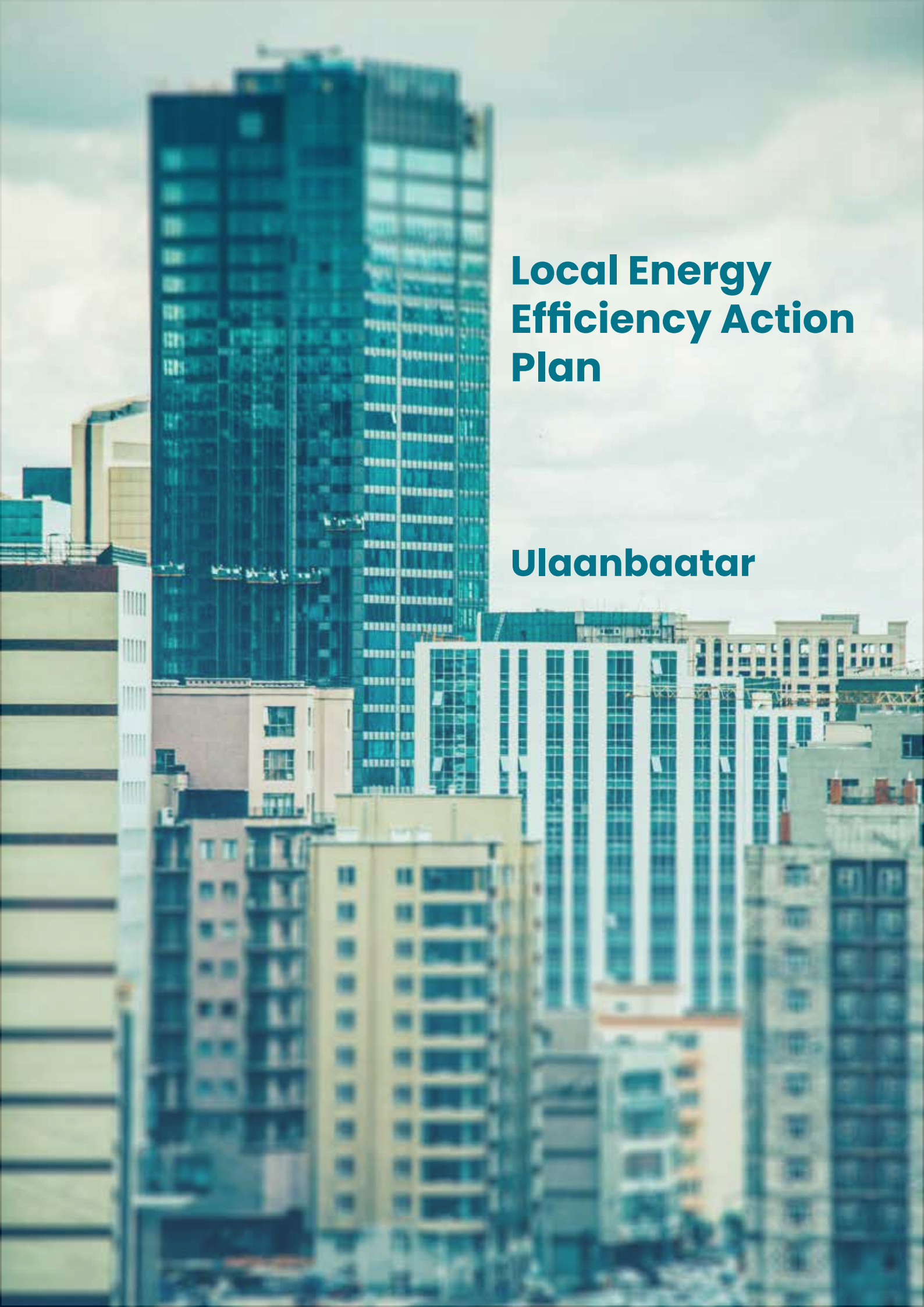

Local Energy Efficiency Action Plan

Ulaanbaatar

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Place and date of publication:

Ulaanbaatar, November 2020

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Summary

Greater energy efficiency is key for shifting country development paths toward lower-carbon economic growth. This is especially the case in Mongolia, where a vast potential for energy saving remains unrealized and the needs to modernise and preserve the building stock are outstanding.

Tapping into energy saving and building renovation projects requires policies and mechanisms to develop and deliver large numbers of relatively small projects, which are scattered among thousands of buildings in different sectors. As such, the energy efficient renovation of buildings often does not compete well with other opportunities for using up-front capital, such as capacity expansion of power plants or a new wind farm. Barriers and problems of high transaction costs, risk perceptions, and unmet needs for technical expertise and lack of financial intermediation mean that much of the potential for saving energy will remain untapped and the existing building stock will dilapidate further.

Institutional innovation is required to address these problems and to put in place efficient policies and programmes for identifying ways of delivering building renovation projects.

Delivering programmes for building renovation is first an institutional development issue. Lack of domestic sources of capital is rarely the true barrier. Lack of policies, weak framework conditions, inadequate organizational and institutional frameworks for building renovation projects, and lacking access to funds are the most typical problems. Mechanisms and policies to capture the opportunities for investment in building renovation need to be strengthened both in Mongolia and Ulaanbaatar. This entails a sustained long-term effort over years because new institutional structures and policies cannot be expected to emerge overnight.

Programmes and finance instruments to deliver large scale buildings renovation must successfully include two main functions:

- a marketing function, which supports project development (from energy auditing and engineering studies to project design) to efficiently package good quality projects, and
- a financing function, which provides affordable capital for project implementation. The form and cost of capital must match the type of asset. Comprehensive renovation of buildings is long term and capital intense.

An unbalance between these two functions (mismatch of asset and liabilities), is a common reason of programme failure, translating either in insufficient project pipeline to meet the needs of financiers, or in the inability to arrange and deliver financing for a series of well-developed projects.

This Local Energy Efficiency Action Plan (LEEAP) is a first step taken by the City of Ulaanbaatar in delivering building renovation programmes. The plan sets boundary for planned interventions and includes a first attempt to quantifies the size of the problem. The initial actions first consider institutional capacity development, clear management structures and processes to deliver building renovation and energy efficiency. Only then do the proposed actions become more concrete, first with pilot projects and then followed up with market up-scaling.

The boundaries of this LEEAP are four building sectors: public buildings, multifamily buildings, single-family buildings in Ger districts and new constructions.

For these building sectors the LEEAP has set 16 strategic objectives:

Short-term objectives until 2025

- → The City of Ulaanbaatar will ensure a clear organizational structure by 2021 for implementing actions to improve energy performance in buildings (multifamily buildings, public buildings, private buildings in Ger districts and new construction)
- → The City of Ulaanbaatar will introduce an energy management system for public buildings
- → The City of Ulaanbaatar will initiate heat energy billing based on metered data in multifamily buildings by 2024
- → The City of Ulaanbaatar will strive to reach fuel and heat energy price equilibrium between energy users in multifamily buildings, public buildings, and private buildings in Ger districts by 2025
- → The City of Ulaanbaatar will introduce mandatory energy performance certificates for new buildings (integrated in the building permit process)
- → The City of Ulaanbaatar will strive to update/enforce building codes for energy efficiency requirements

Mid-term objectives until 2030

- → The City of Ulaanbaatar will ensure the replacement of all inefficient coal stoves and all stoves not complying with emissions standards in private buildings in Ger districts by 2030
- → The City of Ulaanbaatar will strive to introduce a renovation programme for multifamily buildings with the objective to reduce the sector energy consumption by 5% by 2030
- → The City of Ulaanbaatar will introduce a renovation programme for public buildings with the objective to reduce the sector energy consumption by 10% until 2030
- → The City of Ulaanbaatar will strive to introduce a renovation programme for private buildings in Ger districts with the objective to reduce the sector energy consumption by 22% by 2030
- → The City of Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030
- → The City of Ulaanbaatar will introduce norms for mandatory connection of new building to centralised energy sources (if technically possible)

Long-term objectives until 2040

- → The City of Ulaanbaatar will strive to introduce a renovation programme for multifamily buildings with the objective to reduce the sector energy consumption by 15% by 2040
- → The City of Ulaanbaatar will introduce a renovation programme for public buildings with the objective to reduce the sector energy consumption by 20% until 2040
- → The City of Ulaanbaatar will strive to introduce a renovation programme for private buildings in Ger districts with the objective to reduce the sector energy consumption by 50% by 2040
- → The City of Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040

Reaching these objectives meets the vision of the City of Ulaanbaatar for sustainable development, in particular helping Ulaanbaatar to be a safe, healthy, and green city. Ulaanbaatar will have a more liveable environment for its residents through better and more efficient public buildings and housing.

For reaching the LEEAP's objectives, the City of Ulaanbaatar has identified 15 core actions:

Public buildings

- → Introducing energy management
- → Energy monitoring in all public buildings
- → Introducing a heat regulation programme
- → Development of a public building renovation programme
- → Up-scaling the public building renovation programme

Single family buildings in Ger areas

- → Implementation of a clean stove programme
- → Clean stoves in new single family houses
- → Development of a single family home-renovation programme (based on GERES approach/ experince)
- → Up-scale of single family house renovation programme

Multi-family buildings

- → Installation of energy meters (pilot projects with heat regulation and/or meters only)
- → Introducing full cost recovery tariffs
- → Development of building renovation programme
- → Up-scale building renovation programme

New construction

- → Mandatory energy performance certificates and norms for new and renovated buildings
- → New building connection to centralised energy source

The implementation of this plan will require capital, which will be used for the development of programmes and measures. For the period 2021-2025 the LEEAP will need about €21.5m. These funds will support the implementation of an Energy Management Systems and the establishment of an energy monitoring system for Public Buildings. Funds will then be used to set up and run pilot projects for renovation programmes for public buildings, multifamily buildings, and single-family buildings in ger districts. To tackle the air pollution problem a clean stove programme for ger district buildings will be renewed, including the new settlements. In this first period the City of Ulaanbaatar will strive to gradually introduce cost recovery tariffs, which is an essential element for supporting energy efficiency programmes. Regarding new construction the City of Ulaanbaatar will strive to introduce mandatory energy performance certificates and norms to ensure the energy efficient design of buildings. A priority of the City is also to limit new sources of pollution, therefore evaluating and enforcing connection to existing district heating system is part of this plan.

To reach mid and long-term objectives of the LEEAP, the actions are upscaled in all building sectors. Upscaling will require new capital, which is estimated at €133.3m for the period 2026-2030, €178.9m for the period 2031-2035, and €270.9m for the period 2036-2040.

1 INTRODUCTION

Climate change and air pollution is one of the major challenges that Mongolia faces in this century. Finding interventions aimed to improve energy efficiency and reduce emission in the atmosphere has become imperative to safeguard the health of people. In this scenario local authorities play a key role.

In Mongolia the emissions of greenhouse gases have increased by over 21% between 2010 and 2017. Air pollution in Ulaanbaatar is a critical issue. Air quality monitoring reports revealed that as of January 2019, the 24-hour mean level of PM2.5 is 3.9 times higher, the PM10 is 2.5 times higher, SO_2 is 34% higher and NO_2 is 14% higher than target thresholds for air quality standards in Ulaanbaatar. The population of Ulaanbaatar has increased by 28.5% during the last 10 years and so do greenhouse gas emissions and air pollution.

The City of Ulaanbaatar's priority is to be a safe, healthy, and green city that is resilient to climate change, providing a liveable environment for its residents through appropriate land use, planning, infrastructure, and housing. This target is challenging and will need a copious number of actions to demonstrate how the City can reduce greenhouse gas emissions from transport, electricity, heating, power generation and transmission within the City boundaries.

A first step to tackle this challenge is to focus on the building sector by introducing a Local Energy Efficiency Action Plan (hereinafter LEEAP) for the City of Ulaanbaatar with practical and immediately applicable actions. This LEEAP addresses four building sectors: public buildings, multifamily apartment buildings, residential buildings in ger districts and new construction. The transport sectors and other building sectors like tertiary, industrial and energy production are not covered in this LEEAP.

The action plan includes estimates on how much the City can reduce greenhouse gas emissions and improve energy efficiency levels by the year 2040.

The actions described in this plan will enable Ulaanbaatar to reach important energy efficiency targets and most importantly also improve air quality. The LEEAP also includes monitoring and energy management actions, which will support the City of Ulaanbaatar to develop new climate and energy efficiency goals and plans in the future.

The building sector is the top user of energy and emitter of greenhouse gasses in Mongolia. Today's buildings consume 70% of Ulaanbaatar energy, release at least 50% of Ulaanbaatar greenhouse gas emissions and use more than 50% of all potable water in Ulaanbaatar. Given that Ulaanbaatar is currently the largest user of energy in Mongolia, it becomes even more important for the City to take a leadership role in making buildings more efficient in their use of energy and water. At first glance, designing new buildings and updating existing ones to achieve greater energy efficiency seems to be a straightforward and logical first step towards a safer, healthier, and greener city.

The business case for greater energy efficiency in buildings is obvious only when the price of energy is cost-based, and even better if it includes the real social, health and environmental costs of excessive energy usage. This is not the case in Mongolia, where end-user energy tariffs are particularly cheap and kept artificially low by direct and indirect subsidies.

On the other side, existing well known technologies and solutions yield impressive energy savings; this is even more relevant in Ulaanbaatar which has one of the world coldest climate.

The business case for building renovation provides far more opportunities than just energy savings. The ambitious goal of improving efficiency across the entire built environment is achievable, but only through the recognition and quantification of other tangible and intangible benefits. Otherwise, when the business case is more closely examined with the goal to achieve high energy savings for all buildings, the massive scale of investment required to upgrade the existing building stock is daunting and the energy savings alone are not enough to trigger mass renovation programmes.

In other words, a large-scale building renovation programme in Ulaanbaatar cannot be simply evaluated on the economic quantification of energy saved. A multicriteria analysis is required considering what are the alternative options and which indicators matter: energy savings, greenhouse gas emission, air pollution, indoor comfort, building asset conservation and enhancement, health, and safety, etc...

This is Ulaanbaatar's first LEEAP, which was closely developed with the City's various guiding policies. It describes actions that will be decided by the City' councils for reaching energy efficiency targets in the building sector during the programme period.

This LEEAP is a first step in the right direction for a safer, healthier, and greener city; establishing a common understanding of the starting point with a first quantification of the scale of the problem and a set of short, mid, and long-term targets. This LEEAP shall be used as a guiding document and reference for budgeting programmes and operational planning of Ulaanbaatar.

2 THE BUILDING RENOVATION CHALLENGE

Buildings are responsible for about 24% of energy consumption and over a third of CO_2 emissions in Mongolia. Most of today buildings will still exist in the year 2040 and for many years after. The renovation of the existing building stock is therefore key to reaching long term energy and climate targets and most of all, the existing building stock is an essential infrastructure which need to be preserved.

The energy efficient renovation of a building can be divided in three types of activities, which preferably are performed together, but if that is not possible, then in the following sequence:

1) Automated Heating Regulation with Metering on Building Level

For buildings connected to district heating this means to renew substations (with direct or indirect connection) in each building, which makes it possible to measure and automatically adjust the heat input in relationship to the outdoor and indoor temperatures. For non-connected buildings this would be about improving the efficiency of their heating stoves.

This investment is very interesting for buildings that are not full time used, such as schools and offices and could bring energy savings of roughly 10-15%. For multi-family buildings the savings would be less (around 5-10%), unless the building is currently overheated, which nowadays is rarely the case in Ulaanbaatar. Putting in more efficient stoves should be a minor but effective investment for ger-district houses with savings in the range of 15-30%.

Investments in heating regulation and generation are the most effective energy saving investments, but they do not increase the lifespan of the building.

2) Renovation and Regulation of Internal Engineering Networks

Typically, iron hot water pipes in old buildings are huge contributors to heat losses and are corroded and close to their end of lifetime. To prevent overheating thermostatic radiator valves should be installed on each radiator. Automated balancing of the heating network (risers) is also required. Often the cast iron sewer pipes need replacement. New piping technologies offer numerous solutions for retrofitting and new heating systems with long life-cycle expectancy.

Without improving the internal networks, it is hard to receive the full energy benefits of any other energy efficiency measure (thermal insulation of walls, replacement of windows, etc.). Furthermore, it does not make much economic sense to invest in the exterior of a building to last for more than 30 years, while the interior networks are in critical conditions. Moreover, if corroded pipes are not replaced soon, the damages of current and future leakages will be very costly to repair.

3) Improvements the Building Envelopes

This includes full renovation of windows, doors, and thermo-insulation of all building fabric elements: walls, roofs, and basement ceilings. These measures should always be implemented together, and of good quality to prevent moisture penetrating the envelope from any place at any time in the future. For instance, one must absolutely prevent leakages from the roof penetrating the newly insulated walls. Because the building will become almost airtight, measures to improve the ventilation system must be implemented simultaneously.

In cold climates, recladding a building and improving glazing can improve energy performance by as much as 70%. Full envelope insulation is a costly

Table 2.1: Expected Energy Savings

	Multi-Family Buildings	Schools, Administrative Buildings, etc.	Ger district houses
Automated Heat Regulation per Building or New Stoves	5-10%	10-20%	15-30%
Thermal Insulation of the building envelope	35-45%	35-45%	40-55%
Renovation and Regulation of Internal Networks	15-25%	10-15%	-
Total Combined Savings	~55-65%	~55-65%	~50-70%

investment but is the key to preserving the building for several generations, enhancing asset value. This measure should only be done if heating regulation is in place, otherwise energy savings may not be reached at the expected levels.

Renovation opens numerous possibilities and generates far-reaching social, environmental, and economic benefits, alongside with energy savings. With the same intervention, buildings can be made healthier, greener, interconnected within a neighbourhood district, more accessible, resilient to extreme natural events, and even equipped with recharging points for e-mobility and bike parking[1]. Besides the significant energy and emission reductions that can be achieved with energy efficiency renovation of buildings, the reasons for individuals and the municipalities of Ulaanbaatar to invest in this sector are many, with the top five reasons being:

1)There is a huge shortage of decent quality buildings in Ulaanbaatar and the population continues to grow, therefore every existing building will be needed for several generations to come

2)The cost of new construction in Mongolia for green field development is around €600 per m2, but the cost of a full energy efficiency renovation is estimated at €100-150 per m2 (excluding VAT) and therefore much more affordable.

3) An energy efficiency renovation of a building simultaneously protects the building from further dilapidation. Inadequate or no maintenance, including disrepair or delay in repair, is the main cause of dilapidation of a building. Unprotected and damaged buildings elements (roof, walls, windows, etc.) get worse and worse when exposed to sun rays and moisture and are subject to extreme temperature gradients between day and night, including freezing and thawing cycles. Proper building renovation put the existing building inside a dry and new "blanket", extending the lifespan by at least another 30 years. Without this protection many buildings will start to fail soon or will face costly repairs and eventually decommissioning. At the same time old internal engineering networks need replacement, as they are at the end of their technical lifetime.

4) The economic value added to buildings through renovation, which is estimated at 20% higher sales value, is usually more than the required investment.

5) An energy efficiency renovation of a building improves the indoor comfort for the users and the image of the building, the neighbourhood, and the city.

Doing nothing and leaving the buildings to decay further is not an option for the younger generation of Mongolians.

In practice however, the renovation of building stocks is a very challenging and rather complicated and costly process in any country, but especially in countries like Mongolia, where the price of energy is below cost-covering. The value of the saved energy, compared to the cost of the renovation, does not justify investments in a timeframe that owners, investors, or financial institutions

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1603122220757&uri=CELEX:52020DC0662

are willing to consider. Alongside with this cheap energy challenge, the idea of just building something new is considered more predictable, easier, and often more attractive to developers and politicians rather than to renew an old existing building.

Therefore, from an economic perspective, energy efficiency renovations of buildings should primarily be understood as housing and public building infrastructure investments and only secondarily as energy and pollution saving investments.

3 ENERGY AND ENERGY EFFICIENCY POLICY FRAMEWORK

Energy conservation and environmental sustainability are among the main principles of the Mongolian Strategy for Sustainable Development of the Energy Sector, which were also confirmed in the 2019 review.

The Energy Law of Mongolia came into force on February 1st, 2001 (and was amended in 2015) and provides the legal framework to allow the energy sector to be restructured from being centrally planned to more market based. This law authorized the establishment of an independent energy regulatory commission (ERC) and assigned responsibilities to key institutions involved in managing and operating the energy sector. The ERC is responsible for issuing energy tariffs[2]. The tariffs have been increased since 2001, but they are still heavily subsidised. The current tariff structure does not encourage energy savings in Ulaanbaatar, especially in the residential sector.

In parallel, Mongolia has stepped up efforts to improve conditions for domestic development and deployment of renewable energies. The Renewable Energy Law, passed in 2007 (and amended in 2015), has provided the legal basis to regulate the generation and supply of renewable power.

The Energy Conservation Law of Mongolia came into force on November 26th, 2015 to fill a country gap on efficient use of energy and energy efficiency services. Since then, energy auditing schemes have been developed and introduced in the country.

To better address air quality problem, in 2012 a specific law on air quality was introduced in Mongolia. The purpose of this law was to regulate actions related to the protection of ambient air, prevention of air pollution and reduction and monitoring of emissions of air pollutants.

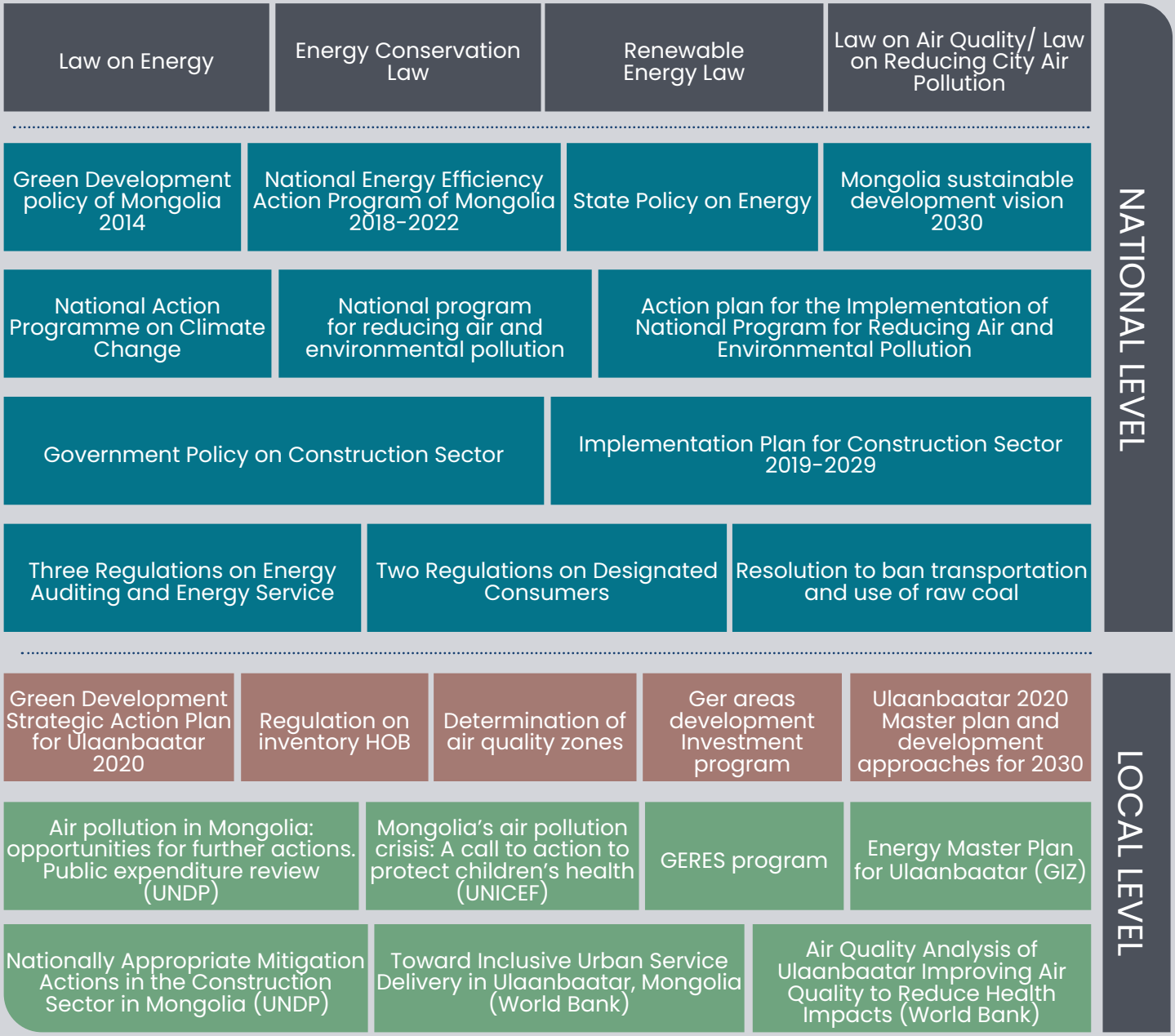
These four Laws are the main policies and normative acts, which this LEEAP fully supports. However, there are numerous policy documents (laws, programmes, plans) and studies in Mongolia and Ulaanbaatar, which the LEEAP has considered and integrated, addressing the Energy sector, Urban development, and the Health & Environment (see Figure 1). These documents can be categorised in three main groups:

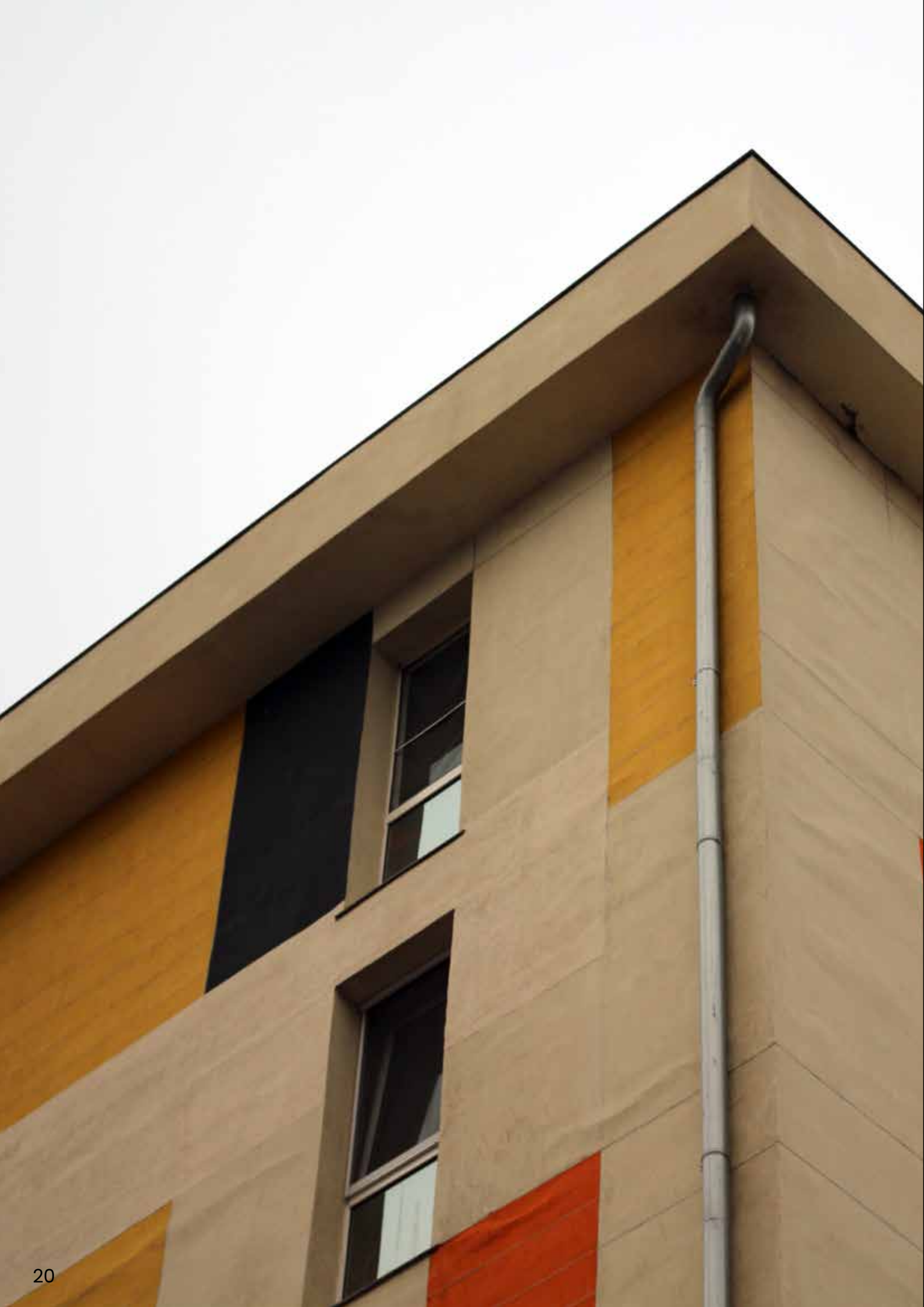
1) Programmes and plans on national level, for example the Green Development Policy of Mongolia and the Government policy for energy sector development for 2015-2030;

2) Programmes and plans for Ulaanbaatar, for example the Ulaanbaatar 2020 Master Plan and Development Approaches for 2030;

3) Different studies regarding Ulaanbaatar like the UNDP study on Air Pollution.

[2] S. Ernedal and E. Gombosuren. On a path towards an energy efficiency policy framework – the case of Mongolia, ECEEE 2011.


Law on Energy
Energy Conservation Law
Renewable Energy Law
Law on Air Quality/ Law on Reducing City Air Pollution
Green Development policy of Mongolia 2014
National Energy Efficiency Action Program of Mongolia 2018-2022
State Policy on Energy
Mongolia sustainable development vision 2030
National Action Programme on Climate Change
National program for reducing air and environmental pollution
Action plan for the Implementation of National Program for Reducing Air and Environmental Pollution
Government Policy on Construction Sector
Implementation Plan for Construction Sector 2019-2029
Three Regulations on Energy Auditing and Energy Service
Two Regulations on Designated Consumers
Resolution to ban transportation and use of raw coal
NATIONAL LEVEL
Green Development Strategic Action Plan for Ulaanbaatar 2020
Regulation on inventory HOB
Determination of air quality zones
Ger areas development Investment program
Ulaanbaatar 2020 Master plan and development approaches for 2030
Air pollution in Mongolia: opportunities for further actions. Public expenditure review (UNDP)
Mongolia's air pollution crisis: A call to action to protect children's health (UNICEF)
GERES program
Energy Master Plan for Ulaanbaatar (GIZ)
Nationally Appropriate Mitigation Actions in the Construction Sector in Mongolia (UNDP)
Toward Inclusive Urban Service Delivery in Ulaanbaatar, Mongolia (World Bank)
Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts (World Bank)
LOCAL LEVEL



4 STARTING POINT FOR THE CITY OF ULAANBAATAR

There are many definitions of energy efficiency in buildings; for example: energy efficiency means using less energy (heating) to perform the same task (keep a suitable indoor temperature). Energy efficient buildings (new constructions or renovated existing buildings) are therefore buildings designed to provide a significant reduction of the energy need for heating, or cooling, or other tasks.

Therefore by definition, energy efficiency is a comparison between two status of a system delivering the same task, for example:

- the energy consumption of a building before renovation compared to after renovation,
- the energy consumption of a new design compared to an old design, and
- the energy consumption of an old appliance compared to a new appliance.

For this reason, an energy efficiency action plan needs a starting point, against which the proposed actions can be measured. This starting point is called baseline inventory, which in this LEEAP includes an analysis of the situation in four building sectors:

- Public buildings
- Multifamily buildings
- Single family houses in Ger districts
- New constructions

Understanding the energy consumption of existing buildings and their needs is essential for effective planning of possible energy efficacy improvements. In LEEAP's first edition, the baseline study is based on available energy consumption data collected from district heating, from house maintenance companies and from the municipality.

For this LEEAP, existing building databases and energy audits were used for setting a baseline for the four building sectors. The building databases contained technical data (building size, type, number of floors, construction year, etc.) and information on energy consumption. Energy audits, which were carried out in November 2019, helped to verify that information obtained from the statistical analyses of the data in the databases.

In general, current data lacks consistency and quality; this mostly caused by the lack of widespread heat energy metering at building level and scattered and unsystematic collection of data between several entities in Ulaanbaatar.

4.1 Public buildings

Public buildings are very important to deliver core services to the inhabitant of Ulaanbaatar. Generally speaking, buildings should provide good working environment and microclimate to enhance employees' productivity, students' achievements and the well-being and health of people and staff working in them.

The database of public buildings in Ulaanbaatar included more than 1800 entries among which are schools, kindergartens, administrative, health sector and other types of buildings.

The statistical analysis of energy consumption data showed very high discrepancy between average and median, which means that the data are extremely asymmetrical, including a large proportion of extremely large or small specific energy consumptions (kWh/m² year), for unknown reasons which will require further investigation (the data showed poor correlation between heated area and specific energy consumption).

As additional investigation, energy audits of three typical schools and three kindergartens were carried out in November 2019. The calculations showed that the average space heating consumption in kindergartens is expected at 510 kWh/m² year, and 360 kWh/m² year for schools. The numbers calculated abased on energy audits are higher than compared with data obtained from the building database. There may be several reasons for this discrepancy, the most relevant of which is the actual indoor temperature maintained in the buildings. A reduction of energy consumption of about 50% was determined as the technically possible energy efficiency potential using typical energy efficiency measures (thermal insulation of building envelope, replacement of windows and doors, renovation of heating and ventilation systems).

Table 4.1: Average specific energy consumption of a schools and kindergartens (based on provided data by municipality of Ulaanbaatar)

	Average specific heat demand, kWh/m² year
All public buildings in the database	239
Schools in the database	217
Kindergartens in the database	284

Figure 4.1: Public buildings in the Ulaanbaatar

4.2 Multifamily buildings

Different source of information provides different number of the multifamily buildings in Ulaanbaatar. There are studies claiming that about 20% of the housing stock in Ulaanbaatar comprises social housing apartment buildings constructed during the socialist era (some 47,000 housing units in over 1,000 apartment buildings), mostly using the pre-cast panel building technique[3]. While others declare there are over 400 pre-cast panel buildings in Ulaanbaatar[4].

All studies agree that these buildings are structurally sound, but with very low energy performance. A pilot project, supported by German Development Cooperation and UB in 2007, demonstrated that substantial energy savings are technically possible implementing typical energy efficiency measures.

Table 4.2 is extracted from the Energy Master Plan of Ulaanbaatar and presents the relevant values and characteristics for the multifamily buildings in the municipality of Ulaanbaatar. The values in the table are based on different sources, assumptions, and calculations.

Table 4.2: Residential sector and heat demand of the multifamily buildings in the municipality of Ulaanbaatar based on existing literature

	Population .000	Households	Heated area m²	Specific heat demand kWh/m² year	Yearly heat demand GWh/ year	Yearly heat demand (DH) GWh/year
Pre-cast panel buildings	222.2	59,909	3,295,019	562	1,852	1,852
Old brick buildings	74.2	20,000	960,000	390	374	193
New apartment building before 2015	275.8	74,351	2,974,022	350	1,041	1,041
Total	572.2	154,260	7,229,041	452	3,267	3,086

Figure 4.2: Typical multifamily buildings in Ulaanbaatar

[3] Source: https://www.ulaanbaatar.mn/files/p1ajohme371cgaovo1mnn60ckue1.pdf
[4] Source: Seven, ENERGY AUDITS OF CHOSEN TYPICAL BUILDINGS IN MONGOLIA. Common overview and summary, Ulaanbaatar, November 2013

Table 4.3: Multifamily buildings in the main districts

	Number of buildings	Heated area m²	Yearly space heating demand, GWh/year	Yearly domestic hot water demand, GWh/year
Bayangol district	510	1,541,392	420	452
Bayanzurkh district	438	1,300,007	355	106
Khan-uul district	154	533,242	91	33
Songino Khairkhan district	194	867,204	202	73
Sukhbaatar district	297	843,374	237	61
Chingeltei district	176	446,859	136	34
Total	1,769	5,532,079	1,441	760

Table 4.4: Average and median specific energy consumption of an average multifamily building (based on provided data by municipality of Ulaanbaatar)

	Specific heat demand for space heating kWh/m² year	Specific heat demand for domestic hot water kWh/m² year	Total specific heat demand kWh/m² year
Median	263.1	91.0	354.1
Average	316.4	143.4	459.9

For the preparation of this LEEAP a database of multifamily buildings was compiled, including information of more than 1700 multifamily buildings located in different districts of the City of UB. The summary of the data by districts are given in Table 4.3.

Based on these data, average and median specific energy consumption for these buildings were calculated (see Table 4.4). The median is less affected by outliers and skewed data than the average and is usually the preferred measure of central tendency when the distribution is not symmetrical as in this case. For this analysis the median is used, because the database includes a proportion of extremely large or small values with unknown reasons, and so the median gives a better idea of a "typical" value representing the building stock.

As additional investigation, energy audits of three typical multifamily building were carried out in November 2019. These energy audits showed that the average space heating consumption in these buildings is around 297 kWh/m² year, which is higher than the median calculated value from the database of the 1769 buildings. The value of 297 kWh/m² year has been assumed in the further calculations in LEEAP.

Electricity demand of multifamily buildings in 2016 was estimated to be around 357 GWh/year while for Ger districts – 425 GWh/year[5].

[5] Source: Energy Master Plan

4.3 Single family houses in the Ger districts

The number of households living the Ger districts is approximate in different publications and studies. According to Energy Master Plan of Ulaanbaatar, in 2016, almost 800'000 inhabitants lived in Ger areas which correspond to nearly 60% of the total population of Ulaanbaatar (1.35 million inhabitants). According to the General Statistical Database[6], there were 412 thousand households in Ulaanbaatar in 2019 compared to 376.42 thousand in 2015. While approximately 220'000 households (nearly 60%) are located in ger areas, the inhabitants of around 114'526 households are living in Mongolian gers themselves[7]. Traditional Mongolian gers are poorly insulated wood-framed, felt-covered dwellings used by nomadic households and households in high density areas of towns including Ulaanbaatar.

Usually, dwellings in the ger districts form areas without a formal/planned structure. Ger areas typically lack access to the infrastructure network like central city heating, water supply, sanitation and in some cases electrical supply, as well as paved roads, in addition to receiving lesser urban service provision. Most of the households in ger areas rely on coal burning stoves for heating and cooking.

The City Government aims to control the expansion of these individual and private settlements as they severely complicate urban planning and cannot be considered a safe and environmentally friendly home[8]. The Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 also target the re-development and re-structuring of Ger areas.

Table 4.5 is extracted from the Energy Master Plan of Ulaanbaatar and presents the relevant values and characteristics for the ger single family buildings in the Ger districts regarding their current heat demand. The values are based on different sources, assumptions, and calculations[9].

Two databases are available from the municipality of Ulaanbaatar. The first database contains data by districts and the other data from 174 single family buildings in Ger districts. From these databases the following average specific heat energy consumption values were computed:

General database by district:

→ 709±133 kWh/m² per year

Figure 4.3. Traditional single-family buildings in Ger districts

[6] Source: http://1212.mn/Stat.aspx?LIST_ID=976_L03&type=tables
[7] Source: Energy MasterA Plan
[8] Source: 3S Solution, ES, K-PEC, Mongolia, Ulaanbaatar City ECO Park Complex and waste-to-energy projects: The Feasibility Study Report, 2016.
[9] Source: Energy Master Plan

Table 4.5. Heat demand in private buildings in Ger districts based on existing literature

	Population .000	Households	Heated area m²	Specific heat demand kWh/m² year	Yearly heat demand GWh/ year	Yearly heat demand (DH) GWh/year
Single Family Houses existing 2015	382.9	103,211	5,676,605	405	2,299	0
Ger (traditional Mongolian tent)	425	114,526	3,265,017	625	2,041	0
Total	807.9	217,737	8,941,622		4,340	0

Database including survey data from of 174 single family houses (space heating):

- → Average: 673 kWh/m² per year
- → Median: 615 kWh/m² per year

As additional investigation, energy audits of eight detached single-family buildings were carried out in November 2019. During these energy audits, the buildings were inspected, surveyed and all necessary measurements carried out. The energy audits were calculating with sensitivity analysis on several parameters, for instance for varying indoor air temperatures from 14 to 22°C, air exchange rate from 0.6 to 1.0 h-1, U-values of windows from 2.4 to 2.8 W/(m²K), and so for the U-values of other building fabric elements.

These calculations showed that energy consumption for space heating in these single-family buildings can vary from 484 kWh/m² to 1121 kWh/m² year and the difference depends from the set of parameters used and building geometry. In general, the average specific energy consumption for space heating for these three buildings is estimated at 761.6 kWh/m² year.

Based on available data, assumptions and energy audits, the total energy consumption in single family houses in all Ger districts is estimated at 4323 GWh per year.

Beside energy consumption in single family buildings, energy consumption in traditional Mongolian tents adds an estimated amount of 2299 GWh per year (if used during the wintertime).

The total estimated space heating energy consumption in Ger districts (single family houses + traditional Mongolian tents) is then around 6600 GWh per year. This requires about 2.15 GW installed peak capacity.

The average space heat consumption values differ considerable between previous publications, studies, and existing datasets. It is mainly due to the different assumptions made.

Electricity demand of Ger districts in 2016 was estimated to be around 425 GWh/year[10].

[10] Source: Energy Master Plan for Ulaanbaatar, Final report, Fraunhofer Institute for Solar Energy Systems ISE, 10 August 2018.

4.4 New construction

According to a survey conducted by the National Statistics Office in 2018, the construction sector has accounted for an average of 5% of Mongolia's GDP annually since 2010; reaching 12.3 trillion MNT in 2018[11]. As the City of Ulaanbaatar is experiencing rapid population growth, as more and more people are moving from the countryside to the city, new construction is an important sector to consider.

rapid population growth in the city of Ulaanbaatar.

As many people travel each day to the city for work or live in the city only during the winter period, the total number in the city could be higher. As the number of people is growing, besides renovating existing building, there is also a great need for new buildings (residential, schools, kindergartens, commercial buildings, and other buildings).

According to the Ulaanbaatar 2020

Figure 4.4: New construction in the Ulaanbaatar

The City of Ulaanbaatar has an urban core area with a city newly built downtown mixed with apartment buildings and unplanned Ger areas (informal settlements), where buildings have been built without any strict regulations and urban planning. New residential and commercial buildings have also been built recently, which in this LEEAP are consider as new construction.

According to the official Mongolian statistics, the population of the city in 2018 reached

1 440 447 inhabitants (see Figure 4.5) exceeding the estimates made in the 2020 Ulaanbaatar Master Plan and development approaches for 2030, where 1 400 000 were forecasted by 2030 only. As can been seen in Figure 4.5 there is

master plan, the average apartment floor area should be 13.5 m^2 per person by 2030, so it means 24.3 million m^2 which, in terms of needs, is almost twice the floor area currently available. At this point the housing supply is far from meeting the highly growing demand and some studies[12] indicate that most of the new construction currently underway is creating a significant oversupply of luxury projects with very limited number of new affordable housing being constructed.

Because of the high rents and tight supply of affordable housing, the government has launched the State Rental Housing Programme. Therefore, it can be expected that the active construction of new buildings will continue though not nearly at the numbers required

[11] Source: Mongolian Statistical Yearbook and State Policy on Construction Sector Mongolia
[12] https://www.globalpropertyguide.com/Asia/Mongolia/Price-History

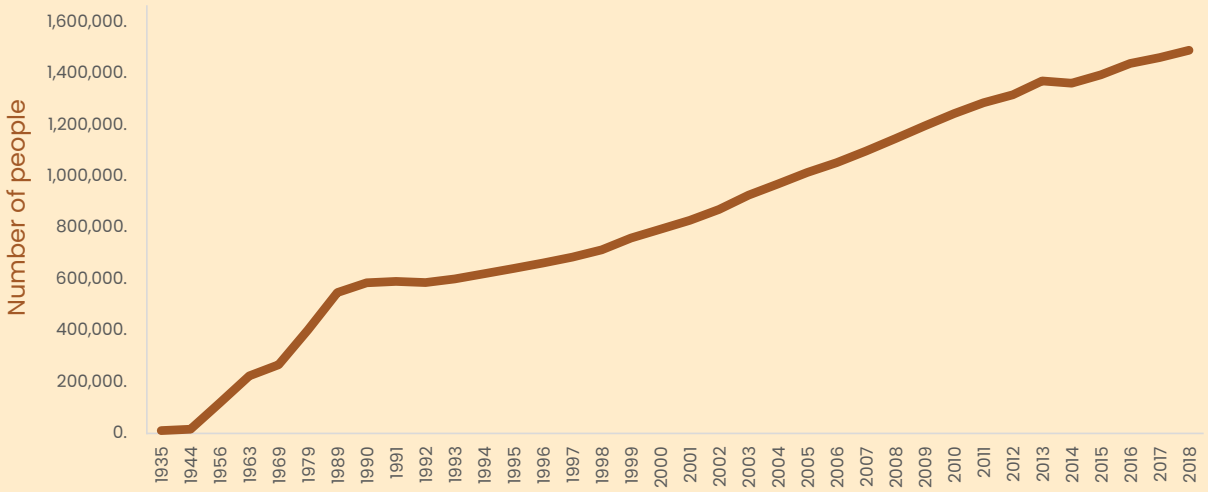


Figure 4.5: Population of Ulaanbaatar

Energy consumption of new constructions has been calculated based on the analysis of 150 buildings with a total area of 850 628 m^2 and with total calculated energy consumption for space heating 144 213 MWh/year. The average specific space heating consumption of these buildings is 216.6 kWh/m^2 year and the median 185.3 kWh/m^2 year. The database includes buildings with very high specific energy consumption and building with very low specific energy consumption.

In this sector the main issues to address are existing construction standards regarding energy efficiency and compliance with the standards during project development process (design and construction phase). As mentioned in the UNDP report[13] Mongolia's system of building controls is still largely based on the former Soviet Union's system of building energy efficiency standards. Energy efficiency requirements also largely refer to socialist period construction methods and materials that are no longer used. According to the report, ground floor, basement and foundation insulation methods and levels are unclear and inadequate Roofs are generally poorly insulated and only an estimated 10% of new buildings are fitted with the required triple glazed performance windows.

As a future outlook, it is important to standardized renovation packages and the integration of renewables and energy efficiency solutions for heating and/or hot water systems. Strengthening the regulations and enforcement of standards of clean heating appliances, codes for house/building construction, and providing training for the construction industry are needed. Training seminars and workshops should be organized to upskill the existing workforce and engineers. The objective should be to increase the number of skilled building professionals and/or blue-collar workers across the building design, operation and maintenance value chain (designers, architects, engineers, building managers, technicians, installers, blue-collar workers including apprentices, and other building professionals). Recourse to skilled professionals/ workers both for renovations and new constructions of buildings and district-scale solutions should be made more attractive and easier for companies and homeowners alike. Renewable energy supply systems are not generally applied for new buildings and new developments. Solar full potential (PV) should be considered as a great opportunity to reduce coal consumption. The analyses of existing studies show the great potential of the use of PV and solar energy. Standardized installation packages integrating renewable and energy efficiency solutions for heating and/or hot water preparation should be utilized. It is important to introduce quality control mechanisms during the

[13] UNDP, project Energy Efficiency in New Construction in the Residential and Commercial Buildings Sector in Mongolia

physical construction phase and it is the duty of the project supervisor to force construction companies to follow the technical design and to check the quality of works. An experienced supervisor will note and stop all observed non-compliances and steered the construction company to comply with the technical design. The tendering process should avoid cost dumping and set a certain level of energy efficiency as one of the achievable and verifiable targets upon commissioning of the building.

5 MAIN CHALLENGES FOR THE CITY OF ULAANBAATAR

The City of Ulaanbaatar is characterised by harsh natural conditions. During the eight-month winter season temperatures may drop to as low as minus 40°C and in summer as high as 30°C. Reliable energy supply and infrastructures are key for the development of the City. This priority is accentuated by a fast-growing urbanisation. More than 60% of the population in Mongolia live in urban areas; cities and settlements keep expanding. The population of Ulaanbaatar has more than doubled since 1995, and the city is now home to more than 1.4 million inhabitants; every day adds more and more pressure on energy and natural resources.

Against this background, Mongolia and the City of Ulaanbaatar face many challenges to sustainable development, some of which can be addressed and alleviated by energy efficiency in the building sector. Among these are the most significant challenges that this Local Energy Efficiency action has identified and will address:

- **Inefficient building stocks:** in today's context of climate change and air pollution, the thermal characteristics of existing building stocks in Ulaanbaatar is considered highly unsuitable, even for moderately cold countries. The combination of being the coldest capital city in the world, combined with the extreme low cost of energy has, made Ulaanbaatar the highest energy consumer per square meter of any capital city in the world. In most of the buildings heat energy consumption is not even metered, nor regulated,

and therefor unknown and inefficiently used.

- **Air pollution and health issues:** air pollution is identified as the main challenge associated with alarming public health concerns. Ulaanbaatar is the coldest capital city in the world and is reliant, almost entirely, on coal for its heating. Houses in the ger areas are heated with very inefficient and heavily polluting stoves. The apartment area is generally heated by district heating from coal powered combined heat and power plants. Smog is a dreadful feature during all winter. Data collected by the Government of Mongolia reported on 30 January 2018, at 05:00, air pollution levels of 3,320 µg/m³ (at Baruun 4 zam), which is 133 times recommended daily average concentration . Exposure to air pollution of such a magnitude has very serious health consequences for all age groups, but particularly for children. These include risks of pneumonia, bronchitis and chronic respiratory conditions that can affect them later in life, such as reduced lung function. It has also been shown to have serious effects on unborn children, including lower birth weight, preterm and stillbirth. Emerging evidence is pointing to potential impacts on brain and cognitive development, especially during pregnancy and the early years of life[15];
- **Energy tariffs:** low cost of coal and subsidies makes end-user energy prices in Mongolia roughly 10 times cheaper than in most post-soviet Central European countries and up to 20 times cheaper than in European countries with high energy taxation. Policymakers in Mongolia have as yet not tried to introduce a pricing mechanism that would encourage people to save energy. On the contrary, the authorities actively subsidize the use of energy thereby creating a real disincentive for people to reduce their energy consumption.
- **Affordability:** affordability is the concept of reasonably pricing linked to the ability to have sufficient money to buy it. The purpose of the Local Energy Efficiency Action Plan is to integrate energy efficiency in the building sector. In this context affordability is an important constraint and challenge. For example, an energy efficiency programme for renovation of multifamily buildings must ensure that the population living in these building can afford any additional payment, or tax, or obligation that the programme may envisage.
- **Institutional capacity:** many of the green challenges that Ulaanbaatar faces result from institutional inefficiencies, lack of regulations or failure to implement existing regulations. There are skill gaps, overlapping functions which lead to confusion and poor coordination between public institutions[16].

Therefore, the implementation of this LEEAP will face technical, financial, institutional, and organisational challenges; with different outlooks by building sector. Table 5.1 provides a description of the challenges by building sector.

[14] UNICEF Mongolia's air pollution crisis: A call to action to protect children's health. Discussion paper. February 2019
[15] UNICEF Mongolia's air pollution crisis: A call to action to protect children's health. Discussion paper. February 2019

Table 5.1. Main challenges of the Ulaanbaatar to address in the Local Energy Efficiency Action plan

Types of challenges in respect to energy efficiency	Types of buildings			
	New construction	Public buildings	Multi-family apartment buildings	Ger districts
Technical	Control and inspection for the application and implementation of existing standards and norms	Little practical experience in building renovation. Most of the buildings are not renovated. Some of the renovations are poorly implemented, and lack any form of heat regulation therefor not achieving the expected level of energy savings	Little practical experience in building renovation. Most of the buildings are not renovated. Most of the renovated buildings are poorly implemented	Little practical experience in building renovation. Only recently a promising renovation programme has started (Geres)
	New schools and kindergarten made using old blueprints, not complying with current building codes	Old heating systems without control possibilities	Old heating systems without control possibilities	Heterogeneous stock of buildings
		Lack of heat metering	Lack of heat metering	Lack of detailed/reliable fuel consumption data
		Deferred maintenance issues (structural issues, depreciated engineering networks)	Deferred maintenance issues (structural issues, depreciated engineering networks)	Urban planning development (access roads, addresses, etc.)
	District heating system outdated and in poor technical conditions. Low reliability of supply	District heating system outdated and in poor technical conditions. Low reliability of supply	District heating system outdated and in poor technical conditions. Low reliability of supply	Inadequate capacities of electricity distribution network to provide more power to ger areas (UNDP, 2019)
		Lack of proper ventilation systems. Low indoor air quality/ thermal comfort	Low indoor air quality/ thermal comfort	Use of old, low combustion efficiency stoves
	Lack of environmentally friendly standards for fuels, boilers, buildings (UNDP, 2019)	Lack of environmentally friendly standards for fuels, boilers, buildings (UNDP, 2019)	Lack of environmentally friendly standards for fuels, boilers, buildings (UNDP, 2019)	Lack of environmentally friendly standards for fuels, stoves, buildings (UNDP, 2019)
		Quality / availability of energy audits	Quality / availability of energy audits	Quality / availability /needs of energy audits
	Commissioning procedures for energy efficiency projects (blower door testing, thermal imaging inspection, thermal bridge analysis, etc.)	Commissioning procedures for energy efficiency projects (blower door testing, thermal imaging inspection, thermal bridge analysis, etc.)	Commissioning procedures for energy efficiency projects (blower door testing, thermal imaging inspection, thermal bridge analysis, etc.)	Commissioning requirements in relation to low budget projects
Financial	Lack of public budget allocated for new schools and kindergarten	Business case jeopardized from low (subsidised) heat tariffs and lack of metering	Business case jeopardized from low (subsidised) heat tariffs and lack of metering	Business case directly in the hands of homeowners
		Lack of structured and consistent financial instruments / programmes for building renovation	Lack of structured and consistent financial instruments / programmes for building renovation	Upscaling the experience of Green Climate Fund and Xac-bank

[16] Green Development Strategic Action Plan for Ulaanbaatar 2020
[17] https://www.geres.eu/en/country/mongolia/

Types of challenges in respect to energy efficiency	Types of buildings			
	New construction	Public buildings	Multi-family apartment buildings	Ger districts
Financial			Flat owners / tenant's affordability issues	Low-income. Ger district households cannot meet the minimum requirements to obtain mortgage loans (UNDP, 2019)
				Lack of available financing for cleaner fuel, stoves, and energy efficiency measures (thermal insulation, windows, doors, etc.)
		Challenging technical and financial standardization to upscale	Challenging technical and financial standardization to upscale	Challenging technical and financial standardization to upscale
	Ability of the municipality / government to access debt funding for energy efficiency programmes	Ability of the municipality / government to access debt funding for energy efficiency programmes	Ability of the municipality / government to access debt funding for energy efficiency programmes	Ability of the municipality / government to access debt funding for energy efficiency programmes
Institutional	Lack of public utility development requirements/control (district heating, water supply, electric grid, communication, infrastructure, etc.)	A lot of institutions involved in energy efficiency / lack of resources	A lot of institutions involved in energy efficiency / lack of resources	Little institutional involvement, lack of comprehensive register
	National housing programme	Conflicting interests are in place (District heating company | HOB vs Energy Efficiency). Inability to increase heating tariff due to political influences. Lack of specific study to reach a detailed timetable over which it is possible to move to full cost recovery.	Inability to increase heating tariff due to political influences. Lack of specific study to reach a detailed timetable over which it is possible to move to full cost recovery.	
	Both ministry, ERC and city council involved - no clear allocation of responsibilities	Both ministry, ERC and city council involved - no clear allocation of responsibilities	Both ministry, ERC and city council involved - no clear allocation of responsibilities	Both ministry, ERC and city council involved - no clear allocation of responsibilities
		Lack of operational energy auditing scheme and mechanism to benchmark buildings and evaluate programmes	Lack of operational energy auditing scheme and mechanism to benchmark buildings and evaluate programmes	Lack of institution to control use of fuels and stoves
	A lack of firm long-term commitment to necessary actions (UNDP, 2019)	A lack of firm long-term commitment to necessary actions (UNDP, 2019)	A lack of firm long-term commitment to necessary actions (UNDP, 2019)	A lack of firm long-term commitment to necessary actions (UNDP, 2019)
	Complex district heating institutional set-up	Complex district heating institutional set-up	Complex district heating institutional set-up	Complex district heating institutional set-up

Types of challenges in respect to energy efficiency	Types of buildings			
	New construction	Public buildings	Multi-family apartment buildings	Ger districts
Orgnaisational	Urban planning to reflect green development	No responsibilities assigned (or too scattered) at top level for public buildings	Empowering homeowners / decision making in multi-ownership residential buildings	Empowering homeowners
		Unclear responsibilities for maintenance of each building	Lack of general organisational capacity for project implementation (even if a building would take a decision to renovate, will they be able to practically do it: energy audit/project design/bank providing loans/entities collecting payments, etc…)?	Build on municipal service points, schools, and kindergarten
		No responsibilities assigned to acquire reliable (credible) energy consumption data and costs of energy / lack of energy management procedures	No responsibilities assigned to acquire reliable (credible) energy consumption data and costs of energy	Scale to attract supplier and construction industry
		Lack of specific simplified procedures for energy efficiency rehabilitation projects (Mainstreaming energy efficiency project cycle)	Lack of specific simplified procedures for energy efficiency rehabilitation projects (Mainstreaming energy efficiency project cycle)	Lack of specific simplified procedures for energy efficiency rehabilitation projects (Mainstreaming energy efficiency project cycle)
	Lack of effective monitoring mechanism to measure progress of the actions against the plans, e.g. monitoring programmes in place	Lack of effective monitoring mechanism to measure progress of the actions against the plans, e.g. monitoring of the renovated buildings or programmes in place	Lack of effective monitoring mechanism to measure progress of the actions against the plans, e.g. monitoring of the renovated buildings or rent program in place	Lack of effective monitoring mechanism to measure progress of the actions against the plans, e.g. monitoring of programmes in place
	Lack of targeted public expenditure (UNDP, 2019)	Lack of targeted public expenditure (UNDP, 2019)	Negative lesson learned from restructuring/ redevelopment programmes run in Ulaanbaatar.	There has been some criticism of past clean stove programs because they did not address local unavailability of the required fuel and suffered from weak governance arrangements. However, this was a problem with implementation arrangements, rather than a fundamental flaw in the policy. (UNDP, 2019)
Environmental and social	Improving the living environment	Lack of suitable ventilation leading to poor indoor air quality and climate / lack of indoor comfort	Lack of suitable ventilation leading to poor indoor air quality and climate / lack of indoor comfort	Bad indoor air quality and climate / lack of comfort / lack of ventilation? High fluctuation (min and max) indoor temperature during winter
	Bad air quality during the heating season / air pollution	Bad air quality during the heating season / air pollution	Bad air quality during the heating season / air pollution	Bad air quality during the heating season / air pollution
				Emissions from coal burning

Types of challenges in respect to energy efficiency	Types of buildings			
	New construction	Public buildings	Multi-family apartment buildings	Ger districts
Environmental and social	How to ensure that this sector will have as small as possible environmental and social impact?			Lack sanitary infrastructures
				Energy poverty - expenses for winter fuel are estimated to consume on average at least 17.5% of the household budget of the poorest households in peri-urban Ger districts. At present only Ger district residents pay full market prices for energy (UNDP, 2019)
			Lack of trust in public programmes?	Lack of trust in public programmes?
			Lack of trust in financial institution? Reluctance to debt financing?	Lack of trust in financial institution? Reluctance to debt financing?
	Overcrowded public buildings	Overcrowded public buildings		Substantial migration to Ger district from rural area if Mongolia
	Environmental, social management plans for new constructions; also including stakeholder engagement plans	Environmental, social management plans for new constructions; also including stakeholder engagement plans		
	Waste management plans for construction works addressing reuse and recycling of construction waste	Waste management plans for construction works addressing reuse and recycling of construction waste	Waste management plans for construction works addressing reuse and recycling of construction waste	Coal/wood ash disposal
	Weak labour practices among construction companies	Weak labour practices among construction companies	Weak labour practices among construction companies	Weak labour practices among construction companies
	Environmental, Health and Safety (EHS) plan on construction sites	Environmental, health and Safety plan on construction sites	Environmental, health and Safety plan on construction sites	

6 VISIONS AND TARGETS FOR ENERGY EFFICIENCY IN BUILDINGS IN ULAANBAATAR

The City of Ulaanbaatar has ambitus goal and a vision for sustainable development. The main pillars of this vision are:

- → Ulaanbaatar will be a safe, healthy, and green city that is resilient to the impact of climate change,
- → Ulaanbaatar will provide a liveable environment for its residents through appropriate land use planning, infrastructure, and housing,
- → Ulaanbaatar will be a city with good governance and a developed legal environment that serves the general public and private sector,
- → Ulaanbaatar will encourage the further development of settlements, towns, and satellite cities outside the city centre,
- → Ulaanbaatar will be one of Asia's tourist destination cities,
- → Ulaanbaatar will have an internationally competitive business centre and be developed as a world-standard capital city.

The target and actions of this LEEAP have been developed to realize this vision. The LEEAP sets targets and strategies how the City of Ulaanbaatar can reach energy efficiency targets for 2025, 2030 and 2040. For those targets where the Ulaanbaatar has authority of action, the target is expressed as "the City will ..." Where the City lacks direct authority to act, the target is expressed as "The City will strive to ..."

6.1 The goals of the LEEAP

Following the adoption of the Sustainable Development Goals, the Parliament of Mongolia approved its own long-term development strategy (Mongolia's Sustainable Development Vision 2030) in 2016 reflecting the 2030 Agenda. In 2019 Government of Mongolia launched Mongolia's first Voluntary National Review on the implementation of the Sustainable Development Goals .

This LEEAP directly addresses four of the 17 Sustainable Development Goals: good

health and well-being, sustainable cities and communities, responsible consumption and production, and peace, justice, and strong institutions (see Figure 6.1).

Based on the Sustainable Development Goals, this LEEAP sets the following short, medium- and long-term targets and objectives. In total this LEEAP has **16 objectives.**

Figure 6.1: Sustainable Development Goals

6.2 Short term targets and objectives until 2025

objective #1

The City of Ulaanbaatar will ensure a clear organizational structure by 2021 for implementing actions to improve energy performance in buildings (multifamily buildings, public buildings, private buildings in Ger districts and new construction)

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

objective #2

The City of Ulaanbaatar will initiate heat energy billing based on metered data in multifamily buildings by 2024

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

objective #3

The City of Ulaanbaatar will introduce an energy management system in public buildings

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

objective #4

The City of Ulaanbaatar will introduce mandatory energy performance certificates for new buildings (integrated in the building permit process)

11 SUSTAINABLE CITIES AND COMMUNITIES

objective #5

The City of Ulaanbaatar will strive to update/enforce building codes for energy efficiency requirements

11 SUSTAINABLE CITIES AND COMMUNITIES

objective #6

The City of Ulaanbaatar will strive to reach fuel and heat energy price equilibrium between energy users in multifamily buildings, public buildings, and private buildings in Ger districts by 2025

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

[18] Source: https://sustainabledevelopment.un.org/content/documents/23342MONGOLIA_VOLUNTARY_NATIONAL_REVIEW_REPORT_2019.pdf

6.3 Mid- term targets and objectives until 2030

objective #7

The City of Ulaanbaatar will ensure replacement of all inefficient coal stoves and all stoves not complying with emissions standards in private buildings in Ger districts by 2030

objective #8

The City of Ulaanbaatar will introduce norms for mandatory connection of new building to centralised energy sources (if technically possible)

objective #9

The City of Ulaanbaatar will strive to introduce a renovation programme for multifamily buildings with the objective to reduce the sector energy consumption by 5% by 2030

objective #10

The City of Ulaanbaatar will introduce a renovation programme for public buildings with the objective to reduce the sector energy consumption by 10% until 2030

objective #11

The City of Ulaanbaatar will strive to introduce a renovation programme for private buildings in Ger districts with the objective to reduce the sector energy consumption by 22% by 2030

objective #12

The City of Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030

6.4 Long term targets and objectives until 2040

objective #13

The City of Ulaanbaatar will strive to introduce a renovation programme for multifamily buildings with the objective to reduce the sector energy consumption by 15% by 2040

objective #14

The City of Ulaanbaatar will introduce a renovation programme for public buildings with the objective to reduce the sector energy consumption by 20% until 2040

objective #15

The City of Ulaanbaatar will strive to introduce a renovation programme for private buildings in Ger districts with the objective to reduce the sector energy consumption by 50% by 2040

objective #16

The City of Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040

7 RESULTS OF THE SWOT ANALYSIS

Reaching the 16 LEEAP's short, mid and long-term targets brings the City of Ulaanbaatar several strengths and opportunities. However, to reach these targets the City also needs to address weaknesses and treats. SWOT-analysis is a strategic planning technique, which was used in this LEEAP to help the City of Ulaanbaatar to identify strengths, weaknesses, opportunities, and threats related to the implementation of this LEEAP.

A first general consideration is the time factor of the LEEAP objectives; several mid and long-term targets rely of the implementation of short-term actions. Short-term actions mainly include measures related to systemic, regulatory, and structural changes; which serve as a basis for further mid and long-term actions. Missing short term action is a threat to reach mid and long-term targets.

Opportunities for short-term objectives are mostly related to better organizational structures, more transparent procedures, and the availability of quality data. Mid-term and long-term objectives focus on reducing the impact on climate change, improving air quality, addressing housing problems and on improving the energy market.

Common weaknesses and threats for all objectives are, first of all, a lack of political support, lack of knowledge, experience, motivation and financial resources.

The full SWOT analysis report is available as a separate report.

7.1 SWOT summary for short term objectives until 2025

Objectives

- Ulaanbaatar will ensure a clear organizational structure by 2021 (objective #1)
- Ulaanbaatar will initiate energy billing based on metered data in multifamily buildings by 2024 (objective #2)
- Ulaanbaatar will introduce energy management system in public buildings (objective #3)
- Ulaanbaatar will introduce mandatory energy performance certificates for new buildings (integrated in building permit process) (objective #4)
- Ulaanbaatar will strive to update/ enforce building code for energy efficiency requirements (objective #5)
- Ulaanbaatar will strive to introduce fuel price equilibrium and between energy users in multifamily buildings, public buildings, and private buildings in Ger districts by 2023 (objective #6)

Strengths and opportunities

- Better organizational structures enable the possibility to assign clear roles and tasks of different units of the Mayor's office of UB.
- The implementation of an Energy Management System (EnMS) and other measures can trigger significant reductions in air pollution and energy consumption.
- More transparency – involved parties are better informed of the actions taken to reduce consumption and pollution.
- Monitoring enables sustainable future improvements.
- Better informed consumer - people get aware of how much they consume and pollute, as well as how they can impact it.
- People to pay for what they consume. Fair price motivates to save energy.
- Energy metering improvements makes energy efficiency measures possible.
- Successful improvements of organizational structures and EnMS enable the replication of the experience nationwide.
- Possibility to introduce measurable quality criteria and performance indicators.
- Smaller operational and maintenance costs of the buildings.
- Better indoors microclimate, healthier environment for people.

Weaknesses and threats

- **Overlapping** of functions and tasks with other organisations.
- **Lack of funding** for implementation of measures and for personnel costs.
- **Lack of competence and capacity** among employees and institutions.
- Employees turnover due to the elections or other factors.
- **Lack of political support** for implementation of all the objectives.
- **Low interest and resistance** from the district heating company and other relevant stakeholders, including inhabitants.
- There are too many **different interests** and visions, e.g. at the district levels how the EnMS should be introduced.
- Lack of **control and monitoring** of compliance with the new systems, rules, certifications.
- Unforeseen institutional and legal **barriers**, e.g. compliance with other legal documents.
- High **resistance** from the construction sector.
- Increased energy costs can increase vulnerability for low income households.

7.2 SWOT summary for mid-term and long-term objectives until 2030 and 2040

Objectives

- Ulaanbaatar will ensure replacement of all inefficient coal stoves and all stoves not complying with emissions standards in private buildings in Ger districts until 2030 (objective #7)
- Ulaanbaatar will introduce norms for new building mandatory (if technically possible) connection to centralised energy sources (objective #8)
- Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 5% by 2030 (objective #9)
- Ulaanbaatar will reduce energy consumption in public buildings by 10% until 2030 (objective #10)
- Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 22% (to the average level of 550 kWh/m² year) by 2030 (objective #11)
- Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030 (objective #12)
- Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 15% by 2040 (objective #13)
- Ulaanbaatar will reduce energy consumption in public buildings by 20% until 2030 (objective #14)
- Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 50% (to the average level of 350 kWh/m2 year) by 2030 (objective #15)
- Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2030 (objective #16)

Strengths and opportunities

- Previous experience with clean stoves programmes.
- Reduced air pollution and energy consumption, positive impact on climate change.
- Improved indoor and outdoor air quality, resulting in healthier environment for people.
- Reduced maintenance and energy costs.
- Opportunities to attract foreign investment funding.
- Sustainable energy management, that eliminates creation of new pollution sources.
- More efficient use of fossil fuels and promotion of RES.
- Increased value of the buildings once renovated by 20%, ensured continuous lifetime of the buildings for the next 30 years.
- Possibility to create fair energy market, to introduce energy service companies and create ESCO market.
- There are organisations working with residents in ger areas.
- There are methods available and tested to achieve results.

Weaknesses and threats

- Lack of **political support** for achieving the targets.
- Lack of **knowledge**, skills and **capacity** of assigned responsible persons and institutions.
- Lack of **cooperation** with other important stakeholders.
- **Resistance** from involved parties, including residents from the Ger district.
- Lack of **financial** resources.
- Lack of control and monitoring mechanisms to ensure successful implementation of measures.
- **Lack of motivation** to introduce and follow the new systems, certifications, and regulations.
- Most of the measures depend on implementation quality of short-term measures.
- Risk of introducing high **bureaucracy** procedures that will result in high administrative costs.
- **Low quality** of the construction works.

8 INVOLVEMENT OF STAKEHOLDERS

Each city consists of multiple layers of systems and stakeholders, the interrelation and interconnection of which is multifaceted. The process of transition to sustainable development and the implementation of energy efficiency action plans shall engage all these layers to be effective.

For complex project with numerous stakeholders, like the development of master plans, sustainable energy action plans (SEAP), and local energy efficiency action plans (LEEAP), it is important to carry out a detailed stakeholder analysis and engagement/ management plan, not at least because the success or failure of the project can depend on ensuring key stakeholders are kept informed and “on side”.

Important roles in the LEEAP are played by a great number of stakeholders, whether driving the process or involved in a variety of degrees and positions. Stakeholder mapping takes these dynamics into account for the development of the LEEAP in Ulaanbaatar[19].

[19] Separate report on Stakeholder mapping and engagement

The stakeholders are grouped/ categorized based on their range of influence, in particular regarding:

- → Political: Members of the City Council, Member of the Parliament,
- → Economic: Chamber of Commerce, Banks, Financial Institutions, Private Business, Developer Companies etc.,
- → Social: Associations, NGO's, religious groups,
- → Technological: Energy Supply Companies (district heating, heat only plants, fuel supplier), energy agencies,
- → Legal: Local and National Government;
- → Governance: Local government, Local Administration;
- → Environmental: Environmental associations, consumer associations, health care, etc.,
- → Spatial: Institutes of Architects/ Engineers/Agencies/Built environment sector/Developers.

Some of the Stakeholders are involved in more than one category (for example economic, but also technological) having multiple roles and overlapping categorization.

The stakeholders map has been developed on a matrix according to the level of influence / importance and interest of these stakeholders to the success of the LEEAP. Based on this matrix, the most relevant stakeholders for the development and implementation of the LEEAP are shown in the chart in Figure 8.1.

Stakeholder mapping is not a one-off process, but should be continual throughout the project, to identify new stakeholders and changes in known ones. This is also part of stakeholder engagement and management and LEEAP implementation process.

The engagement of a stakeholder goes along with the understanding of the concerns a stakeholder may have and the actions needed to address its needs. For these LEEAP the stakeholders' engagement plan related to the four building categories, including:

- → Assessment of the stakeholders' interest, influence and allegiance.
- → What is important to the stakeholder?
- → How could stakeholder contribute?
- → How could stakeholder block?

The list of identified stakeholders categorised by groups and the initial stakeholder engagement plan for the LEEAP implementation is available as a separate repor.

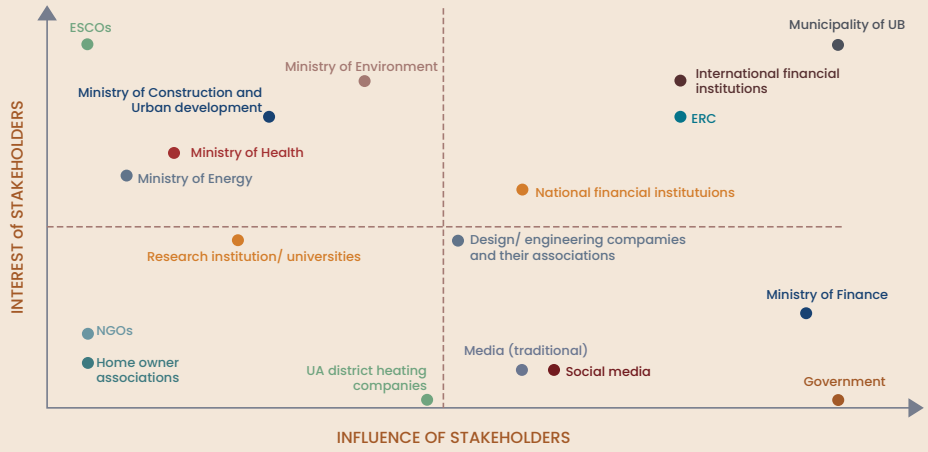


Figure 8.1: Level of influence and interest of the stakeholders involved in LEEAP development

9 COORDINATION AND ORGANISATIONAL STRUCTURE

Often one of the main barriers for the implementation of actions is an unclear division of responsibilities and tasks among involved stakeholders. The scope of the LEEAP is to encourage municipality of Ulaanbaatar to involve all the main stakeholders and ensure successful implementation of the actions identified in the LEEAP. There are many actions to be implemented in Ulaanbaatar in each of the four building sectors. It cannot be done only by the municipality of Ulaanbaatar.

Therefore, the objective #1 of this LEEAP is: "Ulaanbaatar will ensure clear organizational structures in place by 2021 to address the main building sectors: multifamily buildings, public buildings, private buildings in Ger districts and new construction".

There are different options and opportunities regarding the organizational structure that could be set up to meet this objective. Based on the experience gathered in other Cities, Ulaanbaatar will set up a three-level organisational structure, including top management, steering committee, and executive groups. The basic idea is presented in the Figure 9.1.

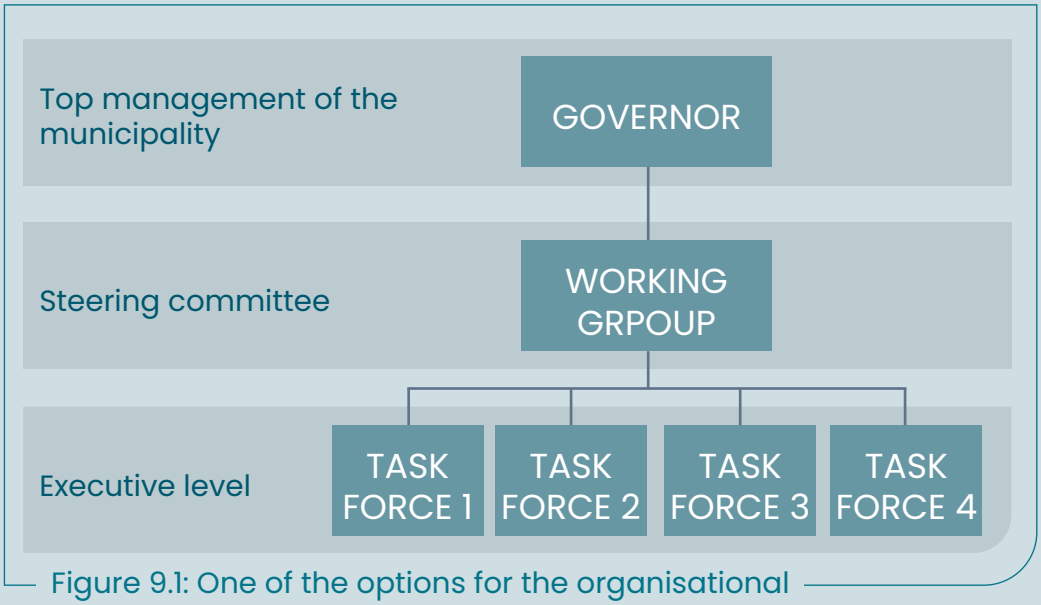


Figure 9.1: One of the options for the organisational structure of the LEEAP

Table 9.1: Potential roles and responsibilities of the involved parties

Top Management
Top Management demonstrates leadership and commitment with respect to continuous improvement of energy performance and reduction of the air pollution in the city of Ulaanbaatar, by: → ensuring that objectives and targets are established and are compatible with the strategic direction of the municipality, → ensuring that actions are implemented, → ensuring that the resources needed for the LEEAP are available, → ensuring that the LEEAP achieves its intended outcome, → promoting continual improvement of energy performance in buildings, → ensuring formation of the effective and efficient organisational structure, → directing and supporting persons to contribute to the implementation of the LEEAP, → supporting Working Group and Task Force units to demonstrate their leadership as it applies to their areas of responsibility.
Working group
Working Group plays the role of the Steering Committee and its main tasks are: → to overlook the implementation of the LEEAP, → to assist Task Force units in implementation of the actions, → to take decisions and/or consult with the Top Management in order to ensure successful and continuous implementation of the LEEAP, → to revise LEEAP once in two years.
Task Force units
Task Force units are assigned by the Top Management to ensure implementation of the planned actions in the LEEAP. At least four separate Task Force units (consisting of 6-7 persons) should be created with assignment to achieve respective objectives. Task Force units report to the Working Group in order to assess the work flow, results, barriers, next steps. The meetings of the Task Force units are organised separately at least once in two weeks. In the initial months there might be need to meet more often. The leader of each Task Force unit is the member of the Mayor's office of Ulaanbaatar city. For each meeting minutes of the meeting should be prepared and shared with the members of the Working Group. It is essential that Task Force units identify relevant stakeholders, e.g. Universities, associations, NGOs, financial institutions and donors etc. and ensure close cooperation with them.

Each of the involved parties will have its role and responsibilities that are defined in Table 9.1 above.

The Task Force units will be sufficiently staffed to enable the implementation of the LEEAP in the four building sectors.

A preliminary plan of the City of Ulaanbaatar includes the establishment of four tasks units as follows:

Task Force 1 consists of representatives of Mayor's office of Ulaanbaatar city and Office of the Capital City Governor. Mayor's office of UB city should assign responsible employees in this Task Force,

e.g. potential energy manager or head of the unit should be appointed. This Task Force is responsible for achievement of following objectives:

- Objective #1: Clear organisational structure (main responsible entity: Office of the Capital City Governor).
- Objective #3: Energy management system in public buildings (main responsible entity: Mayor's office of Ulaanbaatar city).
- Objectives #10 and #14: reduction of energy consumption in the public buildings (main responsible entity: Mayor's office of Ulaanbaatar city).

Task Force 2 consists of representatives of Mayor's office of Ulaanbaatar city and Energy Regulation Commission, District heating company, Energy Regulatory Board of the Capital City and is responsible for achievement of following objectives:

- Objective #2: Energy billing based on measured data in MFB (main responsible entity: Energy Regulation Commission).
- Objective #6: Energy/fuel price equilibrium between MFBs, PBs and Ger (main responsible entity: Energy Regulation Commission).
- Objective #8: New buildings / construction connection to district heating (if technically possible) (main responsible entity: Mayor's office of Ulaanbaatar city).

Task Force 3 consists of representatives of Mayor's office of Ulaanbaatar city, Ministry of Construction and Urban Development, Energy Regulation Commission, State Professional Inspection Agency, Construction Development Center and Metropolitan Specialized Inspection Agency. This Task Force is responsible for achievement of following objectives:

- Objective #4: Mandatory energy performance certificates (main responsible entity: Ministry of Construction and Urban Development).
- Objective #5: Updating/enforcing building code for energy efficiency requirements (main responsible entity: Ministry of Construction and Urban Development).
- Objective #9 and 13: reduction of energy consumption in the MFB (main responsible entity: Mayor's office of Ulaanbaatar city).

Task Force 4 consists of representatives of Mayor's office of Ulaanbaatar city, Ministry of Construction and Urban Development, Ministry of Energy and Office of the Capital City Governor and is responsible for achievement of following objectives:

- Objective #7: Replacement of all inefficient coal stoves and all stove not complying with emission standards in Ger private houses (main responsible entity: Ministry of Environment and Tourism).
- Objective #11 and 15: reduction of energy consumption in the Ger private buildings (main responsible entity: Mayor's office of Ulaanbaatar city).
- Objective #12 and 16: reduction of CO_2, PM, CO, SO_2 emissions and air pollution in UB (main responsible entity: Ministry of Environment and Tourism).

10 PLANNING OF THE ACTIONS

This LEEAP includes 15 different actions to reach the 16 LEEAP objectives (see Figure 10.1). The actions were identified and selected based on the following principles:

- Actions already tested in other municipalities in Europe,
- Simple actions are planned beforehand. Simple actions are:
  - Actions which requires less investments,
  - Actions aiming to gather reliable data, and
  - Actions aiming to improve and/or change management processes and behaviour;
- Actions that are necessary for upscaling are planned at the earliest possible stage;
- Testing phase of actions is foreseen before upscaling.

Each action is further described in table format, including the following information:

- Background,
- Timeline,
- Main steps required for implementation,
- Responsibilities and roles,
- Approximate costs and evaluation,
- Potential funding source,
- Technical information,
- Environmental impact,
- Main indicators,
- Monitoring, and
- Good practice examples.

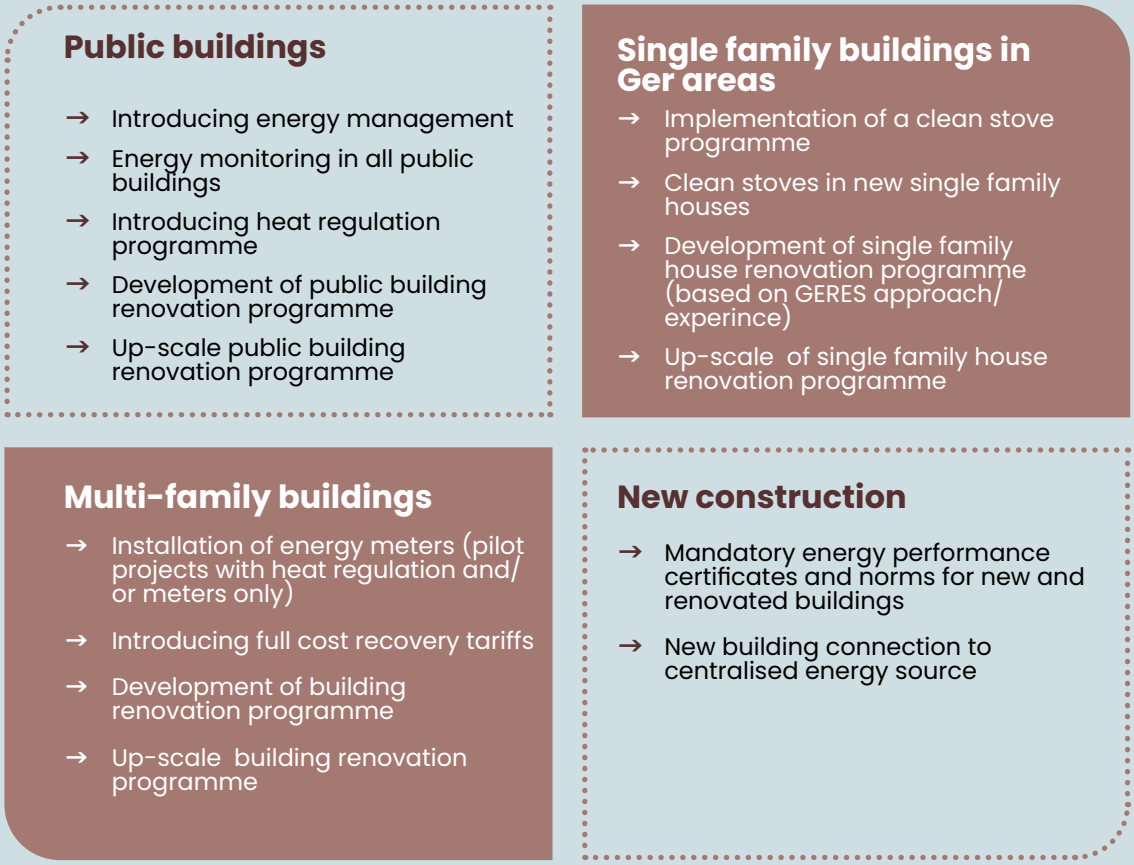


Figure 10.1: LEEAP actions

10.1. Energy management system in public buildings

Issue	Description
Objective	This action supports the achievement of objective #3: Ulaanbaatar will introduce energy management system in public buildings
Background information	Energy management is a systematic effort to achieve efficient and effective use of energy with available resources. An international standard MNS ISO 50001:2019 defines the main principles for development, implementation, and continuous improvement of energy management systems for any organisation, including municipalities. An EnMS follows a Plan-Do-Check-Act (PDCA) approach: → Plan: planning is the first step, starting from the boundaries of the system. Then in energy efficiency, planning is the determination of the initial energy baseline, the selection of suitable energy performance indicators, the strategic energy objectives. The energy consumption of the different buildings included in the system is determined with this review. These data and evaluations form the basis of the following improvement processes. They also make it possible to identify potential for improvement of energy efficiency → Do: in this phase, planning and action takes place, improvements are aimed and implemented. Indicators and objectives for energy performance are defined based on the results of energy assessments. In this phase, action plans are developed with the objectives for the improvement of energy performance. The plans are also implemented in this phase. → Check: provide a methodological and operational approach for monitoring and analysing the energy performance of the public buildings. An action makes sense if it leads to the desired result. The plans executed in the "Do" phase must continually be checked to ensure that they are effective. To do this, core processes that are significant to the energy-related performance are monitored and measured in this phase. The results are compared to the previously established objectives. → Act: continually improve energy performance with the aim that the EnMS becomes not just a niche tool, but rather actually an integral part of the administration's Energy Policy and day-to-day operations. The best way to set an energy management system (EnMS) for UB, is to build up a tailor-made system suitable to track the results of the LEEAP. Based on the core concept of continuously improving energy performance, the City of Ulaanbaatar with energy management can define and address important requirements of the LEEAP and support the successful implementation of all other objectives.
Timeline	Development and implementation until 2022; certification in 2023; operation – continuous since implementation.

What are the main steps to start the measure	→ Decision of the Council of UB to develop, implement and certify EMS according MNS ISO 50001:2019 → Appointing energy manager(s) → Training of energy managers and internal energy auditors → Definition of public municipal buildings (where Urban Development Agency can have an impact) → EnMS pilot: selection of the pilot district(s) or types of buildings (e.g. schools and/or kindergartens) where the EnMS will first be implemented and tested → Creation of EnMS manual and procedures (roles and responsibilities, planning, operation, monitoring, etc.) → Trainings of the employees and involved parties/stakeholders → Implementation of the EnMS and approval by the Council of UB → Certification of the EnMS → Continuous operation of the EnMS and implementation of the energy reduction and other measures (heat regulation, ventilation, changing behaviour, efficient stoves, etc.) → Preparation and implementation of energy audits for the top energy consuming buildings (for example 10-20 buildings with the highest annual specific energy consumption) identified during EnMS implementation → Introduction of new standards and procedures (if necessary) and update of the EnMS documentation → Expanding the boundaries of the EnMS and inclusion of more or all districts, building types, other energy consuming assets (public lighting, public transport, etc.) → Ulaanbaatar to strive for government refund of audit costs, if the audit conducted by the Energy Auditing Entity achieves tangible result.
Responsibilities and roles	→ Task Force 1 – overlooking implementation of the planned measures → Mayor's office of UB – responsible for development of the EnMS and implementation of the action; achievement of the results; attracting technical assistance and foreign donors (if necessary) → Appointed energy manager – responsible for implementation and operation of the EnMS in the pilot district and later in all UB; involved in the development of the EnMS → Directors / technicians of the public buildings – follow instructions of the energy manager; ensure monthly energy data collection and submission to energy manager; implements energy reduction measures etc. → Consultant (if necessary) – responsible for development of the EnMS and initial assistance with the implementation of the EnMS.

Approximate costs and payback	The costs will depend from the boundaries of the EnMS, i.e. how many districts/buildings will be included in the pilot EnMS. Development and implementation costs will be approximately 15000-20000 EUR; payback time is generally around 1 year. Certification costs need to be explored. Operation costs will depend from the planned measures to ensure reduction of the energy consumption and improvement of the air quality.
Potential funding source	UB budget and/or international donors via technical assistance projects (e.g. GIZ etc.)
Technical information	Based on the initial data provided by the municipality of UB (see more in Chapter 4.1), there are 1830 public buildings in UB, from which 159 are kindergartens and 136 – schools. Based on energy audit results, average heat consumption in kindergartens is around 510 kWh/m2 year while in schools – 360 kWh/m2 year. There is no reliable aggregated data regarding energy consumption, type, and size of public buildings. Based on the experience gained in other Cities, the introduction of an EnMS will ensure annual energy savings of 3-5%.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety and improvement of the public building stock.
Main indicators	→ Heat energy consumption in each public building included in the EnMS (kWh/m^2 year) → Electricity consumption in each public building included in the EnMS (kWh/m^2 year) → Indoor comfort and indoor air quality improvements in each public building included in the EnMS
Monitoring	Al least monthly and annual monitoring based on the planned monitoring procedure in the EnMS. See also action 10.3.
Good practice examples	There are several municipalities certified with EnMS in Europe. These are selected links including good practice examples: → More than 15 municipalities in Latvia, for example the City of Daugavpils[20]; → Seven municipalities in Italy, for example the City of Montecchio Magore[21].

[20] http://archive.cleanenergyministerial.org/Portals/2/pdfs/Daugavpils_Latvia.pdf
[21] http://archive.cleanenergyministerial.org/Portals/2/pdfs/Montecchio_Italy.pdf

10.2 Energy monitoring in public buildings

Issue	Description
Objective	This action supports the achievement of objective #3: Ulaanbaatar will introduce energy management system in public buildings. The implementation of this action also supports the achievement of the objectives related to building renovation in general and related to air quality improvements.
Background information	One of the core elements of the EnMS is monitoring energy performance of public buildings. However, the EnMS will first be implemented in a pilot districts or in a sample of buildings only. In the meantime, it is important to start collecting reliable energy data and information about all public buildings in UB, as currently the quality of data for public buildings is poor and with inconsistent input and missing information. The City of UB will set up a suitable monitoring system. This will include a detailed inventory of public buildings to collect relevant building data and a system for periodic collection of energy consumption data. There are different options regarding the establishment and organisation of building energy monitoring. The simplest option is to set a database with simple available tool, like a spreadsheet-based tool with manual data inputs. More advance and recommended options, which are currently used by several municipalities in Europe, include online Energy Monitoring Platform specifically designed for municipalities (both with manual data input and remote meter readings).
Timeline	Implementation in 2021-2022 and afterwards continuous updates.
What are the main steps to start the measure	→ Selection of the most appropriate monitoring system → Adaptation of the monitoring system for UB needs and conditions → Ensuring energy data input from all public buildings (not only from pilot districts or buildings but from all public building in UB) → Trainings of the technicians in public buildings about monitoring system and their role as well as on simple energy saving measures → Continuous operation of the energy monitoring system → Annual summaries with result analysis and reporting to UB and Force Task 1
Responsibilities and roles	→ Task Force 1 – overlooking implementation of the planned action → Mayor's office of UB – responsible for implementation of the action and selection of monitoring system; achievement of the results; attracting foreign donors (if necessary) → Appointed energy manager – responsible for operation of the monitoring system; reporting back to Mayor's office → Directors / technicians of the public buildings – follow instructions of the energy manager and ensure monthly energy data collection and submission in energy monitoring system

Approximate costs and payback	The costs will depend from the selected option for monitoring. Available tools and platform including their adaptation for UB needs may cost between 3000-6000 EUR with annual costs around 1500-2000 EUR. This are the costs for platform services, where data input is manually performance by building assigned responsible persons. Remote data collection and inputs will require additional investments in metering and submetering at building level.
Potential funding source	UB budget and/or international donors (e.g. GIZ etc.)
Technical information	There are 1830 public buildings in UB. The total heat and electricity consumption are not systematically collected, and other relevant data affecting energy consumption not all known. Introduction of monitoring in all buildings will ensure annual energy savings of at least 3%; in particular, when linked with informative campaigns on changing behaviour regarding building operation.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety, and improvement of the public building stock.
Main indicators	→ Heat energy consumption in each public building (kWh/m² year) → Electricity consumption in each public building (kWh/m² year)
Monitoring	Continuous
Good practice examples	→ There are several municipalities around Europe using Energy Monitoring Platform. A relevant example for Ulaanbaatar is the platform developed in framework of the COMPETE4SECAP project financed by the European Commission Horizon 2020 programme[22].

[22] More: https://compete4secap.eu/home/; https://www.youtube.com/watch?v=ob8S8vMxhfU&t=5s and https://v2.energoplanosana.lv/login/en

10.3 Heat substation programme in public buildings

Issue	Description
Objective	This action supports the achievement of: → objective #3: Ulaanbaatar will introduce energy management system in public buildings, → objective #10: Ulaanbaatar will reduce energy consumption in public buildings by 10% until 2030, and → objective #14: Ulaanbaatar will reduce energy consumption in public buildings by 20% until 2040 → objectives related to air quality improvements.
Background information	In this action, district heating substation is defined as the component or point in the building where the district heating network is connected to a building's own heating system. The amount of heat utilised from the circulating district heating system water depends mainly on the design and adjustment of the building's internal heating systems, but also on the performance and the condition of the district heating substation. Good cooling of the district heating water (i.e. more heat subtracted) and good performance of the district heating substation are in the interests of both the customer and the heat supplier[23]. Customers can be connected to the primary network using two main connection principles: → indirect connection of the customer heating circuit to the district heating network: a heat exchanger provides the hydraulic separation. → direct connection of the customer heating circuit to the district heating network, where the same district heating water is used in the secondary network (radiators). Metering at building level, shall occur at the heat substation point. Currently part of the public buildings in UB have very limited or no options to regulate the heat supply in the buildings. Therefore, often in winter buildings are underheated or overheated, which negatively influences energy consumption and/or indoor comfort. Also building level heat energy metering is not available in all public buildings. Currently there is no reliable information on the number of public buildings with operational heating systems and substations with options to efficiently regulate heat supply. Therefore, the City of UB will introduce a municipal programme to modernise heat substations in public buildings. The first phase of the project will focus on an inventory analysis and feasibility study to identify type and magnitude of the needed investments, i.e. where only minimal investments are needed and where modern heat substations are necessary. The second phase will include actual implementation of the action.
Timeline	Implementation from 2021 till 2026

[22] Guidelines for District heating Substation, Euroheat&Power: https://www.euroheat.org/wp-content/uploads/2008/04/Euroheat-Power-Guidelines-District-Heating-Substations-2008.pdf

What are the main steps to start the measure	→ Inventory of heat substations in all public buildings, including information about heat meters, existing engineering system and options to regulate. This analysis is carried out based on questionnaire template filled by technicians of the public buildings, including photos of the existing heating system and equipment. ▸ Analysis of inventory and division of the buildings in at least 3-4 groups: ▸ Buildings with heat meters and effective (automatic) options (group 1) ▸ Buildings with heat meters but no possibilities to regulate (group 2) ▸ Buildings without heat meters but possibilities to regulate (group 3) ▸ Buildings without heat meters and no possibilities to regulate (group 4) → Creation of the action plan for each group above with an objective to ensure regulation. These groups should also be subdivided in smaller groups based on the types of the buildings and their use (e.g. kindergartens, schools, hospitals, administration buildings etc.) → Ensuring funding for the planned actions → Implementation of the action plan, including procurement of the works → Regulation and guidelines of the City Council regarding mandatory regulation of the heat demand and consumption in the public buildings → Trainings of the technicians of the public buildings based on the introduced EnMS procedures in the municipality.
Responsibilities and roles	→ Task Force 1 – overlooking implementation of the planned action → Mayor's office of UB – responsible for implementation of the action; approval of the action plan; procurement of works; achievement of results; attracting foreign donors (if necessary) → Appointed energy manager – involved in the creation of the inventory. Liaison person with district heating company → Urban Development Agency – responsible for inventory; creation of the action plan and supervision of the implementation of the actions → Directors / technicians of the public buildings – providing information about the building and heat system.
Approximate costs and payback	Costs for inventory around 2000 EUR (for online data questionnaire). Costs of implementation will depend on the results from the inventory. There will be in average a need of 1000 EUR per building with minimal improvements and 5000-10000 EUR per building to fully modernise its heat substation. Payback time will depend from necessary investments, however, will be less than 5 years (if objective #6 will be achieved).
Potential funding source	UB budget and/or international donors
Technical information	There are 1830 public buildings in UB. The total heat and electricity consumption data are not reliable and well known. Modernisation of the heat substations will ensure average energy savings of at least 5-15%. This programme will also benefit district heating, whereas cooler return temperature will increase the overall efficiency of the system.

Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety, and improvement of the public building stock.
Main indicators	→ Number of improved/ modernised heat substations. → Heat energy consumption in each public building (kWh/m^2 year) → Electricity consumption in each public building (kWh/m^2 year)
Monitoring	The activities should be monitored on yearly basis in the framework of the EnMS.
Good practice examples	Since 1990, many of East European countries, with district heating system comparable to UB, have upgraded District Heating systems making them a financially sustainable way of providing good quality heat and hot water services at affordable prices. These countries implemented policy reforms through effective changes to the legal and regulatory framework, creating independent regulators, raising tariffs to reflect full cost of service, involving the private sector, and enabling new investments. The introduction of heat metering and refurbishment of heat substation at the building level was among the first steps in implementation of the investment programs. Examples of this approaches are from large district heating system like in Riga (Latvia), Vilnius (Lithuania) and Warsaw (Poland).

10.4 Development of public buildings renovation programme

Issue	Description
Objective	This action supports the achievement of: → objective #10: Ulaanbaatar will reduce energy consumption in public buildings by 10% until 2030, → objective #14: Ulaanbaatar will reduce energy consumption in public buildings by 20% until 2040, and → objectives related to air quality improvements.
Background information	Currently specific heat energy consumption for space heating in kindergartens is estimated between 176 and 513 kWh/m² year; and in schools between 143.1 and 362 kWh/m² year. The introduction of an energy management system and energy monitoring (see actions 10.1 and 10.2) will ensure consistent data collection of heat energy and electricity consumption. However, most of the existing public buildings have not undergone any major overhauling and upgrade since they were built 30-40 years ago. These buildings face significant technical problems, often resulting in high energy losses, poor indoor air quality and a lack of thermal comfort. The City of UB will introduce a heat substation programme (see action 10.3) to improve heat regulation and building level metering. However, these buildings also need capital investments targeting internal engineering networks and the building fabrics. The City of UB has already gained some experience in this sector, and pilot projects have been carried out in the past; like for example in the framework of international support programmes (from GIZ and KfW). This experience shall be continued and upscaled. The renovation programme shall be designed to support: → 1) energy efficiency measures (renovation of the space heating system, ventilation system, domestic hot water system, comprehensive improvements of the building envelope, etc.), → 2) Structural measures (ranging from fixing building structural elements to seismic upgrades) → 3) Aesthetical measures to repairs areas affected from the implementation of energy efficiency measures, → 4) Possibility to integrate renewable energy sources as part of the renovation programme, → 5) Possibility to introduce energy efficient appliances and lighting fixtures. This programme will first be tested on a pilot project. UB will select a sample of buildings based on different criteria. like type of building, number of users, energy source, specific energy consumption, technical conditions of the building, specific indoor air quality problems, etc.

Timeline	→ Detail planning of the programme from 2021 to 2023; → Pilot project from 2023 to 2028 → Upscaling the programme 2028-2040
What are the main steps to start the measure	→ Agreement on the scope of the renovation programme and development of detailed implementation plan, e.g. divided in different phases. It will be based on EnMS and energy monitoring (see action 10.1 and 10.2). Selection of priority buildings and priority groups of the buildings will be based on different criteria like if connected to HOB, highest specific energy consumption, type of the buildings, buildings in critical technical conditions, etc. → Detailed feasibility study and business plan for the renovation programme. → Development of procurement strategy (traditional bid design bid and build or design and build or design build and operate), → Attracting financing for the renovation programme and development of a programme management and implementation manual including requirements, processes, and standardised templates for procurement, bundling of subprojects; project supervision; environmental health and safety; monitoring, etc. → Implementation of the pilot project for testing the programme (from project development to commissioning), → Exploitation and operation manuals provided to each building after renovation. → Trainings for the employees in the renovated buildings. → Analysis of the pilot project and lesson learned used to improve the programme management and implementation manual for programme upscaling.
Responsibilities and roles	→ Task Force 1 – overlooking implementation of the planned action → Mayor's office of UB – responsible for implementation of the action; approval of the renovation plan; procurement of works; achievement of results; attracting foreign donors (if necessary) → Appointed energy manager – involved in the development of the renovation plan → Development department of the UB – development of the renovation plan → Technical department of the UB – responsible for implementation of the renovation plan
Approximate costs and payback	There are 1830 public buildings in the City of Ulaanbaatar. The renovation costs of the 295 educational institutions (kindergarten and schools) is in the range of 182-315 m€ (70 to 120 €/m2). Based on current energy tariffs the simple payback, which among all project benefits is calculated considering energy saving only, would be more than 40 years. Information on other building type is less reliable and will be gathered as part of action 10.2. The development of the programme may require EUR 100,000 to 200,000 Euro.

Approximate costs and payback	For the pilot project, the renovation costs will depend from the selected number of buildings. As preliminary input for the action: → 10-20 kindergartens will be in range from 3 to 10.5 m€ (investment costs assumed from 70 to 120 €/m^2; average area of one kindergarten – 4406 m^2). → 10-20 schools will be around 9.8-33.7 m€ (investment costs assumed in range from 70 to 120 €/m^2; average area of one school – 14052 m^2). Alongside with energy savings, these projects will ensure CO_2 emissions reduction, which could be traded. They will also reduce air pollution, resulting in lower expenses for the health system. On the top of this, the programme will preserve essential infrastructures (schools, kindergartens, and other public buildings).
Potential funding source	UB budget, national budget, international donors, loans.
Technical information	There are 1830 public buildings in UB. The first effort will be put on buildings with the greatest problems, like educational buildings where indoor air quality and thermal comfort is of great importance for children. Comprehensive building renovation will ensure heat energy savings of at least 30-40%. It is important to have a programme minded on a comprehensive renovation approach to both ensure energy savings and asset preservation and enhancement. The effect of a single energy efficiency measures may not work as expected. For example, the improvement of the thermal characteristics of the building envelope (like thermal insulation of walls, roof, new windows, etc.) may be ineffective if the building is still equipped with an old substation and old space heating system which cannot be regulated and balanced.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety, and improvement of the public building stock. Such programme will have a positive effect not only on the indoor air quality and reduce energy consumption; it will also reduce air pollution and ensure their lifetime for the next 30-40 years.
Main indicators	→ Heat energy consumption in each public building (kWh/m^2 year) before and after → Electricity consumption in each public building (kWh/m^2 year) before and after → Indoor air quality (ppm) → Number of renovated buildings → New RES capacity installed (MW) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Monthly energy and indoor air quality monitoring should be compulsory (in the framework of EnMS).
Good practice examples	There are many good practice examples available worldwide, especially in Europe, with public building refurbishment programmes developed at national and/or municipal level. If UB will attract funding from international donors and/or international financial institution, the programme should be set up in cooperation with them.

10.5 Up-scaling public buildings renovation programme

Issue	Description
Objective	This action supports the achievement of: → objective #10: Ulaanbaatar will reduce energy consumption in public buildings by 10% until 2030, → objective #14: Ulaanbaatar will reduce energy consumption in public buildings by 20% until 2040, and → objectives related to air quality improvements.
Background information	The implementation of the pilot project with the renovation of 20-40 educational buildings will allow all involved stakeholders to learn the process, to perform and deliver (10.6). In other to reach the expected objectives the experience learned in the pilot project must be replicated with continuity. In this phase continuity will be the key, to keep build up capacities operating and delivering. The greatest challenge in up-scaling is to both secure funding and pipeline of projects. It will be important for UB to ensure proper process standardisation, good integration of the lesson learned from the pilot project and setting fruitful cooperation with financial institutions.
Timeline	Implementation from 2029-2040
What are the main steps to start the measure	→ Based on the lesson learned from the pilot project (10.6) the programme will be reviewed and improved. This review will be carried out in concertation with the main stakeholders of the programme. Regulation, norms and programme management and implementation manual will be reviewed accordingly. → Selection of the buildings in the 2nd and further phases. → Application for funding for the 2nd and further phases. → Approval of the designs and selected measures and solutions. → Standard procurement for the renovation works and supervision, including energy efficiency guarantees. → Monitoring and O&M guidelines.
Responsibilities and roles	→ Task Force 1 – overlooking implementation of the planned action → Mayor's office of UB – responsible for implementation of the action; approval of the selected buildings; procurement of technical designs and construction; achievement of results; attracting foreign donors (if necessary) → Development department of the UB – responsible for development of business plan/application for funding → Technical department of the UB – responsible for implementation of the renovation projects

Approximate costs and payback	Renovation costs will depend from the selected number and type of buildings and the investment costs at the time when the tender will be launched. Payback time will also depend on energy tariff (action 10.8). The quality and availability of data is not enough for understanding the quantity of public buildings to be renovated for reducing energy consumption by 20% by 2040 (objective #14). As a first input to be reviewed during the implementation of action 10.4 the programme could target the renovation of 2.5 million m² of public buildings. A budget of €250m-€260m shall be planned over the implementation period of 10 years.
Potential funding source	UB budget, national budget, international donors, bonds, loans, financial instruments linked to climate change
Technical information	Comprehensive building renovation will ensure heat energy savings of at least 30-40%. It is important to keep the programme minded on a comprehensive renovation approach to both ensure energy savings and asset preservation and enhancement. The effect of a single energy efficiency measures may not work as expected. For example, the improvement of the thermal characteristics of the building envelope (like thermal insulation of walls, roof, new windows, etc.) may be ineffective if the building is still equipped with an old substation and old space heating system which cannot be regulated and balanced.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety, and improvement of the public building stock.
Main indicators	→ Heat energy consumption in each public building (kWh/m² year) before and after → Electricity consumption in each public building (kWh/m² year) before and after → Indoor air quality (ppm) → Number of renovated pilot buildings → New RES capacity installed (MW) (if applicable) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Monthly energy and indoor air quality monitoring should be compulsory (in framework of EnMS).
Good practice examples	→ See 10.4

10.6 Reform for full cost recovery tariffs

Issue	Description
Objective	This action supports the achievement of objective #6: Ulaanbaatar will strive to introduce fuel price equilibrium between energy users in multifamily buildings, public buildings, and private buildings in Ger districts by 2023.
Background information	In UB energy is still significantly subsidized and under-priced. According to the Energy Law, tariffs should be fully cost covering. In practice, however, the tariffs are kept at much lower levels and do not reflect the actual full economic costs. This is more pronounced for heat supplied by district heating networks to residential buildings. At the same time, payments are not always based on consumption-based billing, but rather charged based on a methodological approach by area or volume of the apartment or houses. The sum of low energy price and the lack of building level metering results in a total lack of interest for building owners and user to invest in energy efficiency measures as the business case is not good. It has been recommended by several stakeholders [...] that subsidies currently provided to the energy sector should be replaced by channelling any remaining financial support directly to vulnerable consumer groups to mitigate the impacts of tariff increases. However, implementing these reforms remained highly problematic and unrealised. Although policy makers and all stakeholder in the energy sector are aware of this issue, restructuring of energy tariff requires commitments from high-level policy makers and long-term visions. As part of this LEEAP, UB together with other stakeholders will strive to implement consumption based real data billing and support a gradual increase in energy tariffs to full cost recovery. The Capital City Governor needs to pay attention to this and cooperate with the Ministry of Construction and Urban Development.
Timeline	Implementation until the end of 2023
What are the main steps to start the measure	→ Estimation of the real costs of heat and electricity in UB and level of subsidies by sectors (CHPs, HOB, individual heating) → Continuous discussions with all relevant stakeholders, including resident organisations, NGOs, private and public institutions → Removal of the barriers in the current regulatory framework → Creation of cost recovery heat and electricity tariff scheme, including sensitivity analysis and approval of it → Identification and implementation of support mechanisms for inhabitants with low income → Within the UB City's fiscal policy, to implement effective budget planning and to define a strategy to improve the efficiency of budget expenditures and budget funds in line with this objective → To achieve this objective, it is necessary to improve energy efficiency of state and local budgetary organizations and move to the principle of measuring their consumption.

Responsibilities and roles	→ Task Force 2 – overlooking implementation of the planned measures and taking supportive and/or corrective actions; organisation of the discussions with relevant stakeholders → Energy Regulation Commission – responsible for implementation of the action; agreement with all involved parties; creation of the new tariff system; removal of the barriers in the current regulatory framework; professional PR campaign to explain the rise → Mayor's office of UB – support to all involved parties; development and approval of the necessary local regulations → District heating companies – providing data to estimate real costs of heat and electricity production.
Approximate costs and payback	Introduction of the full cost recovery tariffs is a needed reform which supports investments in building energy efficient renovation. Tariffs levels below the cost of services requires subsidies, which for example can be re-directed to support the most vulnerable part of the population or towards energy efficiency projects to reduce energy consumption and air pollution. Costs for update of the existing tariff calculation methodology and PR campaign are difficult to estimate. The City of Ulaanbaatar will strive to ensure this reform. For the inhabitant of Ulaanbaatar, the City will organise PR and information campaigns. For this action a budget of 50000 EUR will be allocated
Potential funding source	Energy Regulation Commission budget, national budget, UB budget
Technical information	Currently energy tariff for residential buildings connected to the district heating is 3.51 EUR/MWh (including VAT) while for public buildings is 8.56 EUR/MWh and for private buildings in Ger – 14.78 EUR/MWh.
Environmental impact	Positive impact on climate change. General driver for every energy efficiency projects and reduction of energy consumption. Can lead to improved air quality and improved health of residents. Current subsidies for energy can be shifted towards those in need. Improved social environment, i.e. social fairness among different energy user groups.
Main indicators	Energy tariffs, MNT/MWh by all different energy user groups
Monitoring	Continuous energy tariff monitoring and publication on the webpage of Energy Regulation Commission
Good practice examples	The issue of fossil fuel and/or energy subsidies is still a troublesome topic for several countries worldwide and well acknowledged and addressed in most of the European countries. Heat metering and consumption-based billing, as demonstrated by the success of several East European countries, are critical steps on the path to sector reform. Implementing heat metering at the building level is also an attractive first step as it has the possibility of garnering widespread support from multiple stakeholders. Public consultations showed that many residential DH customers favour heat metering and consumption-based billing. Building level heat metering, coupled with technical solutions to improve efficiency of heat delivery to households, has demonstrated mutual benefits for customers, DH companies, and the Government.

10.7 Clean stove programme in private buildings in Ger districts

Issue	Description
Objective	This action supports the achievement of: → objective #7: Ulaanbaatar will ensure replacement of all inefficient coal stoves and all stoves not complying with emissions standards in the private buildings in Ger districts until 2030 → objective #12: Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030 → objective #16: Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040
Background information	Air pollution in Ulaanbaatar is mostly caused by coal burning using inefficient and outdated (sometime home-made) stoves in private detached houses and gers in Ger districts. These stoves waste a lot of energy with inefficient burning and emit harmful flue gases causing air pollution. Clean stove programmes were already launched in the past (since 2009), with different degree of success. For example, between 2013 and 2015, some 180,000 clean stoves were distributed to ger area households with subsidies provided by the Mongolian Ministry of Energy, the City of Ulaanbaatar, the Millennium Challenge Corporation, and the World Bank. The cost of a stove was 500.0 thousand MNT (around 162 €), and it was sold to households for 25.0 thousand MNT (around 8 €). In 2019 a survey was conducted to assess the use and impact of more efficient stoves. It concluded that only 30% of the delivered clean stoves were still used by the households, however around 70% of these stoves have been sold outside Ulaanbaatar. The recent switch in 2019 to coal briquettes may have improved air quality, but still monitoring and scientific evidences are needed to measure the impact of this action. In the meantime, threshold level for air quality is still systematically over recommended values. Therefore, previous clean stove programme should be further developed and improved based on the lesson learned to achieve the expected outcomes. It is important to assess what level of subsidy will motivate households to switch to clean stoves in their dwellings. Additionally, large effort should be put on awareness raising campaigns to inform residents on the economic, financial, and environmental benefits and effects of the clean stoves on their household finances and health. Alongside with support for replacing old stoves, obligations, penalties, and inspections for no-compliances with emission standards shall be set and enforced. The use of heavily polluting stoves, which do not comply with efficiency and emission standards shall finally be banned.
Timeline	Implementation from 2021 till 2030

What are the main steps to start the measure	→ Identify and learn from previous experience (what failed, what can be replicated, what must be improved). Identification of the clean stoves installed (e.g. clean stove register), assessment of the further real needs. → Discussion with the main stakeholders, including inhabitants in Gers. Involvement of supportive structure in UB for residents in Gers. → Update of the existing clean stove programme , including support mechanisms. Assessment of the level of support. → Broad information campaigns for residents of ger districts. → Creation of the synergy with the Ger renovation programme (action 10.10). For example, for single family building owners that both implement energy efficiency measures and replace the old stove of the stove, can have higher support. → Implementation of the stove programme according to the action plan. → Development of cleaner and more efficient stoves. → Control and monitoring of the implementation. Lessons learned and necessary updates of the programme if needed.
Responsibilities and roles	→ Task Force 4 – overlooking implementation of the planned measures and taking supportive and/or corrective actions; organisation of the discussions with relevant stakeholders → Ministry of Environment and Tourism – update and re-launching of the clean stove programme → Mayor's office of UB – implementation and monitoring of the clean stove programme → Ger support organisations – information campaigns → Clean stove producers in cooperation with universities – development, testing and production of the cleaner stoves → Stove Emissions and Efficiency Testing Laboratory in Mongolian University of Science and Technology – testing of the eligible stoves
Approximate costs and payback	There are around 220 thousand households currently living in Ger districts. If 30% of them are operating clean stoves, then there are still more than 150 thousand households living in dwelling with low efficiency and dreadfully air polluting stoves. The retail cost of a modern, high quality, clean coal stove sufficient for one typical household ranges from 600 EUR to more than 1600 EUR. Mass purchase and industrial order of selected stoves can cut down costs lowering it down from 300-800EUR/pcs. Considering the average costs of 450 EUR for piece, the replacement of 150 thousand stoves in Ulaanbaatar will require about €67.5m. The payback back of this measure will depend from the actual efficiency of existing stoves, the size, and the quality of the single-family houses. For example, for a house of 80-100m² consuming 50MWh/year of heat energy the payback of a 450€ stove can be between 3-5years. Considering the following example: assuming an existing coal stove have a combustion efficiency of 60% and that the new clean stoves have it at above 75%, the investment of 450€ has a simple payback time of 3.65 years:

<table>
<tr><td>Approximate costs and payback</td><td>
<table>
<tr><th colspan="2">Stove efficiency</th><th rowspan="2">Heat demand MWh/ year</th><th colspan="2">Primary energy demand, MWh/ year</th><th colspan="2">Savings</th><th rowspan="2">Investment EUR</th><th rowspan="2">Pay back, years</th></tr>
<tr><th>Existing</th><th>New</th><th>Existing</th><th>New</th><th>MWh/ year</th><th>€/year</th></tr>
<tr><td>60%</td><td>75%</td><td>50</td><td>83.3</td><td>66.7</td><td>16.7</td><td>123.2</td><td>450</td><td>3.65</td></tr>
</table>
* cost of coal briquette about 7.39€/MWh or 49€/t

As part of a clean stove programme, the City of Ulaanbaatar could set up a support programme for clean stoves. This can be set up as in the past with as direct subsidy. Alternatively, it can be developed as a soft loan programme or with a mix of both grant and soft loan. Depending from the final structure of the support programme about €35m shall be planned.

For the whole City of Ulaanbaatar improved air quality will be the main economic driver. According to a study published by World Bank in 2011, the total estimated associated economic benefits in terms of avoided health damage are estimated at $144m per year[25].
</td></tr>
<tr><td>Potential funding source</td><td>UB budget, national budget, international donors, loan</td></tr>
<tr><td>Technical information</td><td>The more efficient is the stove, the less coal it burns for the same heat output. Traditional stoves are extremely polluting. They emit as much as about 600-700 mg PM2.5 per net MJ when using Nalaikh coal or about 1400-1500 mg PM2.5 per net MJ when using Baganuur coal[26]. Since coal briquettes were recently introduced, the air pollution may have improved; however, the level of the pollution from this switch has not been assessed yet.

Coal stoves are being used from centuries for heating and cooking purposes. There has been great progress in the coal burning stove industry over the years and today modern stove have recached better environmental performances concerning emissions of particulates and other emissions.

Modern clean stoves can reduce PM2.5 emissions by as much as 95%, if the stoves are properly used; in particular, regarding the use of proper fuel.</td></tr>
<tr><td>Environmental impact</td><td>The World Bank's study in 2011 estimates that a relatively rapid reduction of 80% of emissions from ger area heating could achieve a 48% reduction in population weighted exposure to PM2.5.</td></tr>
<tr><td>Main indicators</td><td>→ Number of clean stoves installed per year
→ Coal consumption before and after, t/year
→ Air pollution avoided, ppm/year
→ Tested clean stoves</td></tr>
<tr><td>Monitoring</td><td>Monthly air pollution monitoring is mandatory to assess the air quality in the Ger districts. Currently there are few air pollution monitoring control centres in the areas of the Ger districts.

Quarterly and/or annual monitoring of the implementation of the programme should be introduced. In case planned outcomes are not achieved, corrective actions should be considered and implemented.</td></tr>
<tr><td>Good practice examples</td><td>Ulaanbaatar has already previous experience with the clean stove programmes. It is important to assess the lessons learned, revise and adapt the previous programmes for the current needs and technical achievements and proceed with implementation of the actions.</td></tr>
</table>

[25] Source: http://documents.worldbank.org/curated/en/725331468053408990/pdf/660820MONGOLIA0C000Final0report0mon.pdf

[26] Source: http://www.newdawnengineering.com/website/library/Stoves/Stove%20Testing/081%20Baseline%20Traditional,%20front%20lit%202010-08-22/081%20Traditional%20Baseline%20Stove,%20front%20lighting%202010-10-04.pdf

10.8 Clean stoves in the new single-family houses in Ger districts

Issue	Description
Objective	This action supports the achievement of: → objective #7: Ulaanbaatar will ensure replacement of all inefficient coal stoves and all stoves not complying with emissions standards in the private buildings in Ger districts until 2030 → objective #12: Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030 → objective #16: Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040
Background information	The City of Ulaanbaatar is expanding and annually around 8300 new detached single-family houses in the Ger areas are built[27]. The new residents of the UB should be informed and motivated to install new and clean stoves in their buildings. One of the current challenges is delivering of information to these new inhabitants and therefore it is important to identify the main information channels to reach them. If the clean stove and energy efficiency support programmes are created and implemented (action 10.7 and 10.9), also new Ger inhabitants should be eligible to apply.
Timeline	Planning phase in 2021; introduction in 2022; control until 2030
What are the main steps to start the measure	→ Discussion with the main stakeholders, including inhabitants in the Ger districts. → Involvement of supportive structure in UB for residents in Gers. → Setting eligibility rules and requirements for the new ger buildings. → Implementation of the stove programme according to the action plan.
Responsibilities and roles	→ Task Force 4 – overlooking implementation of the planned measures and taking supportive and/or corrective actions; organisation of the discussions with relevant stakeholders → Ministry of Environment and Tourism – update and re-launching of the clean stove programme → Mayor's office of UB – implementation and monitoring of the clean stove programme → Ger support organisations – information campaigns → Clean stove producers in cooperation with universities – development, testing and production of the cleaner stoves → Stove Emissions and Efficiency Testing Laboratory in Mongolian University of Science and Technology – testing of the eligible stoves.

[27] The influx of new entrants was some 30,000 persons annually from 2006-2008, and official statistics show that for every nine persons entering Ulaanbaatar one left over the period from 2000 to 2008. Average household in Mongolia is 3.6 people per household (2018).

Approximate costs and payback	There are around 8300 new households annually settling in the Ulaanbaatar, mostly in Ger districts. The current costs of the modern clean stoves purchased in stocks can be estimated at around 450€/pcs. The annual investment needs for new clean stoves might be around €3.7m per year. Including the delivery of these stoves as part of the clean stove programme in 10.8, will add about €1.2-1.9m per year
Potential funding source	UB budget, national budget, international donors, loan
Technical information	More efficient is the stove, less coal should be burned. Traditional stoves are quite dirty. They emit as much as about 600-700 mg PM2.5 per net MJ when using Nalaikh coal or about 1400-1500 mg PM2.5 per net MJ when using Baganuur coal. Since the coal briquettes are introduced, the air pollution has been reduced. However, the level of the pollution has not been assessed yet. Clean stoves are able to reduce PM2.5 emissions by as much as 95% - if the stoves are used properly.
Environmental impact	The World Bank's study in 2011 estimates that a relatively rapid reduction of 80% of emissions from ger area heating could achieve a 48% reduction in population weighted exposure to PM2.5.
Main indicators	→ Number of clean stoves installed per year → Coal consumption, t/year → Air pollution avoided, ppm/year
Monitoring	Monthly air pollution monitoring is mandatory to assess the air quality in the Ger districts. Currently there are few air pollution monitoring control centres in the areas of the Ger districts. Quarterly and/or annual monitoring of the implementation of the programme should be introduced. In case planned outcomes are not achieved, corrective actions should be considered and implemented.
Good practice examples	Ulaanbaatar has already previous experience with the clean stove programmes. It is important to assess the lessons learned, revise and adapt the previous programmes for the current needs and technical achievements and proceed with implementation of the actions.

10.9 Developing single family house renovation programme in Ger districts

Issue	Description
Objective	This action supports the achievement of: → objective #11: Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 22% (to the average level of 550 kWh/m² year) by 2030 → objective #12: Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030 → objective #15: Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 50% (to the average level of 350 kWh/m² year) by 2040 → objective #16: Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040
Background information	There are more than 220'000 single-family buildings in the ger areas of UB. Most of them are low energy efficient do-yourself type of buildings. Few would comply with current building codes. These single-family buildings are one of the main sources of air pollution in Ulaanbaatar; a refurbishment programme in this sector to ensure affordable and qualitative housing for the residents in the Ger districts is an important long-term policy. One of the main challenges to reach this target is to understand the most suitable financing option for such refurbishment programme and which level of support is needed. There are already ongoing single-family building renovation initiatives launched in Ulaanbaatar, like GERES "Switch Off Air Pollution" programme[28]. This initiative aims to renovate 1000 detached single family buildings and save 1600 tons of coal, avoiding the emission of 6000 tCO_2. Based on recent survey by GERES, there are several challenges to scale-up and replicate the renovation of the single-family buildings. These are the most significant: → Technical assessment of the buildings; → Available financing (affordable loans) for renovation; → Availability of specialised brigades and workers; → Ensure quality of construction works and materials used during renovation. Therefore, it is important for UB to work together with the main stakeholders, like GERES, to assess the best options and solutions for the renovation of the existing single-family buildings and develop a support programme to track the challenges and reach the set objectives. The single-family house renovation programme will then be tested on a pilot project, including buildings in different Ger areas or in the same district. There are different options on how buildings could be selected for the pilot phase. For example, in the current GERES initiative, buildings are selected based on a technical assessment of the energy advisor according to the Mongolian Technical Construction code.

[28] Source: https://www.geres.eu/en/our-actions/our-projects/energy-renovation-fragile-housing-laanbaatar/

	Implementation of the pilot project will allow all stakeholders to assess the efficiency of all the steps, main challenges, barriers etc. to upscale the whole refurbishment programme.
Timeline	Detail planning of the programme from 2021 to 2022 Pilot project from 2022 to 2024 Upscaling the programme 2025-2040
What are the main steps to start the measure	→ Discussion with the main stakeholders on the past and existing renovation programmes. Build upon and support existing initiatives (like GERES on energy efficiency renovation), Discussion of the support programme with the main stakeholders and public. → Evaluation and development of an effective support programme for single family renovation in Ger districts (in cooperation with government, foreign donors, financial institutions, and relevant stakeholders). → Development of norms and regulations for the support programme and development of a programme management and implementation manual. This is an example of aspects to cover: ‣ List of eligibility criteria and requirements to apply to the programme, ‣ Documentation for application (forms, energy and technical appraisal, etc.), ‣ Set of mandatory energy efficiency measures and minimum quality standards, ‣ Amount of the support and disbursement rules, ‣ Selection procedures of contractors for project implementation, ‣ Mandatory monitoring after renovation → Setting-up a supportive structure in UB for residents in Ger areas (also in cooperation with other ongoing initiatives). Informative campaign for the renovation programme, → Setting up the capital structure of the programme and rising needed funds for the programme → Trainings for: energy auditors, designer, intermediaries, specialised brigades, and workers (the scope of the trainings and target groups will depend from the specific programme framework) → Implementation of pilot project to test the programme for 100 buildings. Setting up a proper inspection scheme to ensure compliance.
Responsibilities and roles	→ Task Force 4 – overlooking implementation of the planned measures → Mayor's office of Ulaanbaatar city – responsible for implementation of the action; agreement with all involved parties; achievement of the results; development and approval of the necessary regulations; attracting foreign donors (if necessary) → Main stakeholders like GERES, NGOs, local citizen groups – consultations, assistance in implementation, feedback and further improvement of the renovation programme → University – responsible for organisation of the trainings for specialists, brigades, energy auditors etc.

Approximate costs and payback	The costs for the energy efficient renovation of a single-family house in the Ger district vary between 70 and 100 €/m². For example, a house of 80m² can be renovated for about 5600-8000€. The payback of this measure will depend on the possible energy savings, actual efficiency of existing stoves, the size, and the quality of the single-family house. For example, for a house of 80m² consuming 50MWh/year of heat energy the payback for an 8000€ investment can be between 20-25 years, considering the use of coal briquette as heating source. As part of a programme for single family house renovation in Ger districts, the City of Ulaanbaatar could set up a support mechanism as an incentive for homeowners to renovate their houses. This can be set up as a soft loan programme plus a grant component to reduce the payback period from the current 20-25 years to the range between 12-15 years. Currently low-interest rate eco loans are available for residents with the interest rate subsidized by the Ministry of Environment and Tourism and GCF, therefore becoming the lowest interest rated product in the consumer loan sector[29]. It should be well assessed what support system should be put in place to motivate all groups of residents to implement energy efficiency measures in their buildings; also considering the possibility to differentiate the support based on household's income. The development of the programme may require EUR 80,000 to 120,000 Euro. Depending on the final structure of the support programme for the pilot project of 100 buildings, the City of Ulaanbaatar shall plan €0.36m. These funds for example can be used to: → cover the development costs of a renovation project (energy audits, design), → to include a grant component, → to cover guarantees for soft loans instrument, → to cover a tax rebate mechanism.
Potential funding source	Homeowners of single-family houses in Ger districts, loans to homeowners from financial institutions, UB budget, national budget, international donors.
Technical information	Renovation of the single-family buildings in Ger areas will reduce the energy consumption in average from 30% (in case of simple energy efficiency measures) up to 70%. The total amount of time for one household to go through the process of renovation is averaged to be around 15 days, as some process is carried out simultaneously. This amount of time can vary depending on the availability of craftsman.
Environmental impact	Mainly health benefits and additional climate change mitigation, coal reduction, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety and improvement of the building stock, increased value of the property.

[29] The loan size is estimated to be up to 20 million MNT, with a loan period of 30 months, and with annual interest rate of 8%. The main requirements and conditions of the loan is to have been employed or run a business for the last 6 months, no bad loan history, and movable and immovable property pledged as collateral.

Main indicators	→ Number of renovated buildings → Heat energy consumption in each building (kWh/m^2 year) before and after → New RES capacity installed (MW) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Annual monitoring of this activity is mandatory to assess the success rate, main challenges, and barriers.
Good practice examples	The problem regarding energy efficiency and air pollution in Ger district is quite unique of Mongolia and UB. Therefore, there are not clear good practice example to learn from other countries and cities.

10.10 Up-scaling single-family buildings renovation programme in Ger districts

Issue	Description
Objective	This action supports the achievement of: → objective #11: Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 22% (to the average level of 550 kWh/m² year) by 2030 → objective #12: Ulaanbaatar will reach mid-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 30% by 2030 → objective #15: Ulaanbaatar will strive to introduce renovation of private buildings in Ger districts and reduction of their energy consumption by 50% (to the average level of 350 kWh/m² year) by 2040 → objective #16: Ulaanbaatar will reach long-term emission reduction targets of CO_2, PM, CO and SO_2 emissions: average reduction of 60% by 2040
Background information	The implementation of the pilot project with the renovation of 100 single family buildings will allow all involved stakeholders to learn the process, perform and deliver (10.9). In other to reach the expected objectives the experience learned in the pilot project must be replicated with continuity. In this phase continuity will be the key, to keep build up capacities operating and delivering. The greatest challenge in up-scaling is to both secure funding and pipeline of projects. It will be important for UB to ensure proper process standardisation, good integration of the lesson learned from the pilot project and setting fruitful cooperation with financial institutions.
Timeline	Implementation from 2026-2040
What are the main steps to start the measure	→ Based on the lesson learned from the pilot project (10.9) the programme will be reviewed and improved. This review will be carried out in concertation with the main stakeholders of the programme (inhabitants, brigades, energy auditors, etc.) → Revision/trenching of the support programme for upscaling in planning periods (3-5 years) → Review of norms and regulations for the support programme and review of the programme management and implementation manual. → Application for funding, assistance in the discussions with the financing institutions (depending from the type of programme) → Continuous assessment of the capacity of the construction sector → Assistance in the organisation of the renovation process → Implementation, monitoring and continuous update of actions
Responsibilities and roles	→ Task Force 4 – overlooking implementation of the planned measures → Mayor's office of Ulaanbaatar city – responsible for implementation of the action; agreement with all involved parties; achievement of the results; development and approval of the necessary regulations; attracting foreign donors (if necessary)

Responsibilities and roles	→ Main stakeholders like GERES, NGOs, local citizen groups – consultations, assistance in implementation, feedback, and further improvement of the renovation programme → University – responsible for organisation of the trainings for specialists, brigades, energy auditors etc.
Approximate costs and payback	Investments will depend on budget allocation from the support programme and available loans for the households. UB in cooperation with Ministry of Construction and Urban Development / Ministry of Environment and Tourism will closely follow the construction market and the renovation process to estimate the best value of the support. To reach the objectives in this sector in total about 3.2 million m² of single-family houses shall be renovated by 2040. This will bring down current overall specific energy consumption to the target value of 350kWh/m² year. The renovation of 3.2 million m² will require about €300m investment in renovation projects. Depending on the final structure of the support programme for up scaling the programme the City of Ulaanbaatar shall plan €150m. These funds for example can be used to: → cover the development costs of a renovation project (energy audits, design), → to include a grant component → to cover guarantees for soft loans instrument, → to cover a tax rebate mechanism
Potential funding source	Homeowners of single-family houses in Ger districts, loans to homeowners from financial institutions, UB budget, national budget, international donors, and financial instruments established to finance the programme.
Technical information	Renovation of the single-family buildings in Ger areas will reduce the energy consumption in average from 30% (in case of simple energy efficiency measures) till 70%. The total amount of time for one household to go through the process is averaged to be around 15 days, as some process is carried out simultaneously. This amount of time can vary depending on the availability of craftsman.
Environmental impact	Mainly health benefits and additional climate change mitigation, coal reduction, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety and improvement of the building stock, increased value of the property.
Main indicators	→ Number of renovated buildings → Heat energy consumption in each building (kWh/m² year) before and after → New RES capacity installed (MW) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Annual monitoring of this activity is mandatory to assess the success rate, main challenges, and barriers.
Good practice examples	See 10.9

10.11 Energy meters programme for multifamily buildings

Issue	Description
Objective	This action supports the achievement of: → objective #2: Ulaanbaatar will initiate energy billing based on metered data in multifamily buildings by 2024, → objective #9: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 5% by 2030, → objective #13: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 15% by 2040, and → objectives related to air quality improvements.
Background information	Currently billing on thermal energy in MFBs is based on calculated consumption and not on metered energy. There are 1773 multifamily buildings with no heat energy meters. This means that nobody (residents, district heating companies, municipality etc.) exactly "knows" the real consumption for each building and further discussion on energy efficiency and associated air pollution is therefore rather baseless. Researches have proved that only conscious and informed consumers can impact energy consumption and act further towards building renovation. For sustainable financial institution (like Green Funds) the quantification of energy savings or emission reduction is an essential element.
Timeline	Short term action to be implemented until the end of 2024
What are the main steps to start the measure	→ Local regulation for switching to energy billing based on metered energy → Agreement with district heating companies → Selection of two pilot districts: one where energy meters in MFBs will be installed and other – where heat substations will be installed → Preparation of business plan for pilot district → Attraction of necessary funding (local, national or donor) → Implementation of the pilot project → Planning and implementation in other districts → Monitoring and publication of heat energy consumption of MFBs on the website of district heating companies or municipality
Responsibilities and roles	→ Task Force 2 – overlooking implementation of the planned measures → Energy Regulation Commission – responsible for implementation of the action; agreement with all involved parties; achievement of the results → Mayor's office of UB – support to all involved parties; development and approval of the necessary regulations; attracting foreign donors (if necessary) → District heating companies – responsible for installation of calibrated heat meters in buildings connected to their networks

Approximate costs and payback	Considering the costs of one heat energy meter (including installation) in the range of 300 to 1500€ (depending from required flow rate/size of the building), the total investment for all multifamily buildings is calculate in the range of €1m. The costs to modernise heat substation depends on the technical solution and size of the building. The cost can range from 3000-12000 EUR per building. The payback of the installation of heat meters is typically below 3 years. The payback for heat substations is estimated in 5-6 years (considering cost recovery tariff have been introduced).
Potential funding source	District heating companies recovering investment cost in the heating tariff and financed with loan from a financial institution, UB budget, national budget and/or international donors.
Technical information	Installation of heat meters and heat substations is one of the low-cost measures with good payback as modernisation of the heat substations will ensure average energy savings of at least 5-15%. This measure is also one of the first measure implemented in the modernisation of district heating systems.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety, and improvement of the building stock.
Main indicators	→ Number of heat meters and heat substations installed. → Heat energy consumption in each MFB (kWh/m^2 year)
Monitoring	The activities should be monitored on yearly basis. If necessary, also on quarterly basis.
Good practice examples	The issue on lack of modernised heat substations and/or possibility to regulate heat demand in the buildings has faced and addressed most of the European municipalities, especially in East European countries. There have been different approaches, mainly with different financial and technical solutions.

10.12 Development of multifamily buildings renovation programme

Issue	Description
Objective	This action supports the achievement of: → objective #9: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 5% by 2030, → objective #13: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 15% by 2040, and → objectives related to air quality improvements.
Background information	There are more than 1700 multifamily buildings in UB. Most of them were built 30-40 years ago and have not undergone any major renovation or overhauling maintenance project. After more than 30 years of operation, the internal engineering networks are at the end of their technical lifetime and elements of the building envelop do not comply with modern buildings codes. To start a building refurbishment programme to ensure affordable and qualitative housing for the inhabitants of UB is an important long-term policy. One of the main challenges in this respect is to understand how the financing of such refurbishment programme could be organised and a successful programme framed. Currently, existing heat tariffs are too low to motivate homeowner to invest in energy efficiency measures. Moreover, energy consumption in multifamily buildings is currently based on calculation methodologies rather than on metered energy data, with possible unclear split of benefits from the implementation of energy efficiency measures. Buildings renovation including energy efficiency measure in UB is an asset conservation and enhancement programme; with consistent energy savings. UB is a city in expansion with demand for affordable and qualitative housing; keeping the existing building stock in proper operation is a priority and a need to accommodate the growing population of the City. The renovation programme shall be designed to support: → energy efficiency measures (renovation of the space heating system, ventilation system, domestic hot water system, comprehensive improvements of the building envelope, etc.), → Structural measures (ranging from fixing building structural elements to seismic upgrades) → Aesthetical measures to repairs areas affected from the implementation of energy efficiency measures, staircases, sidewalks, etc. Against this background, it is important that UB works together with the main stakeholders, especially Ministry of Construction and Urban Development to assess alternatives and implement solutions towards renovation of the existing housing stock. Probably, it will not be enough to provide only support; a set of requirements and obligations will also be needed in parallel with solutions to support the most vulnerable groups of the population.

Background information	Once UB and/or Ministry of Construction and Urban Development will create and introduce a programme for the renovation of multifamily building, this will be tested on pilot project. There are different options how buildings for the pilot project could be selected, e.g. based on mandatory requirement for large consumers or voluntary with higher support rate or even combination of both and any other aspects. Implementation of the pilot project will allow all stakeholders to assess the efficiency of all the steps, main challenges, and barriers to prepare for market upscaling (see action 10.14).
Timeline	→ Detail planning of the programme from 2021 to 2023; → Pilot project from 2023 to 2028 → Up scaling the programme 2028-2040
What are the main steps to start the measure	→ Evaluation and development of an effective support programme for multifamily building renovation (in cooperation with government, foreign donors, financial institutions, and relevant stakeholders). Discussion of the support programme with the main stakeholders and public, → Development of norms and regulations for the support programme and development of a programme management and implementation manual. This is an example of aspects to cover: ▸ List of eligibility criteria and requirements to apply to the programme, ▸ Necessary quorum and positive number of votes of homeowners to participate and apply to the programme, ▸ Set of mandatory energy efficiency measures and minimum quality standards ▸ Documentation for application (forms, energy audit, structural survey, project design, etc.), ▸ Amount of the support and disbursement rules, ▸ Procurement guidelines for services and construction works under the programme ▸ Mandatory monitoring after renovation → Preparation of standardised templates for the whole renovation process to reduce bureaucratic burdens, including the development of an online platform for subproject management, → Setting-up a supportive structure in UB for residents of Multifamily buildings on energy efficiency and building renovation. Informative campaign for the renovation programme. To support volunteer club and information centre for residents; establish and run an information centre → Setting up the capital structure of the programme and rising needed funds for the programme → Trainings for: energy auditors, architects, project designer, intermediaries, construction companies, workers (the scope of the trainings and target groups will depend on the specific programme framework) → Implementation of pilot project to test the programme for 100 buildings (on average 25 buildings per year): ▸ Promotion of the programme and transparent selection of the pilot buildings

<table>
<tr><td></td><td>

Testing of the programme procedures and requirement
Involvement of the main stakeholders (inhabitants, maintenance companies etc.)
Assistance in the organisation of the renovation process, including participation in the meetings, procurement process etc.
Monitoring and setting up a proper inspection scheme to ensure compliance.

→ To further support this programme, the City of Ulaanbaatar will strive for the introduction of a national norms for the maximum consumption in multifamily buildings (with revision each 2 years).
</td></tr>
<tr><td>Responsibilities and roles</td><td>
→ Task Force 3 – overlooking implementation of the planned measures
→ Mayor's office of Ulaanbaatar city – responsible for implementation of the action; agreement with all involved parties; achievement of the results; development and approval of the necessary regulations; attracting foreign donors (if necessary)
→ Ministry of Construction and Urban Development – support in development and approval of the necessary regulations and in creation of the refurbishment programme
→ University – responsible for organisation of the trainings
→ Supportive structure in UB for residents – responsible for assistance to inhabitants in the whole renovation process
→ Maintenance companies – responsible for communication with homeowners
</td></tr>
<tr><td>Approximate costs and payback</td><td>
The costs for the renovation of a multifamily building vary between 80 and 120 €/m² depending from the scope of the works and conditions of the buildings. For example, these are the costs estimated for a building of 3000m²:
<table>
<tr><th colspan="2">Description</th><th>Costs excluding VAT</th><th>Costs including VAT</th></tr>
<tr><td>Construction costs for energy efficiency measures</td><td>94.0 €/m²</td><td>282,000</td><td>310,200</td></tr>
<tr><td>Construction costs for aesthetical and structural measures</td><td>6.0 €/m²</td><td>18,000</td><td>19,800</td></tr>
<tr><td>Project development costs (energy audit, technical studies, design)</td><td>10%
10.0 €/m²</td><td>30,000</td><td>33,000</td></tr>
<tr><td>Management and supervision of construction site</td><td>4%
4.0 €/m²</td><td>12,000.0</td><td>13,200</td></tr>
<tr><td>Unforeseen costs for construction and risk margin</td><td>3%
3.0 €/m²</td><td>9,000</td><td>9,900</td></tr>
<tr><td>Total construction costs</td><td>117.0 €/m²</td><td>351,000</td><td>386,100</td></tr>
</table>
With the current heat tariff, the payback of energy efficiency projects is far above 100 years. Therefore, it is crucial that actions 10.7 and 10.13 are implemented, while developing a programme for the renovation of multifamily buildings.
</td></tr>
</table>

Approximate costs and payback	As part of a programme for multifamily house renovation, the City of Ulaanbaatar could set up a support mechanism (or strive to work with the central government for a national programme) as an incentive for homeowners to renovate their buildings. This can be set up as a soft loan programme plus a grant component to make building renovation projects affordable to homeowners. The development of the programme may require EUR 100,000 to 150,000. The renovation of 100 buildings in the pilot project will trigger about €35.4m investments. Depending from the final structure of the support programme, for this pilot phase, the City of Ulaanbaatar shall plan €17.7m. These funds for example can be used to: → cover the development costs of a renovation project (energy audits, structural survey, project design…), → to include a grant component, → to cover guarantees for soft loans instruments, → to cover a tax rebate mechanism.
Potential funding source	Homeowners of multifamily houses, loans to homeowners from financial institutions, UB budget, national budget, international donors, and financial instruments established to finance the programme
Technical information	omprehensive renovation of multifamily buildings will reduce heat energy consumption at least 50%. It is important to keep a comprehensive approach to ensure that energy savings are archived at the expected level; remembering the measure improving the thermal characteristics of the building envelop can perform only if the space heating systems can be regulated and fine-tuned.
Environmental impact	Mainly health benefits and additional climate change mitigation, coal reduction, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety and improvement of the building stock, increased value of the property.
Main indicators	→ Number of renovated buildings → Heat energy consumption in each building (kWh/m_2 year) before and after → New RES capacity installed (MW) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Annual monitoring of this activity is mandatory to assess the success rate, main challenges, and barriers.
Good practice examples	Most often multifamily building refurbishment programmes are developed at national level, like for European Union countries. In parallel with national programmes, regional and local government may develop their own specific support programmes. Programmes developed in Europe in the last ten years have been mostly based on direct investment grants, with eventually options for soft loans. In recent years there as been an effort from the European commission to reduce grant intensities in favour of more structured financial instruments, with the intent to increase private investment in the sector. The design of a programme must consider the requirement of the financial institution which will be involved in financing; this is particularly relevant if UB will attract funding from international donors and financial institutions.

10.13 Up-scaling multifamily buildings renovation programme

Issue	Description
Objective	This action supports the achievement of: → objective #9: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 5% by 2030, → objective #13: Ulaanbaatar will strive to introduce renovation of multifamily buildings and reduction of their energy consumption by 15% by 2040, and → objectives related to air quality improvements.
Background information	The implementation of the pilot project with the renovation of 100 multifamily buildings will allow all involved stakeholders to learn the process, perform and deliver (10.12). In other to reach the expected objectives the experience learned in the pilot project must be replicated with continuity. In this phase continuity will be the key, to keep build up capacities operating and delivering. The greatest challenge in up-scaling is to both secure funding and pipeline of projects. It will be important for UB to ensure proper process standardisation, good integration of the lesson learned from the pilot project and setting fruitful cooperation with financial institutions.
Timeline	Implementation from 2028-2040
What are the main steps to start the measure	→ Based on the lesson learned from the pilot project (10.12) the programme will be reviewed and improved. This review will be carried out in concertation with the main stakeholders of the programme (inhabitants, maintenance companies etc.). → Revision/trenching of the support programme for upscaling in planning periods (3-5 years) → Review of norms and regulations for the support programme and review of the programme management and implementation manual. → Application for funding, assistance in the discussions with the financing institutions (depending from the type of programme) → Continuous assessment of the capacity of the construction sector → Assistance in the organisation of the renovation process, including participation in the meetings, procurement process etc. → Implementation, monitoring and continuous update of actions
Responsibilities and roles	→ Task Force 3 – overlooking implementation of the planned action → Mayor's office of UB – responsible for implementation of the action; approval of the selected buildings; achievement of results; attracting foreign donors (if necessary) → Supportive structure in UB for residents – responsible for assistance to inhabitants in the whole renovation process → Maintenance companies – responsible for supervision of the implementation of the renovation projects

Approximate costs and payback	The objective is to renovate multifamily buildings and to reduce current energy consumption by 5% by 2030 and by 15% by 2040. Reaching these objectives translates in the comprehensive renovation of about 30% of the existing stock of multifamily buildings (about 1.65 million m^2). At current cost of renovation this programme will trigger about €192.8m investments. Depending from the final structure of the support programme, the City of Ulaanbaatar shall plan to secure €96.4m. These funds for example can be used to: → cover the development costs of a renovation project (energy audits, structural survey, project design…), → to include a grant component, → to cover guarantees for soft loans instruments, → to cover a tax rebate mechanism.
Potential funding source	Homeowners of multifamily houses, loans to homeowners from financial institutions, UB budget, national budget, international donors, and financial instruments established to finance the programme.
Technical information	Comprehensive renovation of multifamily buildings will reduce heat energy consumption at least 50%. It is important to keep a comprehensive approach to ensure that energy savings are archived at the expected level; remembering the measure improving the thermal characteristics of the building envelop can perform only if the space heating systems can be regulated and fine-tuned.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, indoor comfort, and quality of live, poverty reduction, safety and improvement of the public building stock, increased value of the property.
Main indicators	→ Number of renovated buildings → Heat energy consumption in each building (kWh/m^2 year) before and after → New RES capacity installed (MW) → CO_2 emissions avoided (tCO_2/year) → PM emissions avoided (ppm/year)
Monitoring	Annual monitoring of this activity is mandatory to assess the success rate, main challenges, and barriers.
Good practice examples	See 10.12

10.14 Energy meters programme for multifamily buildings

Issue	Description
Objective	This action supports the achievement of: → objective #8: Ulaanbaatar will introduce norms for new building mandatory (if technically possible) connection to centralised energy sources, and → objectives related to air quality improvements.
Background information	There is a high rate of new construction in UB; and more is expected for accommodating the growing population of the City. However, there are no clear obligations for new buildings to connect to existing district heating networks. New stoves or decentralised boilers are new sources of local emissions and pollution. Municipalities like UB can control this aspect by introducing urban planning norms and limit air pollution. In the meantime, in some districts, district heating systems lack capacities.
Timeline	Preparation phase in 2021-2022; control until 2040
What are the main steps to start the measure	→ The implementation of this action goes in parallel with the development, refurbishment, and modernisation of the district heating system of Ulaanbaatar. Inventory and mapping district heating network availability (capacities, networks, efficiencies, losses etc.) and options for connecting new consumers are the first important steps. This mapping shall also be carried out considering the energy efficiency programmes introduced in this Local Energy Efficiency Action Plan (renovation of public buildings and multifamily buildings) which will reduce heating demand. → Discussions with the main stakeholders on how to introduce new norm in the most efficient manner. → Creation of regulation on air quality, in which districts connection to district or local heating system is mandatory → Creation of the checklist and guidance document for new developers, district and local heating companies and institutions issuing permits → Introduction of the new norm and trainings for the institutions issuing permits → Control of the implementation of the new norm → Revision of the norms each three years.
Responsibilities and roles	→ Task Force 2 – overlooking implementation of the planned measures and taking supportive and/or corrective actions; organisation of the discussions with relevant stakeholders → Mayor's office of Ulaanbaatar city – responsible for implementation of the action; agreement with all involved parties; development and approval of the necessary local regulations → District and/or local heating companies – implementing the new norm

Approximate costs and payback	For a study for mapping and an preparing an inventory of the district heating and heating sources in Ulaanbaatar a budget of €80,000-100000 shall be planned, including the use of GIS (geographic information system for capturing, storing, checking, and displaying data related to district heating, heat density, heating sources and consumers on Ulaanbaatar's surface). The actual cost of connecting new consumers to the district heating grid shall then be generally covered by project developers Prices to bring district heating, but also mains electricity, gas, telephone, water and drainage to a site will vary enormously, depending on the location and existing services, and the results will confirm whether a plot is more or less financially viable. For large new green field development, district heating companies and utilities may invest in extending the main grid/networks to border of the plot.
Potential funding source	Budget of district and/or local companies and/or developers of the new construction
Technical information	Installation of new district or local heating networks is cost efficient if certain consumption density per meter of the new network is ensured. In some of the European countries the threshold of heat density is around 2.5 MWh/ m^{30}. This means that it is cost efficient to install new pipelines if the heat consumption of the new consumer is not less than 2.5 MWh per meter of pipe to be installed. Heat density limit in UB should be also assessed and set in the local regulation.
Environmental impact	Positive impact on climate change. Can lead to improved air quality and improved health of residents. Current subsidies for energy can be shifted towards those in need. Improved social environment, i.e. social fairness among different energy user groups.
Main indicators	→ Number of buildings connected to district or local heating networks → Area of the new buildings, m^2 → New capacity connected to the district or local heating networks, MW → Length of new networks, m → CO_2 emissions avoided, tCO_2/year → PM emissions avoided, ppm/year → Number of new buildings (including area, installed capacity and fuel) that couldn't be connected to existing networks (with reasoning)
Monitoring	Monitoring of this action is done on annual basis. Local regulation and procedure should be revised if any obstacles in implementation are identified.
Good practice examples	The issue of air pollution in the cities is still acute worldwide and well acknowledged and addressed in most of the European largest cities. In most of these cities local regulations have been approved to limit local air pollution, including zoning area where new polluting activities cannot be installed.

10.15 Mandatory energy performance certificates and norms for new and renovated buildings

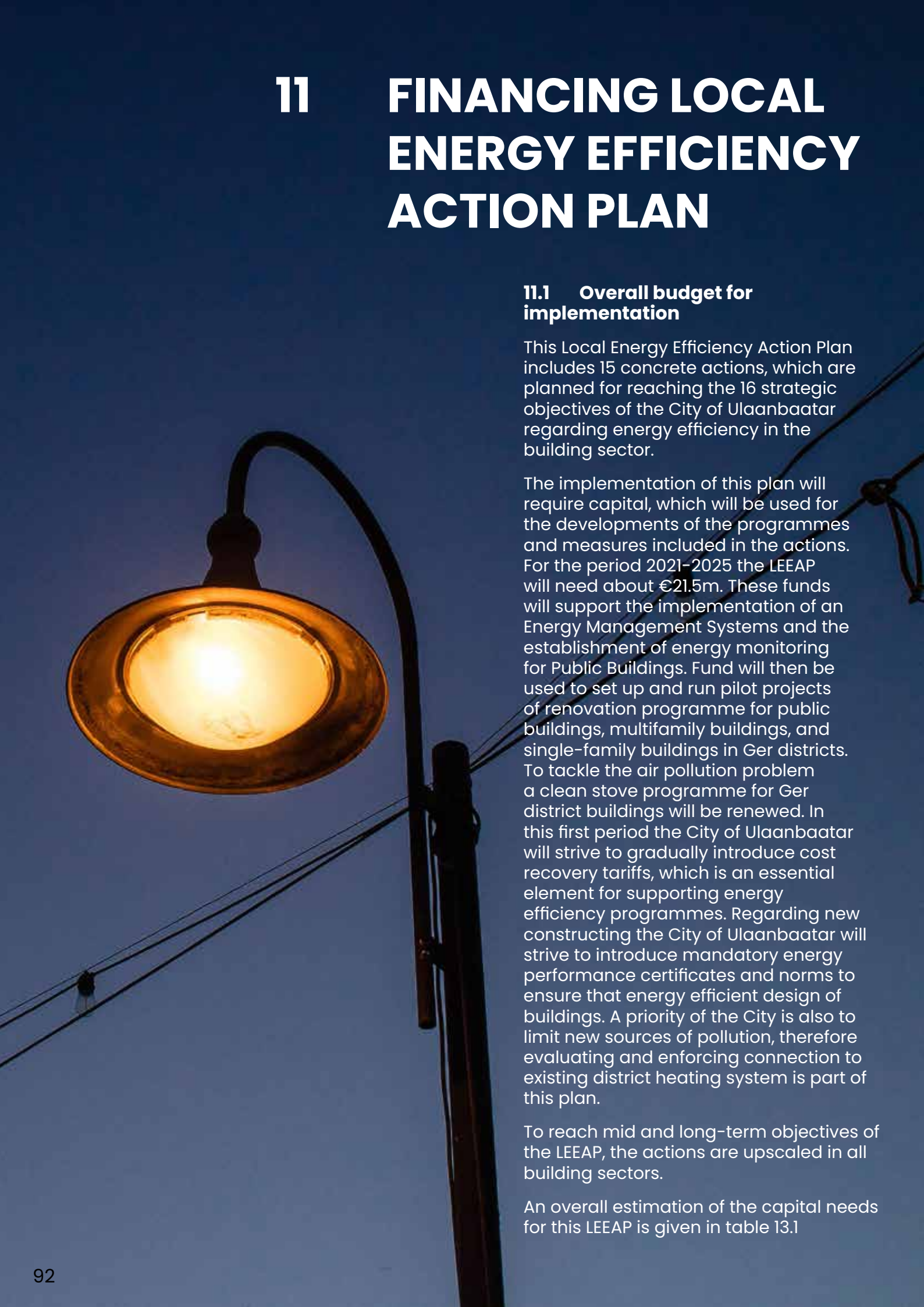
Issue	Description
Objective	This action supports the achievement of: → objective #4: Ulaanbaatar will introduce mandatory energy performance certificates for new buildings (integrated in building permit process), → objective #5: Ulaanbaatar will strive to update/enforce building code for energy efficiency requirements and → objectives related to air quality improvements and energy efficiency targets.
Background information	Currently energy audits and energy performance certificates (EPC) are mandatory only for designated consumers (i.e. consumers with very high annual energy consumption). According to the latest amendments, there are 64 public and 33 private organisations fulfilling national requirements (total area of more than 3000 m^2 and consumption above 300 kWh/m^2 year). In Ulaanbaatar, there seems to be a regulatory disjuncture in the construction sector as reflected by the escalating number of newly built curtain-wall / glass façade buildings. Such buildings inevitably suffer from extremely high winter heat loss and high summer heat gains, thereby, requiring supplemental heating and cooling; and, are highly energy inefficient. Owing to these characteristics, buildings are thermally inappropriate for Ulaanbaatar's extreme winter climate. However, they continue receiving construction permits and are being built because: → they reflect an international "modern" architectural style; → construction methods maximise the gross rentable floor area; → have a lower initial capital cost; and → employ lightweight building structural systems that can be constructed in a shorter time To address this issue, there is need to introduce and enforce legal norms for mandatory energy performance certificates for new and renovated buildings and then set limits for the energy consumption in these buildings. An energy performance certificate shall become compulsory whenever a property is built, sold or rented. All building owners must order an Energy Performance Certificate for potential buyers or tenants before marketing their properties to sell. An energy performance certificate shall include information about a property's energy use and typical energy costs; and recommendations about how to reduce energy usage. An EPC assigns the property an energy efficiency rating from most efficient (for example A) to the least efficient (for example F) and being valid for a maximum number of years. Based on EPC, a legal requirement for building owners and developers can be expressed as a minimum rating (for example C) that a building must reach.

Background information	Failures can be penalised with fines and request of remedy measures. This type of regulation may initially only apply for new construction and then be extended to different building sectors: → New school and kindergartens facilities build with high energy performance. → Renovation of existing schools and kindergartens to high energy performance standard. → New hospitals to meet city need build to high energy performance standards. → New high-rise developments that are connected to the city utility grid and build with high energy performance level. → Low rise developments that are connected to smaller local utility grids. → Renovation of existing multifamily building stock to increase its lifespan and reducing heat energy consumption of at least 40%.
Timeline	It is foreseen that the new norms in the national legislation will be introduced by 2021. Introduction and follow up of the norms in UB will start immediately once the new norms come in force and be followed by continuously in UB.
What are the main steps to start the measure	→ Update of the national legal norms to introduce mandatory energy performance certificates for new buildings and maximum limits of the heat and electricity energy consumption per m^2 → Simple and short guidelines for energy auditors, designers, clients, supervision authorities and construction companies regarding the introduction and control of the new norm → Introduction of the new norm in UB, including update of information given for designers, construction companies and all involved parties → Creation and operation of the database of energy audits for the new construction (could be combined with energy monitoring data base and control system) → Trainings of the energy auditors, architects, and property developers. Training to increase the number of skilled energy auditors and building professionals across the building design, operation and maintenance value chain should be organized → Update of the energy audit report templates (if necessary) → Mandatory energy consumption control system for the 3-5 years after commissioning of the building (can be combined with the energy monitoring of public buildings (see action 10.3)) → Creation of the penalty system.
Responsibilities and roles	→ Task Force 3 – overlooking implementation of the planned measures → Ministry of Construction and Urban Development – responsible for implementation of the action; agreement with all involved parties; achievement of the results → Mayor's office of UB – support to all involved parties; development and approval of the necessary regulations; monitoring of the new construction before and after commissioning

Approximate costs and payback	The total costs of the introduction of the action will be from 10000-15000 EUR. Implementation costs will depend based on the number of the new construction. Once UB implements the system it can be replicated nationwide.
Potential funding source	Ministry of Construction and Urban Development budget; UB budget and/or international donors; private sector; ESCOs
Technical information	It is unknown the energy consumption of the buildings recently commissioned. Due to the glazing energy consumption in the new office and housing buildings might be in average around 450-650 kWh/m^2 year. By introducing the new norms, it can be reduced at least by 20-30%.
Environmental impact	Mainly health benefits and additional climate change mitigation, CO_2 emission reduction, comfort, and quality of live, poverty reduction
Main indicators	→ Number of buildings commissioned annually → Specific energy consumption from energy performance certificate, kWh/m^2 year → Monitored specific energy consumption from energy performance certificate, kWh/m^2 year after commissioning based on real metered data in the building → Energy auditors, architects and property developers trained.
Monitoring	Annual monitoring of the results
Good practice examples	Such norm is introduced in all the 27 EU Member States based on the Energy Performance of Buildings Directive 2010/31/EU[31] and Energy Efficiency Directive 2012/27/EU[32]

[31] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0031&from=EN
[32] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012L0027&from=EN

11 FINANCING LOCAL ENERGY EFFICIENCY ACTION PLAN



11.1 Overall budget for implementation

This Local Energy Efficiency Action Plan includes 15 concrete actions, which are planned for reaching the 16 strategic objectives of the City of Ulaanbaatar regarding energy efficiency in the building sector.

The implementation of this plan will require capital, which will be used for the developments of the programmes and measures included in the actions. For the period 2021-2025 the LEEAP will need about €21.5m. These funds will support the implementation of an Energy Management Systems and the establishment of energy monitoring for Public Buildings. Fund will then be used to set up and run pilot projects of renovation programme for public buildings, multifamily buildings, and single-family buildings in Ger districts. To tackle the air pollution problem a clean stove programme for Ger district buildings will be renewed. In this first period the City of Ulaanbaatar will strive to gradually introduce cost recovery tariffs, which is an essential element for supporting energy efficiency programmes. Regarding new constructing the City of Ulaanbaatar will strive to introduce mandatory energy performance certificates and norms to ensure that energy efficient design of buildings. A priority of the City is also to limit new sources of pollution, therefore evaluating and enforcing connection to existing district heating system is part of this plan.

To reach mid and long-term objectives of the LEEAP, the actions are upscaled in all building sectors.

An overall estimation of the capital needs for this LEEAP is given in table 13.1

Table 11.1: overall budget for the City of Ulaanbaatar (figures in thousands €)

Actions	2021-2025	2026-2030	2031-2035	2036-2040
Energy management system in public buildings	20	-	-	-
Energy monitoring in public buildings	14	10	10	10
Heat substation programme in the public buildings	5,740	3,410	-	-
Development of public building renovation programme	6,700	26,670	-	-
Up-scaling public building renovation programme	-	36,070	102,680	118,150
Reform for full cost recovery tariffs	50	-	-	-
Clean stove programme in private buildings in Ger districts	3,380	31,670		
Clean stoves in the new single-family houses in Ger districts	460	3,840	-	-
Developing single family building renovation programme in Ger districts	480	-	-	-
Up-scaling single-family building renovation programme in Ger districts	-	4,210	38,230	107,560
Energy meters programme for multifamily buildings	1,000	-	-	-
Development of multifamily buildings renovation programme	3,610	14,090	-	-
Up-scaling multifamily buildings renovation programme	0	13,300	37,960	45,130
New building connection to centralized energy source	90	0	0	0
Mandatory energy performance certificates and norms for new and renovated buildings	20	0	0	0
TOTAL	21,564	133,270	178,880	270,850

11.2 Financing options

There are three basic popular types of investment delivery mechanisms for building renovation projects:

- Loan financing schemes and loan guarantee schemes. These operate either within the commercial banking system or as specialized development agencies or funds;
- Use of energy service companies (ESCOs), which are companies using energy performance contracting as part of the investment transactions in a building renovation project. Energy performance contracting (EPC) is a mechanism for organising the energy efficiency financing. The EPC involves an Energy Service Company (ESCO) which provides various services, such as finances and guaranteed energy savings. The remuneration of the ESCO depends on the achievement of the guaranteed savings. The ESCO stays involved in the measurement and verification process for the energy savings in the repayment period[33].
- Utility demand-side management (DSM) programmes. In DSM programs, energy distribution utilities organize all aspects of energy efficiency delivery, including financing, technical development, and interface with users.

It is also common to mix these mechanisms. Additionally, grants are popular support added to the programme to make the business case more attractive.

Grants and subsidies, tax incentives, and soft loans can support the establishment of new markets at its initial stages and provide liquidity and direct access to capital, which is otherwise difficult. This mechanism can also be specifically designed to aid to vulnerable groups and can be used in conjunction with other mechanisms. The intensity of the instrument should be high for building comprehensive renovations and in markets with low energy tariffs.

[33] Hilke and Ryan, 2012

12 MONITORING PROCESS OF THE LEEAP

Monitoring is an important part of the LEEAP commitment and allows the City of Ulaanbaatar to measure progress towards the targets and objectives of the LEEAP. Monitoring allows to track the impacts of actions (see chapter 10) and compare them against what is achieved.

Assessing and evaluating the implementation status of the LEEAP actions allows the City of Ulaanbaatar to verify if the respective action is performing well and to identify corrective measures in case the action does not deliver the expected results. Monitoring is also an important task to identify and better understand the barriers to the implementation of the LEEAP and determine possible causes of failure to the implement of any specific actions. In the meantime, monitoring gives the opportunity to identify best practices and share them with other relevant stakeholders and parties of the LEEAP. Monitoring can also bring to light new opportunities for further actions.

Monitoring energy consumption, indoor air quality, CO_2 emissions, implementation process of the measures enables the City of Ulaanbaatar to understand whether the City is on track to reach the LEEAP targets and also recognise any factors that affect the results, e.g. increase of population etc.

Monitoring of the LEEAP shall occur on regular basis and at least once every two years. The coordination of monitoring activities is ensured by the Working Group. Monitoring of the LEEAP can be divided in two main parts:

- → Monthly energy monitoring according to the energy management system and energy monitoring system (see actions 10.1 and 10.2);
- → monitoring of specific actions (see chapter 10) according to specific monitoring plans.

Data for the monitoring purposes should be provided by responsible stakeholders and identified parties. LEEAP monitoring will be ensured based on indicators in Tables 12.1-12.5. In these tables performance indicators of the energy management system are not included.

Table 12.1: General LEEAP implementation and supervision indicators

Performance indicator	Tendency / result	Responsibility	Baseline
Total electricity consumption in all buildings, GWh/year	Annually increasing	Working Group	Baseline to be selected once data from first year monitoring are available
Total heat consumption in all buildings, GWh/year	Annually increasing	Working Group	Baseline to be selected once data from first year monitoring are available
Specific energy consumption per capita, MWh/capita	Annually decreasing	Working Group	Baseline to be selected once data from first year monitoring are available
CO_2 emissions, tCO_2/year	Annually decreasing	Working Group	Based on the data in the Mongolian national Inventory report

Performance indicator	Tendency / result	Responsibility	Baseline
CO_2 emissions per capita, tCO_2/capita	Annually decreasing	Working Group	Based on the data in the Mongolian national Inventory report
Consumers heat tariffs	Balanced / Annually increasing	Task Force unit 2	In 2019 heating costs in average for: → Single family buildings in Ger districts are around 13-16 €/MWh; → MFBs – 3.51 €/MWh; → Public buildings 8 €/MWh
Total financing for implemented actions, MNT	Annually increasing	Working Group	0 MNT/year
Share of municipal budget for implemented actions, MNT and % of total	Annually increasing	Task Force unit 1	0 MNT/year
Share of national budget for implemented actions, MNT and % of total	Annually increasing	Working Group	0 MNT/year
Share of foreign donor budget for implemented actions, MNT and % of total	Annually increasing	Working Group	0 MNT/year
Share of private financing for implemented actions, MNT and % of total	Annually increasing	Working Group	0 MNT/year

Table 12.2: LEEAP implementation and supervision indicators for public buildings

Performance indicator	Tendency / result	Responsibility	Baseline
Implementation of the energy management system	Implemented; certified and annual surveillance audit	Task Force unit 1	No energy management system in place in 2020
Electricity consumption in public buildings, GWh/year	Annually decreasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available
Heat consumption in public buildings, GWh/year	Annually decreasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available
Specific heat consumption, kWh/m^2 year	Annually decreasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available

Performance indicator	Tendency / result	Responsibility	Baseline
Specific electricity consumption, kWh/m² year	Annually decreasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available
Trainings organised	Annually increasing	Task Force unit 1	At least 3 trainings a year
Persons trained	Annually increasing	Task Force unit 1	At least 500 employees
Number of buildings with refurbished heat substations	Annually increasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available
Number of renovated buildings	Annually increasing	Task Force unit 1	Baseline to be selected once data from first year monitoring are available
Specific heat consumption after building renovation, kWh/m² year	Annually decreasing	Task Force unit 1	150 kWh/m² year
Specific electricity consumption after building renovation, kWh/m² year	Annually decreasing	Task Force unit 1	50 kWh/m² year
Total financing for implemented actions in public buildings, MNT	Annually increasing	Working Group	0 MNT/year
Share of municipal budget for implemented actions, MNT and % of total	Annually increasing	Task Force unit 1	0 MNT/year
Share of foreign donor budget for implemented actions, MNT and % of total	Annually increasing	Task Force unit 1	0 MNT/year

Table 12.3: Implementation and supervision indicators for multifamily building

Performance indicator	Tendency / result	Responsibility	Baseline
Electricity consumption in multifamily buildings, GWh/year	Annually decreasing	Task Force unit 3	Currently estimated - 357 GWh/year (2016)
Heat consumption in multifamily buildings, GWh/year	Annually decreasing	Task Force unit 3	2201 GWh/year (2018)
Average specific heat consumption, kWh/m² year	Annually decreasing	Task Force unit 3	297 kWh/m² year
Average specific electricity consumption, kWh/m² year	Annually decreasing	Task Force unit 3	65 kWh/m² year
Number of buildings with energy meters	Annually increasing	Task Force unit 2	Currently 0. To be estimated in action 10.13.

Performance indicator	Tendency / result	Responsibility	Baseline
Number of buildings with refurbished heat substations	Annually increasing	Task Force unit 2	Currently 0. To be estimated in action 10.13.
Number of renovated multifamily buildings	Annually increasing	Task Force unit 3	Currently around 8. To be monitored in actions 10.15 and 10.16.
Average specific heat consumption after building renovation, kWh/m² year	Annually decreasing	Task Force unit 3	150 kWh/m² year
Total financing for implemented actions in multifamily buildings, MNT	Annually increasing	Task Force unit 3	0 MNT/year
Share of foreign donor budget for implemented actions, MNT and % of total	Annually increasing	Task Force unit 3	0 MNT/year
Share of private financing for implemented actions, MNT and % of total	Annually increasing	Task Force unit 3	0 MNT/year

Table 12.4: Implementation and supervision indicators for single family buildings in Ger districts

Performance indicator	Tendency / result	Responsibility	Baseline
Electricity consumption in single family buildings, GWh/year	Annually decreasing	Task Force unit 4	Currently estimated - 425 GWh/year (2016)
Heat consumption in single family buildings, GWh/year	Annually decreasing	Task Force unit 4	6600 GWh/year (2018)
Average specific heat consumption, kWh/m² year	Annually decreasing	Task Force unit 4	762 kWh/m² year
Average specific electricity consumption, kWh/m² year	Annually decreasing	Task Force unit 4	48 kWh/m² year
Number of households with clean stoves	Annually increasing	Task Force unit 4	54 000 households
Number of new households with clean stoves	Annually increasing	Task Force unit 4	Baseline to be selected once data from first year monitoring are available
Number of renovated single-family buildings	Annually increasing	Task Force unit 4	Currently around 100. To be monitored in actions 10.10, 10.11 and 10.12.
Average specific heat consumption after building renovation, kWh/m² year	Annually decreasing	Task Force unit 4	350 kWh/m² year

Total financing for implemented actions in single family buildings, MNT	Annually increasing	Task Force unit 4	Baseline to be selected once data from first year monitoring are available
Share of foreign donor budget for implemented actions, MNT and % of total	Annually increasing	Task Force unit 4	Baseline to be selected once data from first year monitoring are available
Share of private financing for implemented actions, MNT and % of total	Annually increasing	Task Force unit 4	Baseline to be selected once data from first year monitoring are available

Table 12.5: Implementation and supervision indicators for new construction

Performance indicator	Tendency / result	Responsibility	Baseline
Number of new constructed buildings	Annually increasing	Mayor's office of UB	Baseline to be selected once data from first year monitoring are available
Number of new constructed buildings connected to district heating	Annually increasing	Task Force unit 2	Baseline to be selected once data from first year monitoring are available
Number of new buildings with energy performance certificate	Annually increasing	Mayor's office of UB	0
Electricity consumption in the new buildings, GWh/ year	Annually increasing	Mayor's office of UB	Baseline to be selected once data from first year monitoring are available
Heat consumption in the new buildings, GWh/year	Annually increasing	Mayor's office of UB	Baseline to be selected once data from first year monitoring are available
Average specific heat consumption in new buildings, kWh/m^2 year	Annually decreasing	Mayor's office of UB	200 kWh/m^2 year
Average specific electricity consumption in new buildings, kWh/m^2 year	Annually decreasing	Mayor's office of UB	50 kWh/m^2 year

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