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ENERGY-EFFICIENT RESIDENTIAL HOUSING LOAN: ECONOMIC AND ENVIRONMENTAL IMPACTS AND CURRENT FINANCING SITUATION IN MONGOLIA

Gotov Otgonsuren
National University of Mongolian, School of business (NUM)

Author: Gotov Otgonsuren: otgonsuren.g@num.edu.mn
ORCID: https://orcid.org/0009-0003-1990-2135

Dorjpalam Oyuntsetseg
National University of Mongolian, School of business (NUM)

Corresponding author: Dorjpalam Oyuntsetseg: oyun_tsetseg@num.edu.mn
ORCID: https://orcid.org/0009-0009-0216-028X

Altantsetseg Monkhzul
National University of Mongolian,Computer Science, School of information Tehnology and Electronics (NUM)

Corresponding author: Altantsetseg Monkhzul: Munkhzul.a@num.edu.mn
ORCID: https://orcid.org/0009-0004-3408-8976

Monkh-Erdene Saikhanaa
National University of Mongolian, Khovd Branches (NUM)

Corresponding author: Monnkh-Erdene Saikhanaa:msaikhanaa11@gmail.com
ORCID: https://orcid.org/0009-0003-8555-5960

Highlights

- Energy-efficient housing in Mongolia significantly reduces energy use and greenhouse gas emissions while improving living standards.

- Residential loan volumes are positively correlated with nominal and real GDP, and with household energy consumption.
- Negative correlations are observed with unemployment and poverty levels, indicating their dampening effect on mortgage accessibility.
- Regression analysis reveals that selected macroeconomic indicators explain 97.2% of the variance in housing loan volumes.
- As of Q1 2025, green loans represent only 2.9% of total bank lending in Mongolia, far below the 10% target for 2030.

Abstract

Introduction: Energy-efficient residential housing plays a critical role in sustainable development, especially in countries with severe climates such as Mongolia. These buildings are designed to minimize energy consumption, improve indoor environmental quality, and reduce greenhouse gas emissions. Given that the global construction sector accounts for over 30% of energy use and a large share of emissions, transitioning to energy-efficient housing is crucial. Moreover, energy-efficient homes contribute directly to the achievement of several UN Sustainable Development Goals (SDGs), particularly Goal 7 (Affordable and Clean Energy), Goal 11 (Sustainable Cities and Communities), and Goal 13 (Climate Action). Despite its importance, the green housing sector in Mongolia faces significant financial and regulatory barriers that limit its growth and accessibility for low- and middle-income households.

Methods: The study employs panel data analysis to investigate the relationship between macroeconomic indicators and the volume of residential housing loans issued by Mongolian commercial banks from 2017 to 2023. Correlation and linear regression techniques were applied to assess the impact of selected SDG-aligned indicators, including nominal GDP (GDPn), real GDP (GDPr), unemployment rate (UnIm), poverty rate (Pover), household energy consumption (EnConH), and construction sector energy use (EnConB). Data sources include the Bank of Mongolia and the national statistical database. Excel was used to conduct the statistical analyses and build regression models.

Results: The correlation analysis revealed strong positive relationships between residential loan volumes and GDPn (0.96), GDPr (0.86), and household energy use (0.82). In contrast, unemployment and poverty rates showed negative correlations at –0.66 and –0.77, respectively. The regression analysis produced a high explanatory power: $R^2 = 0.972$ in Model 1. An improved Model 2, excluding weaker energy variables, achieved $R^2 = 0.96$ with lower standard error and higher statistical significance (F-statistic = 0.012). The final regression model is as follows: Loan Volume = 6495.5 + 0.043 × GDPn − 84.3 × UnIm + 234.2 × Pover. The coefficients

suggest that a 1 billion MNT increase in nominal GDP results in a 43 million MNT increase in loan volume, a 1% rise in unemployment reduces loans by 84.3 billion MNT, and a 1% increase in poverty rate corresponds to a decrease of 234.2 billion MNT in loan issuance.

***D**iscussion:* The findings confirm that Mongolia's residential mortgage market is highly sensitive to macroeconomic stability. Economic growth boosts demand and accessibility for housing loans, while unemployment and poverty act as suppressors. Despite progress in expanding the green finance sector, green loans remain marginal, accounting for only 2.9% of total bank lending as of Q1 2025. Moreover, 61.8% of these loans are allocated to enterprises, not households, revealing a mismatch between financing availability and residential needs. Barriers include stringent borrower eligibility requirements, insufficient affordable energy-efficient housing stock, and limited data to assess alignment with SDG targets. To address these challenges, the paper recommends expanding access to green housing finance through subsidized interest rates, standardizing certification procedures, streamlining regulatory requirements, and promoting multi-stakeholder partnerships. Future research should explore regional disparities in mortgage access, examine the influence of household income levels, and evaluate the long-term return on investment of green buildings to support evidence-based policymaking.

Keywords

Energy-efficient housing, green financing, Mongolia, sustainable development, green loans, energy efficiency, housing affordability, SDGs.

JEL classification: Q48, H81, G21.

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Introduction

Energy-efficient residential housing refers to homes designed with advanced technologies to minimize energy consumption. These homes are environmentally friendly, reducing soil and air pollution. Mongolia's housing innovation center classifies energy-efficient buildings into categories such as passive houses and zero-energy homes. Compared to conventional buildings, these homes consume significantly less electricity and other energy, with heating requirements below 70 kWh/m² per year.

Sustainable building encompasses environmental, economic, social, ecological, technical, and technological dimensions [1]. Green and sustainable buildings mitigate the negative impacts of construction on the environment, economy, and society [2]. They promote the use of natural resources, reduce pollutant emissions, recycle materials, ensure safety, and improve indoor environmental quality (IEQ) to lower greenhouse gas emissions. Some researchers define sustainable buildings as green structures capable of reducing emissions beyond conventional standards, even achieving net-zero levels [3]. Energy efficiency is a core concept in sustainable construction, covering green buildings, low-energy structures, and ultra-low-energy designs [4].

Energy efficiency is integral to green and sustainable buildings. Improving energy efficiency in existing and new constructions is a rapid solution to limit the sector's environmental, economic, and social impacts [5]. Sameer Assaf and Mutasim Nour found that implementing energy-saving strategies could reduce energy demand in new residential and commercial buildings by 38% [6]. Energy-efficient homes reduce wasteful energy consumption, greenhouse gas emissions, and reliance on non-renewable resources, fostering healthier living conditions. They also offer financial savings. Energy, as a vital natural resource, underpins national economic development. Efficient energy use is key to conservation, emission reduction, and economic growth [7].

World Bank researchers note that current mortgage loans often favor high-priced homes, which are unaffordable for many. They recommend offering discounted loans for energy-efficient, eco-friendly constructions to improve affordability [8]. Balancing energy efficiency with environmental protection and sustainable economic growth is a global challenge. A study on China's green credit and energy consumption (2007–2017) found that green financing positively influences energy efficiency. However, China's energy efficiency remained relatively low during this period, with provincial averages below [9].

Literature Review

L. Liu et al. examined the impact of China's green credit policies on corporate green productivity (2007–2020) using a double-difference model. They found that green credit guidelines significantly improved the green productivity of firms with limited financing and low capital efficiency. The study recommended standardizing green credit systems and enhancing policy implementation to support corporate green development [10].

U.S. Bhutta, M. H. Malik and Z. Khan analyzed factors influencing green bond growth and their alignment with environmental, social, and governance (ESG) goals. They highlighted challenges in financing eco-friendly projects, issuer characteristics, and the uniqueness of green bonds. The study emphasized the importance of green finance for sustainable development and suggested improving the legal framework for green bonds [11]. Kai-Hua Wang et al. investigated the relationship between green finance and sustainable development globally using a bootstrap rolling-window Granger causality test. They found that green credit positively impacts sustainable development but noted temporal instability. The study recommended enhancing green finance classification standards, evaluation systems, and transparency to boost contributions to sustainable development [12].

Current State of Green Loans in Mongolia

Under the "National Roadmap for Sustainable Finance," Mongolia aims for green loans to comprise 10% of total bank loans by 2030. As of Q1 2025, green loans accounted for 2.9%, with a total balance of 1192.9 billion MNT, a 30.5% increase from the previous quarter. Energy-efficient housing loans dominated, making up 55% of green loans.

Table 1. Green Loan Distribution by Purpose (2025.Q1)

No.	Loan Purpose	Enterprise (billion MNT)	Citizens (billion MNT)	Total (billion MNT)
1	Renewable Energy	100.9	0.3	101.2
2	Low-Pollution Energy	0.5	0.1	0.6
3	Energy Efficiency	737.5	0.1	737.6
4	Green Buildings	26.4	3	29.4
5	Pollution Prevention	4.7	1.7	6.4
6	Sustainable Water/Waste Management	71.5	0.2	71.7
7	Sustainable Agriculture/Forestry	129.7	3.3	133
8	Low-Carbon Transport	55	58	113
	Total Green Loans	**1126.2**	**66.7**	**1192.9**

Source: Compiled by the researchers based on Bank of Mongolia data (2025)

The largest share of green loans (737.6 billion MNT, 61.8% of total) is allocated to Energy Efficiency projects, primarily for enterprises (737.5 billion MNT). This reflects Mongolia's strong focus on reducing energy consumption in industries and infrastructure. Renewable Energy ranks second (101.2 billion MNT, 8.5% of total), with

almost all funding directed to enterprises (100.9 billion MNT). This aligns with global trends toward clean energy transition. Funding sources for green loans: 64.45% international, 31.27% bank capital, 4.28% government funds. Despite progress, challenges remain, including high eligibility criteria, limited affordable energy-efficient housing, and insufficient data for evaluating SDG alignment.

Methodology and Findings

We aimed to identify the impact of sustainable development goals (SDGs) on the volume of residential housing loans issued by commercial banks from 2017 to 2023. For this purpose, we conducted a panel data analysis using correlation and linear regression methods.

From the SDG indicators, we selected the following for Mongolia:

- SDG8.4.1: Nominal GDP (GDP n), Real GDP (GDPr), Unemployment rate (UnIm),
- SDG1: Poverty rate (Pover),
- SDG7: Household energy consumption (EnConH) and construction sector energy consumption (EnConB) (in terajoules).

Most of these indicators are not regularly reported for Mongolia, and quantitative data availability is limited.

Table 2. Macroeconomic Indicators (2013–2023)

Year		GDP at Current Prices (million MNT)	GDP at 2015 Prices (million MNT)		Unemployment Rate (%)	Poverty Rate (%)		Household Energy Use	Construction Sector Energy Use
SDG Indicator		7.3.1	8.4.1		8.5.2	1.1.1			
2013	**Economic Indicators**	19,174,242.5	14,350,689.2	**Social Indicators**	7.9	27.4	**Energy Consumption**	90,146.1	6,382.8
2014		22,227,054.3	15,482,273.4		7.9	21.6		92,171.9	6,361.7
2015		22,894,780.9	22,894,780.9		7.5	21.6		90,146.1	6,382.8
2016		23,931,342.6	23,235,863.8		10	29.6		92,171.9	6,361.7
2017		28,010,710.6	24,545,640.7		8.8	29.6		90,912.1	5,691.1
2018		32,582,629.1	26,446,671.3		7.8	28.4		98,650.1	6,671.1
2019		37,839,225.4	27,928,278.4		10	28.4		107,317.2	7,452.5
2020		37,839,225.4	26,655,376.7		7	27.8		90,929.8	5,730.8
2021		43,555,484.4	27,091,663.8		8.1	27.8		114,998.8	7,085.3
2022		53,851,544.5	28,455,108.6		6.7	27.1		129,085.5	7,756.1
2023		68,871,741.6	30,453,508.6		6.7	27.1		129,085.5	7,756.1

Source: Compiled by the researchers based on www.1212.mn

To examine whether these macro-level indicators influence residential housing loan volumes, we performed correlation analysis on data from 2017 to 2023. The variables included:

Table 3. Key SDG indicators affecting residential loan volumes

Variable	Description	Unit
MLOB	Outstanding residential loans	Billion MNT
GDP n	Nominal GDP	Billion MNT
GDPr	Real GDP	Billion MNT
UnIm	Unemployment rate	Percentage
Pover	Poverty rate	Percentage
EnConH	Household energy consumption	Terajoule
EnConB	Construction energy consumption	Terajoule

Source: Compiled by the researchers

We used Excel for panel data analysis, including correlation and linear regression. The correlation results are summarized below:

Table 4. Correlation Analysis Results. Sample Period: 2017–2023

	GDP n	GDPr	UnIm	Pover	EnConH	EnConB
MLOB	0.96	0.86	-0.66	-0.77	0.82	0.65

Source: Compiled by the researchers

Key Findings from Correlation Analysis:

– Residential loan volumes (**MLOB**) showed a **strong positive correlation** with:
  – Nominal GDP (0.96)
  – Real GDP (0.86)
  – Household energy consumption (0.82).
– **Negative correlations** were observed with:
  – Unemployment rate (-0.66)
  – Poverty rate (-0.77).

To further analyze these relationships, we conducted a two-stage regression analysis.

Regression Analysis (Model 1):

– **R-squared: 0.97** (97.2% of loan volume variation explained by the selected indicators).
– Standard error: 157.1 (low margin of error).

– Excluded energy consumption due to weaker correlation in **Model 2**.

Improved Model (Model 2):

– **R-squared: 0.96** (96% explanation power).

– Standard error reduced to 148.

– F-statistic: 0.012 (improved significance after removing less relevant variables).

Regression Equation:

$$MLOB = 6495.5 + 0.043GDP\,n - 84.3UnIm + 234.2*Pover$$

Interpretation of Coefficients:

1. **GDP n (0.043)**: A 1-billion MNT increase in nominal GDP raises loan volumes by 43 million MNT, holding other factors constant.
2. **UnIm (-84.3)**: A 1% rise in unemployment reduces loans by 84.3 billion MNT.
3. **Pover (234.2)**: A 1% increase in poverty decreases loans by 234.2 billion MNT.

Conclusion

This study systematically examines the economic and environmental impacts of energy-efficient residential housing development in Mongolia, along with the current challenges in financing such green construction. Key findings and policy implications are summarized below:

1. Economic and Environmental Benefits of Energy-Efficient Housing

– Energy Savings: Energy-efficient buildings consume less than 70 kWh/m² annually for heating, achieving 30–40% greater efficiency compared to conventional structures.

– Environmental Impact: Reduces greenhouse gas emissions and air pollution, directly supporting Mongolia's commitments to SDGs 7 (Affordable and Clean Energy), 11 (Sustainable Cities), and 13 (Climate Action).

– Economic Efficiency: Lowers household utility costs, alleviating financial burdens for residents while promoting long-term energy independence.

2. Financing Challenges

– Limited Green Loan Penetration: Green loans account for only 2.9% of total bank loans (2025 Q1), far below the 2030 target of 10%.

- Concentration in Enterprises: 61.8% of green loans are allocated to businesses, with minimal focus on affordable housing for low-income citizens.
- Stringent Eligibility Criteria: High barriers, such as income requirements and certification standards, restrict access for marginalized groups.

3. Macroeconomic Drivers of Housing Loans

Correlation and regression analyses (2017–2023) reveal:

- Positive Correlations:
  - Nominal GDP (0.96) and Real GDP (0.86): Economic growth directly increases demand for housing loans.
  - Household Energy Consumption (0.82): Reflects demand for energy-saving technologies.
- Negative Correlations:
  - Unemployment (-0.66) and Poverty (-0.77): Higher rates reduce loan accessibility.
- Regression Equation:
  - Loan Volume=6495.5+0.043×GDPn−84.3×Unemployment+234.2 ×PovertyLoan Volume=6495.5+0.043×GDPn −84.3×Unemployment+234.2×Poverty
- GDP Growth: A 1-billion MNT increase in GDP raises loans by 43 million MNT.
- Unemployment: A 1% rise decreases loans by 84.3 billion MNT.

4. Policy Recommendations

- Expand Green Financing Accessibility: Introduce subsidized interest rates, public-private partnerships, and technical assistance for low-income households.
- Regulatory Improvements: Standardize green building certifications and streamline loan approval processes.
- Data Transparency: Establish SDG-aligned monitoring systems to track progress.
- Multi-Stakeholder Collaboration: Foster cooperation among government, banks, and construction firms to scale investments.

5. Future Research Directions

- Investigate regional disparities in loan accessibility and household income impacts.
- Assess long-term ROI of energy-efficient buildings to justify policy incentives.

Final Remarks

Mongolia can simultaneously achieve environmental sustainability, economic growth, and social equity by prioritizing energy-efficient housing. Overcoming financing barriers requires targeted policies, robust data systems, and cross-sector collaboration. Further research and pilot projects are critical to refining strategies and ensuring alignment with global sustainability benchmarks.

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