

CASE STUDY

Building Energy Efficiency and Thermal Retrofitting, Ulaanbaatar, Mongolia

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In the latest Nationally Determined Contribution (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2020, Mongolia raised its ambition for climate action with a new goal to cut down total greenhouse gas (GHG) emissions by 22.7% by 2030, compared to the projected emissions under a business as usual (BAU) scenario for 2010. The updated NDC features the construction sector contributing to 830 million tons carbon dioxide equivalent (CO₂e) reduction through various measures, including insulating old precast panel buildings in the capital city, Ulaanbaatar.

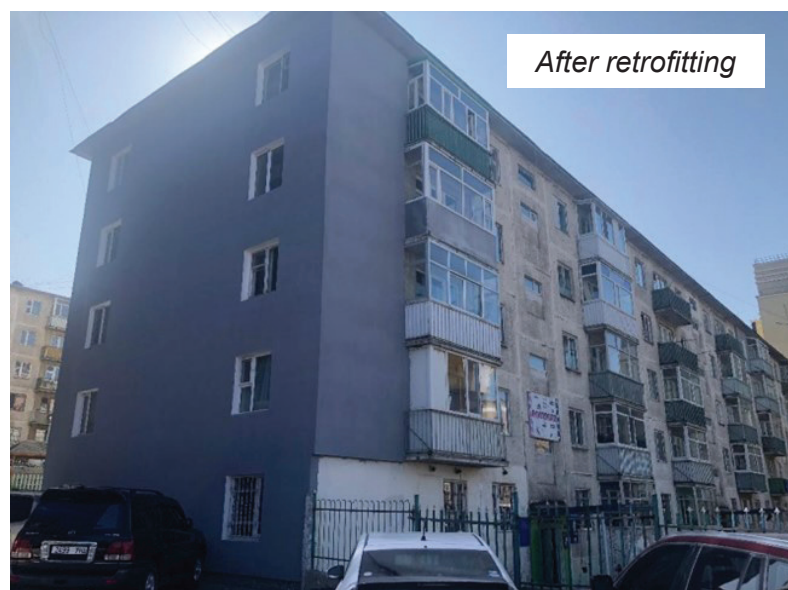
Building heat loss has been a pressing issue in Mongolia. 46% of the national population are settled in Ulaanbaatar where 30% of building stock

is in the form of precast buildings constructed between 1960 and 1990. The Soviet-era precast buildings are characterised by thin walls, insufficient insulation, poor piping configurations and lack of thermostatic controls. Heat loss through thin walls and windows during winter nights, when temperature falls below minus 40°C, leads to households experiencing severe cold, and ultimately desiring retrofitting of their buildings. Additionally, the old and corroded pipes deprive households of heat generated by the coal-fired combined heat and power (CHP) plants.

Enhancing building insulation and energy efficiency (EE) in Mongolia is a tall order. It calls for intensive and coordinated efforts by multiple stakeholders, a range of capital investment,



Before retrofitting



After retrofitting

Bayanzurkh district apartments, Mongolia

and a well-developed collaborative mechanism. Ulaanbaatar has been consistently working towards improving resource efficiency and quality of life for households.

Innovation in business models demands an environment conducive for multistakeholder dialogues and social infrastructure. Retrofitting a building requires unanimous consent among all occupants, which may be difficult because precast buildings in Ulaanbaatar are mostly co-owned by multiple families, as much as over 30 households in one building. Additionally, to proceed with retrofitting under the urban development plan developed by the local government, buildings are required to pass the earthquake test. Further, utilities and heat distribution substations are crucial to building EE performance, considering the city's heating sector and its business model.

The Municipality of Ulaanbaatar (MUB) leverages resources from international organizations to overcome the below mentioned challenges. Facilitated by ICLEI East Asia Secretariat, MUB joined the Building Efficiency Accelerator (BEA) – a platform to import global experience into local actions under the UN Sustainable Energy for All (SEforALL) Initiative. Ulaanbaatar was selected as one of the BEA deep-dive cities. With the goal of reducing building heat loss by 31% by 2030, MUB is committed to retrofitting 1,077 old precast building blocks and has selected pilot buildings to test and implement different building EE measures.

Under the BEA Partnership since 2018, the Mayor's Office of Ulaanbaatar has been working closely with ICLEI East Asia and the Global Green Growth Institute (GGGI) and made strides in multi-stakeholder engagement, technical pre-assessment and pilots, business models development, and fundraising. This case study aims to share the outcomes of MUB's actions and the lessons learnt.

Challenges in Thermo-Technical Retrofitting in Ulaanbaatar

The main challenges in retrofitting existing residential buildings include ownership, large upfront investments and long term payback period.

Insufficient experience of deep retrofitting and non-alignment of stakeholders' expectations in Ulaanbaatar further hinder the progress.

Insufficient experience of deep retrofitting

In Mongolia, the most common thermo-technical retrofitting measure is to enhance the envelope of buildings by adhering expanded polystyrene (EPS) on external walls. This is the most cost-effective option, proven effective in energy-saving, and fulfils Mongolia's national requirements for fire resistance.

Theoretically, compared to the situation before retrofitting, external insulation can save up to 30%-36% energy consumption per year but actual savings can be a lot lower depending on the building's condition. Actual savings may be maximized, up to an estimated 51%-56%, by further insulation measures on rooftops, basements and windows through what is called deep retrofitting.

Despite excellent potential to further reduce energy loss, deep retrofitting has rarely been attempted in Mongolia. While construction companies and contractors may be familiar with individual techniques such as windows renewal and rooftop insulation, deep retrofitting remains a relatively new field for engineers to integrate all techniques at once for higher EE performance.

Non-alignment of stakeholders' expectations

Over the years, the Mayor's office has directed funds from the municipal budget towards insulating external walls of residential buildings to enhance citizens' quality of life. However, these financial resources have sufficed for partial not deep retrofitting, despite consciousness that the latter could secure significantly greater energy savings.

With their strained public budget, the city government is unable to meet the residents' expectations for maximum support for retrofitting their houses. A deep retrofitting project could cost two times a partial retrofitting project, whose upfront cost is already far beyond a family's affordability, the average family monthly income in Ulaanbaatar being approximately EUR 380 (1.3 million Mongolian Tugrik). This signals

at the need for injecting private funding and new business models.

Households and the government seek a performance-guaranteed retrofitting service for energy-saving and indoor comfort. Occupants care about the real impact of retrofitting on their quality of life which is why they seek construction contractors who can guarantee the effectiveness of EE for a certain time. However, in the current market, construction companies only provide one-time retrofitting services, and maintenance services are not common. The contract ends when the insulation work is completed and the payment done, which means contractors are not responsible for the performance of heat loss savings and indoor comfort once they conclude the engineering services.

The issue of ownership

Precast buildings in Mongolia, on average, are shared by around 30-40 households. With 1,077 precast buildings located in Ulaanbaatar, MUB's plan to greatly reduce heat loss is expected to directly affect at least 43,000 families. A household's ownership is limited to their apartment. On shared spaces, local regulations allow retrofitting and construction work without households' consent. Thus, carrying out partial retrofitting (i.e. insulation of exterior walls and rooftops) is relatively straightforward for MUB.

In cases where households are expected to contribute to the deep retrofitting costs including replacement of windows, one of the main challenges is to obtain their unanimous consent on the scheme and scope. Even when they live in the same building, occupants can be affected by heat losses at varying levels. This leads to their perceptions of retrofitting shaping up differently. For example, families living in the corner unit apartment tend to suffer more from inadequate insulation than those in the inner unit.

High upfront investment and long term payback period

According to a market survey in 2020, the unit price of external wall insulation material ranges from EUR 33-41 per sq m. A standardized 9-storey building block with 30 households would require approximately EUR 47,600-59,100. In the absence of alternative funding support, each

family would have to pay around EUR 1,790 which happens to equal one-third of their annual household income.

The long-term payback period renders retrofitting investment less bankable, discouraging households from taking action. Heating is heavily state-subsidized in Mongolia, with billing based on apartment size (in sq m) rather than actual consumption. As the piping configurations of precast buildings restrict installation of heat metering at the apartment level and complicate the installation of thermostatic controls, consumption-based billing (CBB), though on the government's agenda for a while now, is yet to be fully implemented. Consequently, households have little incentive to act immediately on heat conservation.

The Municipality's Actions and Results

Despite the enormous challenges, the Mayor's office is geared to reduce building heat loss and aware of the significant environmental and social benefits retrofitting promises. Since 2018, several actions have been implemented to end the deadlock.

Collaboration with the central government

The local government appreciates that given its fiscal limitation in retrofitting 1,077 building blocks, collaboration with the central government would be their best bet to leverage more resources. MUB and the Ministry of Construction and Urban Development (MCUD) have worked together and agreed that retrofitting is the top priority not only for the city but also the state. In 2019, the Ministry earmarked EUR 2.3 million for MUB to improve the external insulation of 24 building blocks.

Further, MUB has also prepared for CBB implementation. Since meters are the basic equipment for data collection and energy market reform in the building sector, meters were installed in 16 retrofitted building blocks in early 2019. It was the first instance of meters being installed at a building block level with governmental financial support to cover the installation cost. An energy audit conducted in February 2021 on the 16

buildings revealed achieved energy savings ranging from 21%-27%.

Cooperation with international organizations

MUB efficiently utilizes the BEA Partnership network to mobilize international resources. In 2018, GGGI and ICLEI East Asia supported Ulaanbaatar to develop a project proposal for international funding and technical assistance, to be submitted to the Nationally Appropriate Mitigation Action (NAMA) Facility, aiming to establish an EE fund for multi-families residential building retrofitting, with auxiliary financial mechanisms including on-billing repayment, performance-based contract, and standard-offer scheme. The first submission in 2018 failed to beat the intense competition, but with stronger support from several ministries and local stakeholders, the 2019 proposal was shortlisted. The Detailed Preparatory Phase (DPP) was completed in Q2 2021 and full submission made to the Technical Support Unit (TSU) in July 2021. The implementation grant is pending approval from TSU, expected by Q1 2022.

A revolving EE fund will be established with seed capital from NAMA Facility, MUB and several ministries. The fund would pay the partial upfront cost of deep retrofitting for construction companies on behalf of households; rest of the expenses would be executed according to the energy-saving performance of retrofitting. Households would repay the cost to the revolving fund through long-term on-billing repayment - a scheme that allows them to pay apportioned cost in addition to their regular heating bills. Meanwhile, the utility companies, viewing energy savings as renewable energy production, will purchase the 'value of energy' by paying construction companies for 'energy-savings', in accordance with the energy audit results.

In addition to project development, international collaboration also supports local capacity building. High-level officials from the Mayor's office and MUB are keen to learn from EE improvement experiences and Energy Service Company (ESCO) business models in other cities, particularly from countries with precast buildings. In 2018, with the support of GGGI, a delegation of government officials from Ulaanbaatar and

relevant ministries visited Bratislava to learn about how Slovakia finances its building retrofitting and housing modernization, and utilizes the ESCO model.

Strengthened communication with stakeholders

As heat loss reduction requires joint efforts, MUB's top priority is to set up direct communication channels with stakeholders. In 2019-2020, they co-organised five workshops and consultation meetings in a two-stage approach. In stage one, workshops were organised for participants from the same field. For example, one workshop was designed specifically for building practitioners and civil engineers with fieldwork experience. Through this first round of workshops, MUB was able to gather sufficient information and in-depth feedback from participants. In stage two, all stakeholders were pooled for cross-cutting and interdisciplinary discussion. The two-stage approach ensures that every stakeholder's opinions are received, expressed, and discussed; different stakeholders have adequate dialogues to explore the interrelationship between and within the energy sector (e.g. heating supply and temperature control), and construction sector (e.g. retrofitting design and insulation scope) and households (e.g. use of heating and issue of mould around windows).

Although the ownership issue is complicated, MUB attempts to deal with it through practical steps. Supported by the BEA Partnership, MUB developed a series of communication materials in 2019 to advocate for thermo-technical retrofitting by communicating about its benefits. To address the elderly not familiar with the Internet, they broadcasted television interviews with experts and households who have gone through the process of retrofitting. For the general public and younger audience with regular access to the Internet and social media, they produced and released a series of animations on media platforms like YouTube. Hard-copy infographic flyers were also developed and shared during workshops and consultation meetings. In 2020, along with preparing for the NAMA Facility project proposal, MUB further engaged youth and local NGOs to operate blogs and a Facebook page to disseminate information and collect feedback from citizens.

With GGGI and ICLEI East Asia's support, MUB conducted a survey to understand the socio-economic status of households living in the 1,077 precast building blocks. Of over 2,000 households interviewed, about 57% of the respondents reported indoor heating services being insufficient the previous winter and 55% complained about mould-associated problems. Over 75% of the respondents endorsed the new project proposal with deep retrofitting and innovative revolving-fund business model.

Key findings

Buildings are responsible for almost one-third of global energy consumption and about 40% of GHG emissions. The vast potential to improve building EE remains to be unlocked, calling for policymakers to steer the pathway to a zero-carbon future. In Ulaanbaatar, three "C-actions" have been taken to accelerate the transition:

Commit

The national government's commitment to building EE is not only a powerful signal to the market and stakeholders, but also serves as guidance for sub-national governments to take action. As the quantitative target is included in the country's NDC and two high-level policy

agendas, local practitioners and government officials have clear directions to explore solutions and investment.

Collaborate

Only when stakeholders work together can targets and commitments be achieved. MUB works closely with the national government for thermal retrofitting and collaborates with international organizations. This partnership has allowed the concept of building EE to be transformed into an action-oriented project proposal. The proposal lays a solid foundation for more partners' contributions—including construction companies, utility companies, households, and homeowner associations.

Communicate

Improving residential buildings' EE is not easy. Every individual's actions have impacts on building energy-saving performance. Households' behaviours, construction companies' retrofitting techniques, and utilities' central heating system setting can improve building EE. Clear and transparent communication with target groups is vital. MUB has developed different communication strategies and materials for engaging a variety of stakeholders and understanding their expectations better.

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