan inşaatın maliyeti) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

10. Appropriate technology (uygun teknoloji: Yenilemeye olanak sağlayan, atığı en aza indiren, konut ihtiyaçlarını karşılayan, inşaat maliyetini azaltan, inşaat süresini azaltan, bakım maliyetini azaltan uygun teknoloji.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

11. Efficient management (Verimli yönetim: Tüm yaşam döngüsü boyunca yönetim, bakım ve müteakip genişleme maliyetlerini en aza indirmek için inşaat ve işletme aşamasında etkili bir yönetim mekanizmasının benimsenmesi.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

12. Renovation and reusing (Yenileme ve yeniden kullanım: Evlerin yaşanabilir ve verimli kalması için düzenli bakıma ve ara sıra güncellemelere ihtiyacı vardır. Konut stokunun ekonomik sürdürülebilirliği, sahiplerinin ve hükümetlerin bu devam eden maliyetleri karşılayıp karşılayamayacağına bağlıdır) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

13. Value stability (Değer istikrarı: Konutun mali değerinin zaman içindeki değişim miktarının minimum olması, işleyen karlılık.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

14. Added value (Katlanmış değer: Satın alınan konutun fiyatının zaman içinde artması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

15. Cost recovery (Maliyet kurtarma: Yapımda harcanan maliyetin veya yatırım amaçla alınan konut maliyetinin daha sonradan kendi kendine harcanan maliyetini çıkarması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

16. Ensure balanced housing market (Dengeli bir konut piyasası: Fiyat, tutarlılık, uygunluk vb. açısından dengeli bir piyasa sağlanması) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

17. Economic fusion (Ekonomik füzyon: Satın alma ve kiralama durumu, yerel satın alma niyetleri, piyasadaki hareketlilik vb.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

18. Business activity (İş faaliyeti/İstihdam fırsatı: Topluluk içinde ve çevresinde ticari faaliyetler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

19. Safety (Konut çevresi güvenliği) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

3. DELPHI SURVEY

Adınız:

1. Effective policy and legal frameworks (Etkili politika ve yasal çerçeveler: Özellikle sosyal konut sağlama faaliyetlerinin (tedarik, sözleşme ve dağıtım) etkin bir şekilde uygulanmasını ve kontrolünü artırmak için etkili politika ve yasal çerçeveler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

2. Good governance (İyi yönetim: Konut ihtiyaçlarını karşılayan yeterli Sürdürülebilir Sosyal Konut sağlanmasına olanak tanıyan ekonomik büyümeyi teşvik etmeye yönelik iyi yönetim.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

3. Reduced life cycle cost (Azaltılmış yaşam döngüsü maliyeti: Karma geliştirme ve esnek yapıların sağlanması için ekonomik tasarım ve kaynakların verimli kullanımı, gelecekteki bakım ve genişleme maliyetlerini teşvik eder ve en aza indirir.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

4. Construction cost (İnşaat maliyeti: Yapılacak olan veya yapılan inşaatın maliyeti) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

5. Value stability (Değer istikrarı: Konutun mali değerinin zaman içindeki değişim miktarının minimum olması, işleyen karlılık.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

6. Cost recovery (Maliyet kurtarma: Yapımda harcanan maliyetin veya yatırım amaçla alınan konut maliyetinin daha sonradan kendi kendine harcanan maliyetini çıkarması.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

7. Business activity (İş faaliyeti/İstihdam fırsatı: Topluluk içinde ve çevresinde ticari faaliyetler.) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6

8. Safety (Konut çevresi güvenliği) (1: en az etkili, 6: en yüksek etkili)

☐1 ☐2 ☐3 ☐4 ☐5 ☐6



PUBLICATIONS FROM THE THESIS

Papers

1. Çövüt, M. and Ercan, T. (2025), "Assessment framework of economic sustainability for current housing stock: case of Türkiye", International Journal of Housing Markets and Analysis, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/IJHMA-01-2025-0017>

