



Green City Action Plan for the City of Ulaanbaatar

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Turning Ulaanbaatar into a city where people really like to live

Green City Action Plan

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Acronyms

ADB	Asian Development Bank
AHURP	Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal Project
BAT	Best Available Technologies
CAPEX	Capital Expenditure
DEH	Direct Electric Heating System
EBRD	European Bank for Reconstruction and Development
ERC	Energy Regulatory Commission of Mongolia
GADIP	Ger Areas Development Investment Program
GCAP	Green City Action Plan
ICLEI	Local Governments for Sustainability
ITP	Industry and Technology Park
LDF	Local Development Fund
MNT	Mongolian tugrik
MUB	Municipality of Ulaanbaatar
NOSK	Capital City Housing Corporation, Ulaanbaatar
OECD	Organisation for Economic Co-operation and Development
OPEX	Operating Expenses
PSR	Pressure – State – Response
RES	Renewable Energy Sources
SO	Strategic Objective
SUMP	Sustainable Urban Mobility Plan
TTR	thermo-technical retrofitting
TUK	Mongolian waste management company
UB	Ulaanbaatar
USUG	Ulaanbaatar Water and Sewage Authority

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Executive Summary

Introduction

We have joined the **EBRD Green Cities framework** in order to build a better and more sustainable future for our City and its residents. The present strategic action plan (GCAP) is a key development milestone for Ulaanbaatar. The GCAP is a **compendium of implementable project ideas** aimed at improving the environmental conditions in the city and the social wellbeing of all its citizens. It concludes the findings of a thorough data collection and analysis of the quality of the environment and resumes a city environmental baseline which reveals the important environmental challenges for the city. These challenges have been prioritized through a technical analysis and stakeholder consultations and concrete actions were developed to address them. GCAP's outcomes provide a framework for future investments into a green and prosperous city.

Methodology insight

Throughout the development of the Green City Action Plan, we applied the methodology developed by OECD and ICLEI on behalf of EBRD. The methodology is based on a **Green City Pressure-State-Response (PSR)** framework, which identifies human activities that exert **pressures** on the urban environment in the transport, energy, building, industry, water, solid waste, and land-use and change its **state** in terms of environmental performance. It also identifies how society **responds** to these changes through general environmental, economic and sectoral policies, investments, and through changes in behaviour, thus affecting the pressures on environment by human activities.

The resulting set of PSR indicators show the extent of the pressures on the urban environment, the state of the environment and the efficiency or shortcomings of actions addressing these pressures. The benchmarking and prioritisation of PSR indicators allowed for identifying priority environmental challenges.

In parallel, relevant national and local policy documents and initiatives were collected and reviewed and response indicators were assessed, and linkages provided to the respective policy documents, plans and initiatives.

In the context of several competing challenges and responsibilities and a wealth of existing planning and policy documents, one could wonder about the utility of the GCAP. The plan tells the vision and story of how Ulaanbaatar can become greener as the citizens and stakeholders see it and at the same time relying on an objective baseline established through rigorous data collection. It stands out as it pulls together all existing knowledge combines these with international best practice and filters out priorities.

Building on what we already have, GCAP proposes **14 priority actions** with concrete targets, estimated costs, responsibilities and a stepwise approach for implementation of each measure. As many areas of the city need re-thinking and re-development, the actions are integrated and multi-purposes. They are chosen to maximize the positive environmental change in the city in the most urgent problem areas.

This tool helps us to work within the framework of our capacities focusing efforts and directing funds to where it is most needed and will bring the best results for our citizens.

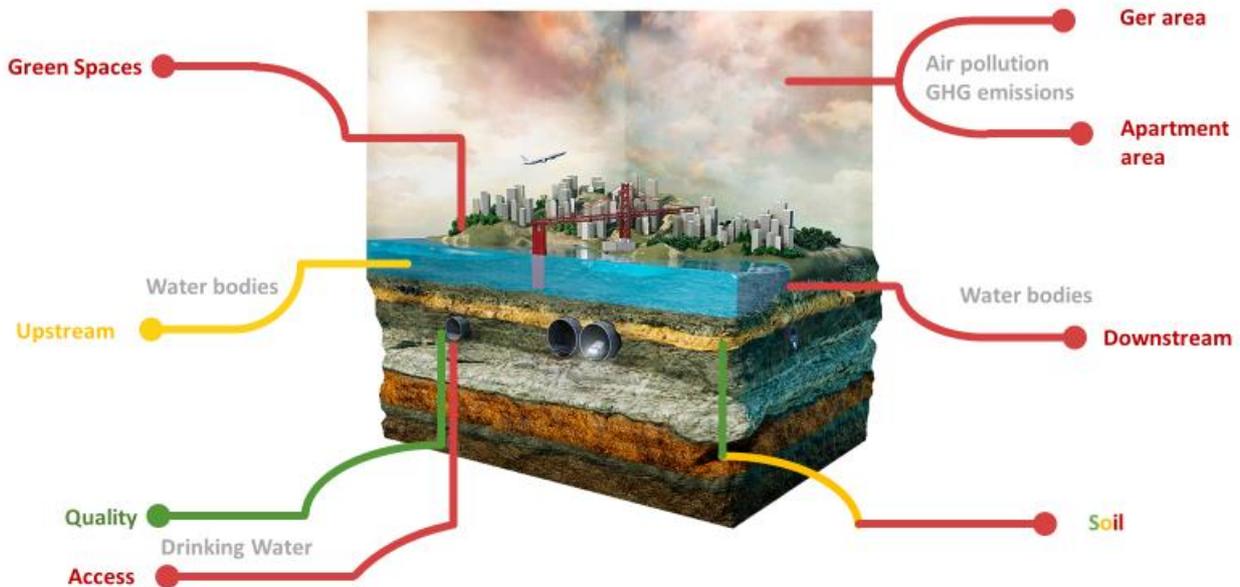
About Ulaanbaatar

Our city is the most populated administrative area in Mongolia with a population around 1,491.3 thousand persons as of 2018 (Mongolian National Statistical Office). In the last decade, the city's population growth significantly outpaced the national growth rate, generally attributed to inward migration from rural areas. UB's growth stands out not only for the population growth, but also for the substantial expansion of the city. The development pattern has divided the city in two distinctly different areas. The first is the formal or **urban central** area, consisting mainly of the large apartment blocks and public buildings. The second is the so called **Ger areas**, located around the city centre, characterized by their unplanned nature, lack of infrastructure, and limited utility services.

Priority environmental challenges

Given the available data and time series trends for the state indicators, coupled with expert knowledge of the local context, we have identified the following **priority environmental challenges** for the city:

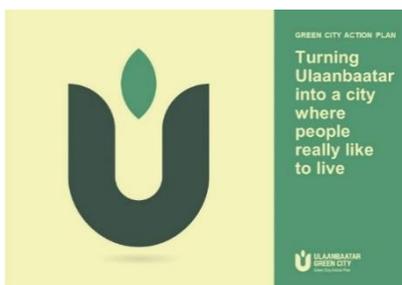
- **High level of air pollution**, caused by coal burning in Ger areas, the low energy performance of buildings, low efficiency of energy system in general and inefficient transportation;
- **Poor surface water quality**, due to poor sanitation infrastructure, industrial pollution and insufficient wastewater treatment;
- **High climate change impact**, due to energy intensive sectors such as buildings, coal-based energy generation, transport;
- **Scarce green spaces**, especially in the Ger area.



Priority pressures:

- Energy
- Buildings
- Land use

Ulaanbaatar Green City Vision



Our city is developing fast and we aim at turning it into a city where people really like to live in. This means that the city should provide opportunities for all citizens in order to fulfil their needs (economic, recreational, social, etc.) and to increase their level of satisfaction related to the standard of living. Our vision is referring to a balanced development for the city where we consider people as the central element. At the same time, we will take care that the environmental and socio-economic conditions will enable citizens enjoy at maximum their time spent in the city.

The green city stories and strategic objectives to address the identified challenges

When developing the GCAP, we had in view that the identified challenges ought to be tackled in an **integrated** manner, since the environmental and socio-economic issues that UB is facing are complex and in order to be able to solve them, we need to have multi-purpose interventions and actions that contribute to more than one challenge.

There are **4 recurrent ‘stories’** being told in UB, which incorporate all or some of the issues presented: the story of air quality, the story of climate change, the story of climate resilience and the story of how to have a happy city.

(1) The story of air quality in Ulaanbaatar



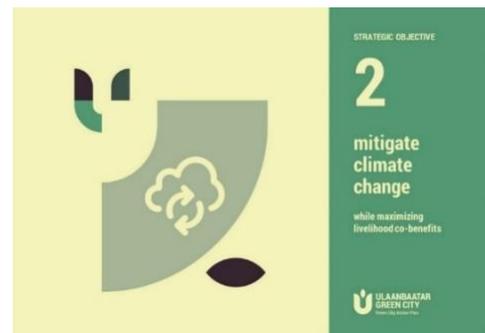
Air quality is the number one environmental problem in Ulaanbaatar and a serious threat to public health. The most important pressures causing and aggravating this problem are the **inefficient energy system** in the city; **burning of raw coal** as a source of heat in the Ger areas and in the 3 coal based thermal power plants, combined **high energy consumption** due to climate and **low energy performance of buildings**.

The story of air quality also includes **heavy traffic congestion**, **open burning of waste** and **poor standards regarding fuel**.

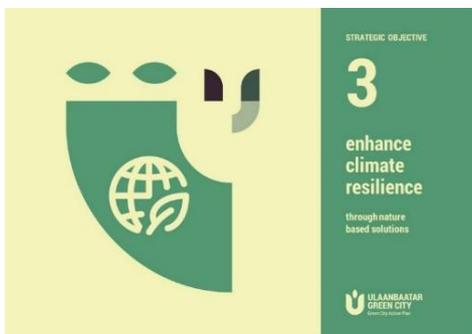
(2) The story of climate change impacts intertwined with livelihood issues

The causes of climate change impacts are almost entirely congruent with the air pollution causes. Nevertheless, the impact of climate change deserves separate attention in the context of Ulaanbaatar. **Inefficient coal-based heat and power generation** has a high GHG emission impact. The losses in energy distribution and the lack of demand-side energy efficiency are significant contributors too.

Climate change impacts are worsened by traffic congestion, low fuel quality sold on the market due to non-compliance with fuel quality standards. The lack of adequate waste management leads to methane generation at landfills, but also to black carbon emissions due to the open burning of waste mixed with hot ashes from coal-based heating in the Ger area.



(3) The story of climate resilience



Ulaanbaatar is a city located in a water scarce environment, yet regularly facing severe **flooding**. Future climate projections indicate that this situation is only going to intensify, as there will be fewer, but more extreme rain and storm events. Meanwhile, people living in Ger areas are most vulnerable to these climate extremes, as they live in ground-level houses/gers (yurts) with lack of access to water supply and sewerage. **Lack of access to drinking water and sanitation** is currently tackled on a limited scale, with a view of immediate relief, without a longer-term vision in place.

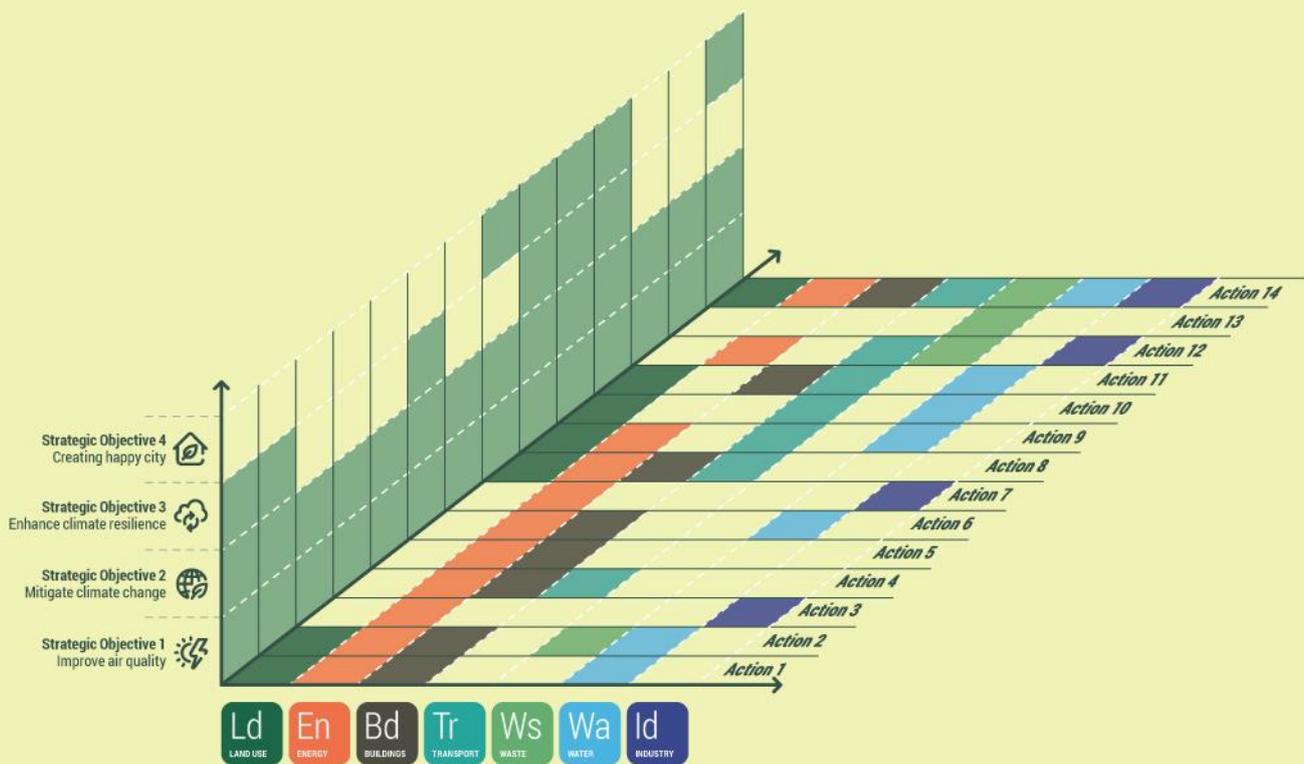
(4) The story of how to have a happy city

The current level of urban development in Ulaanbaatar shows major differences between **Ger areas** and the **city centre area**. There are socio-economic disparities between the two areas of the city that add to the causes of the dissatisfaction of citizens. This is mostly visible in relation to the accessibility of services and **public transportation**, existence and maintenance of green infrastructure and **waste management**.



The strategy for reaching these objectives is reflected in the proposed 14 actions, which are **multi-purpose, inter-sectorial**, meaning that each of them is referring to more than one sector and contributes to more than one strategic objective.

GCAP actions with cost estimates



GCAP Actions	CAPEX (USD)	OPEX (USD)
1. Develop green affordable housing in Ger areas	275,645,500	2,306,000
2. Develop infrastructure in Ger area	16,230,000	35,000
3. Modernize district heating	66,750,000	670,000
4. Implement cross-sectorial green energy solutions	40,930,000	475,000

5. Energy Efficiency in buildings	42,900,000	
6. Water availability and efficiency	17,850,000	160,000
7. Pollution control	6,909,600	400,000
8. Sustainable Urban Mobility for Ulaanbaatar, with focus on public transport system	106,850,000	320,000
9. Urban safety and accessibility	2,650,000	650,000
10. Develop multipurpose green areas in the city	65,150,000	1,060,000
11. Piloting nature-based solutions towards a climate resilient 'sponge city'	13,950,000	30,000
12. Waste collection in Ger areas with source separation of ashes	30,105,000	9,230,000
13. Improve secondary waste collection, transfer and disposal	15,756,000	5,790,000
14. Recycling, industrial symbiosis and circular economy initiatives	11,050,000	810,000
Total	712,726,100	21,936,000

The first two actions are focusing on Ger areas and are referring to development of green affordable housing (Action 1) and the associated infrastructure for energy, district heating, water, sewerage (Action 2). The measures are correlated with the current initiatives and built upon the lessons learnt so far in the Ger redevelopment process. We are aiming at improving the living conditions in all Ger areas by constructing new housing units (both apartments and multi-family detached housing units) and provision of social housing for persons that cannot afford to buy/lease a new housing unit. Also, these two actions are aiming at modernising the heating system in the Ger areas via the provision of alternative heating solutions, thus contributing also to the reduction of air pollution generated by raw coal burning. Beside these, we will tackle the sanitation aspects and focus our interventions towards encouraging dry toilets and septic tanks usage and rainwater harvesting. We will concentrate our attention towards analysing the potential of utilization of renewable energy sources and power storage capacities in the Ger areas.

The next three actions are focusing on energy aspects and are aiming at improving the **district heating system (Action 3)**, implementing **cross-sectorial green energy solutions (Action 4)** and increasing the **energy efficiency in public and private buildings (Action 5)**. Complementary to these actions, we have included in the GCAP a dedicated action focused on industry which refers to the enforcement of **pollution control systems (Action 7)**. These will contribute to reducing the level of air pollutants generated by industrial activities.

One of the key aspects tackled within the GCAP actions is related to water and water scarcity. It is well known that Ulaanbaatar is facing major water challenges. Thus, we have included in the current GCAP a dedicated action on **water availability and efficiency (Action 6)** and two complementary actions related to the development of **multipurpose green areas in the city (Action 10)** and piloting nature-based solutions towards a climate resilient '**sponge city**' (Action 11). All these actions are focusing on solutions for increasing the resilience of the city in front of water scarcity issues.

Transport and especially public transport are one of the major challenges of any city. It is also one of the sectors included in the Green City framework approach. Thus, two dedicated actions have been developed in our GCAP. The first is focusing on improving the public transport system of the city via the development of the **Sustainable Urban Mobility Plan for Ulaanbaatar (Action 8)**. This action includes measures that are aiming at renewing the bus fleet and developing a mass transit system (BRT/metro), and specifically transfer terminals. The second action is focusing on **urban safety (Action 9)** and on the increase of the overall accessibility of citizens in the city perimeter via a clear parking policy and improvements made for pedestrian sidewalks.

The last three GCAP actions are dedicated actions for improving the waste management system within our city. All three actions are to be considered together and are interlinked. The first one is dedicated to waste management in Ger areas with an emphasis on the **waste collection system with source separation of ashes (Action 12)**. The next action is focusing on the **secondary waste collection, transfer and disposal (Action 13)** within the entire city, while the last action is dedicated to **recycling, industrial symbiosis and circular economy initiatives (Action 14)**.

Introduction

Background/context

Cities are dynamic and vital parts of society and are the main engines of social, economic and technological development. According to the UN, around half of the world's population now lives in urban areas and by 2030 this is likely to exceed 60 per cent of the global population.

In order to provide their population with the myriad of demanded services, cities need inputs of large quantities of resources. As such, cities are a source of significant environmental impacts. For example, research indicates that cities already account for up to 70 per cent of energy use and 80 per cent of greenhouse gas emissions, figures which are set to rise over time. Major environmental concerns in Ulaanbaatar as well as are focused around the quality of air and traffic congestion to pressure on limited green space, land and water resources. Urban activities deeply affect the environment and the overall quality of life of our citizens.

At the same time, cities offer opportunities for innovation for sustainable development. Increasingly, our local government and citizens work together recognizing that our future well-being depends on our ability to transform Ulaanbaatar into a green city. This thinking is also in line with the UN's 2030 Agenda for Sustainable Development and the Sustainable Development Goals (UN 2015) and particularly Goal 11 calling for governments to make cities and human settlements inclusive, safe, resilient and sustainable.

Our city faces environmental challenges resulted from human activity in the urban development sectors. Air quality is the number one environmental problem in Ulaanbaatar and a serious threat to public health. The most important pressure causing and aggravating this challenge are the inefficient heat generation in the city's 3 coal based thermal power plants and the burning of raw coal as a source of heat in the Ger areas of the city. Lack of investment and use of poor-quality building material has led to an outdated building stock and low energy efficiency; old public and private means of transportation and low quality of fuel; poor waste management system due to very low waste collection fees; etc. Recently, measures have already been implemented or are being implemented in order to address these challenges, such as: development of Bus Rapid Transport system in order to reduce the traffic congestion; renewal of the city bus fleet; creating green housing units that are energy efficient by redeveloping 100 hectare of Ger areas into eco-districts that are both low-carbon and climate resilient; rehabilitation of district heating network; rehabilitation of the water operations and wastewater treatment technology; etc.

Further action is needed to improve the environment and increase the quality of life in Ulaanbaatar in a systematic way. In this context, the City of Ulaanbaatar has developed the Green City Action Plan (GCAP) in cooperation with the EBRD. The Methodology for the development of the GCAP, prepared with OECD and ICLEI is meant to guide our City through four main steps – from establishing a Green City Baseline, developing a Green City Action Plan, all the way through implementation and reporting on progress and outcomes.

Purpose of the GCAP

The present document is a strategic action plan for the City of Ulaanbaatar, which provides a framework for future investments into a green and prosperous city. The GCAP is a compendium of implementable project ideas that contribute to improving the environmental conditions in the city and the social wellbeing of citizens. Via this document, we aim at attracting the attention of the potential donors and investors in order to be able to develop mutually beneficial investment projects.

It concludes the findings of a thorough data collection and analysis of the quality of the environment and resumes a city environmental baseline which reveals the important environmental challenges for the city. These challenges have been prioritized through a technical analysis and stakeholder consultations, then concrete actions were developed to address them. More details regarding the methodology process are provided in Chapter 1.

By presenting these actions in a concise and visual manner, we hope to induce the readers' imagination and make them envisage a city with proper air and water quality, sustainable industry and infrastructure and welcoming green areas.

The implementation plan included in this GCAP suggests that, if followed with determination, the GCAP is feasible and would ultimately result in Ulaanbaatar becoming a green city where people really like to live.

Structure of the document

When developing this document, we were guided by the endeavour to produce a coherent, well-structured action plan, to make it comprehensive, yet easy to read, understand and use.

The document is structured in three main sections:

Section I provides a comprehensive background in terms of the methodology used and adapted to specifics of Ulaanbaatar, a city overview and baseline. The section consist of several chapters, as follows:

Chapter 1. Methodology – *detailing how the EBRD’s GCAP methodology was adapted to the specifics of the City of Ulaanbaatar*

Chapter 2. Baseline – *providing a thorough review of the city, the findings of the data collection and analysis; the environmental challenges it faces*

Section II is the core part of the document; it presents the Green City Actions developed on the basis of the findings in Section I. The section consist of several chapters, as follows:

Chapter 3. Ulaanbaatar’s Green City Vision, stories and strategic objectives – *describing the 4 recurrent ‘stories’ that led to 4 strategic objectives for addressing the issues and turning **Ulaanbaatar into a city where people really like to live***

Chapter 4. Actions – *detailing the **14 defined actions** which are trans-sectorial and multi-purposed, meaning that each of them refers to more than one sector and contributes to more than one strategic objective*

Chapter 5. Summary of GCAP actions with financial details

Section III presents the plan for the monitoring of the implementation of the actions. The section includes:

Chapter 6. Description of the Monitoring Framework

The simplified tables (screenshots) of indicators database, policy review and monitoring framework are annexes to this document. The full versions of the indicators database and policy review, respectively the monitoring tool are available separately as Excel files.

Section I. Methodology and baseline

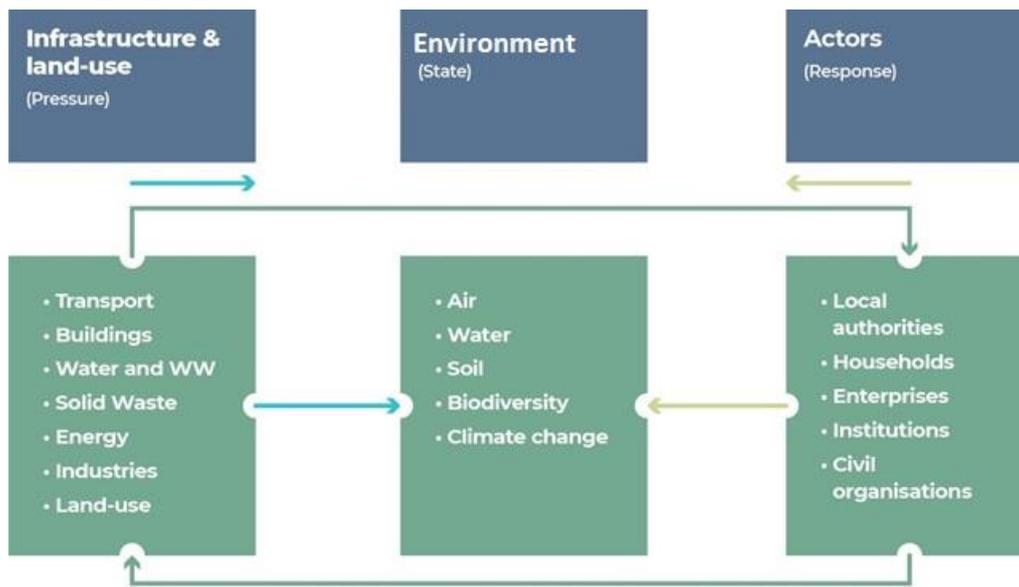


Chapter 1. Methodology

1.1. Methodology for GCAP development

Throughout the development of the Green City Action Plan, the methodology provided by EBRD¹ has been applied, based on a Green City Pressure-State-Response (PSR) framework.

Figure 1 Pressure-State-Response Framework



The Green City PSR framework identifies human activities that exert pressures on the urban environment in the transport, energy, building, industry, water, solid waste, and land-use sectors and change its state in terms of environmental performance. It also identifies how society responds to these changes through general environmental, economic and sectoral policies, investments, and through changes in behaviour, thus affecting the pressures on environment by human activities.

In order to have a clear and objective view on the state of the environment and challenges faced by the city, an environmental baseline assessment was conducted. The collected data was presented as a set of indicators (Annex 1. Indicators Database) that show the extent of the pressures on the urban environment, the resulted state of the environment and the efficiency or shortcomings of actions addressing these pressures.

The baseline assessment was followed by the process of benchmarking and prioritisation of green city indicators: first, these indicators were adjusted to the specificities of Ulaanbaatar, then an analysis was performed to compare these indicators with international benchmarks. Data for the indicators was quite scarce and had significant gaps in terms of consistency throughout the years. This challenge was tackled and to some extent overcome through consideration of various data sources and an iterative data validation process. Afterwards, indicators were ranked, corresponding to traffic light thresholds (“green”, “amber”, “red”).

¹ EBRD, OECD, ICLEI. Green Cities Programme Methodology. Available at: file:///C:/Users/User/Downloads/Green%20cities%20methodology_Final_updatedindicators.pdf

This method also allowed for identifying priority challenges. The linkages between priority state, pressure and response indicators were depicted in problem trees. Problem trees were used to assess and select/discard priority challenges during stakeholder consultation process.

Data collection. Specifics for the city of Ulaanbaatar

Specific data on approximately 120 indicators was collected for Ulaanbaatar, all this data being included in the Indicators Database. Where information was available, disaggregated data (Ger area and apartment area; levels of administration – municipal, district and khoroo) has been included in the database.

Data on State indicators was collected from, not limited to, the Annual Statistics Bulletin of Ulaanbaatar, the Master Plan for Development of the Capital City and other relevant documents, as well as during meetings with officials from the Ministry of Environment and the Departments of Municipality and Municipal Enterprises of Ulaanbaatar.

The same information sources were used for analysing the pressure indicators, as well as the Energy Master Plan and other relevant documents. It must be noted that the pressure indicators as defined in the EBRD GCAP methodology are not generally used in Mongolia's official statistics. Therefore, for many of these indicators it was necessary to convert local statistics data accordingly using simple calculations or use expert judgement decision at the data validation workshop and throughout subsequent interviews with officials.

In parallel, relevant national and local policy documents and initiatives were collected and reviewed and response indicators were assessed; likewise, linkages were provided to the respective policy documents, plans and initiatives. Existing responses were discussed with MUB departments, as well as stakeholders. Out of the approximately 400 existing policy documents in Ulaanbaatar, roughly 150 are approved and ongoing implementation. Out of these, 68 were considered relevant for the GCAP and 42 policy documents were analysed in detail (Annex 2. Policy Review). More information is provided within the Chapter 2. Baseline.

Data validation highlights

The identification of green city challenges was based on technical data, an overview of relevant national and local policy documents and one-to-one consultations with the City's specialists, verified and confirmed through wider stakeholder consultations (see next sub-chapter). For instance, the indicators database has gone through several validation stages, ensuring the highest possible level of confidence in the final data. The final prioritization exercise for green city challenges was performed together with MUB's key decision makers, this step also representing political prioritization. A summary of results is presented in Chapter 2.2. City baseline.

Policy actions, including policy, investment and behaviour change actions were identified only for priority environmental challenges and based on the already existing and ongoing efforts in the city for improvements. First, a long list of ideas was drawn for each priority environmental challenge and discussed with the technical staff of the municipality. The short list of ideas emerged from this technical assessment and were further developed and prioritized in stakeholder consultation. The selected and prioritized actions are then detailed and included in the current action plan.

Both the prioritisation of green city challenges and green city actions/policy options followed a three-step participatory assessment:

- (1) technical assessment,
- (2) stakeholder-based prioritization;
- (3) political assessment, working flexibly with a set of tools available in the GCAP methodology.

1.2. Stakeholder consultations for GCAP development in Ulaanbaatar

The Strategic Planning and Policy Department (Governor's Office) through the Project and Cooperation Unit, Policy and Planning Department within MUB was designated as responsible for the GCAP development. The relevant sectoral MUB departments under the Governor's Office and Mayor's Office, utility companies as well as the Master Planning Department, Statistics Department and Environmental Department have participated in the technical/consultation workshops held throughout the development of the project. These stakeholders have been the most important in terms of technical work required for baseline development, technical assessment and actions development.

During the GCAP development several consultation meetings have been organized, making sure that the GCAP actions are in line with the strategic development objectives of the city, with the existing legal framework and with citizens expectations. Table 1 below lists the main events; a full list of events is provided in Annex 3.

Table 1 Main stakeholder consultation events

<p>March 2019 Stakeholder Consultation Workshop on identified green city challenges</p>	<p>The consultation meeting for prioritizing environmental challenges took place on 6th of March 2019. The exercise was completed through a stakeholder-based analysis of green city challenges, where external experts, citizen representatives, key stakeholders (31 participants) engaged during the GCAP development process have confirmed or disputed the relevance of the identified green city challenges. Out of the total no. of participants, 5 NGOs from different sectors such as transportation, water, waste management and urban development have participated as well (“Unen Hatamj”; “Planning, Research and Education Center of Non-Urban Area”; “Transparency Foundation”; “Water Education Center”; Mongolian National Association for Waste Recycling”). This exercise has led to a list of key priorities for each sector which have been addressed in the current GCAP, priorities which are listed in Sub-chapter 2.2 City baseline. This formed the basis for defining the strategic objectives and developing long list of possible actions.</p>
<p>June 2019 Consultation meeting for prioritizing actions</p>	<p>The meeting took place on June 27th, 2019 where about 22 participants, representing local and national authorities and other interested parties (including 3 NGOs: “Unen Hatamj”; “Transparency Foundation”; “Planners Group”), discussed in detail the proposed actions to be included in the GCAP. Participants have formed two groups and expressed their opinion on the short list of proposed actions and prioritized them in terms of urgency. Moreover, additional data collection has been carried out in order to fill the gaps and detail the prioritized actions as much as possible (detailed action sheets).</p>
<p>October 2019 High-level and technical meetings for fine-tuning the actions</p>	<p>The objective of this series of meetings was to present the GCAP detailed actions to the MUB departments and carry out technical meetings to discuss the final details of the envisaged actions. It also included meetings with high-level MUB officials to present the development status of the GCAP and discuss its approval process.</p>

Chapter 2. Baseline

2.1. City overview

The administrative and institutional setup of Ulaanbaatar

The city is administratively divided into 9 districts as it can be seen in the map below. Each district is subdivided into sub-districts, called khorooos. There is a total of 152 khorooos in Ulaanbaatar and these are subdivided into micro-districts called kheseogs. Each level of administration except for the kheseog includes a structure of self-governance, having elected assemblies and elected governors, and structures of state administration.

Figure 2 Map of the 9 districts of Ulaanbaatar



Within the Municipality of Ulaanbaatar, there are two main administrative units: *The City Governor’s Administrative Unit* and the *UB Mayor’s Office*. The Governor’s Office is the representative of the state and is mainly concerned with policy development and planning. It doesn’t directly report to the line ministries, however reporting duties are carried out to the Cabinet Secretariat, which indirectly reports and cooperates with the line’s ministries. The Mayor’s Office is responsible for all major urban services and the management of the city.

The different levels of government within the city, i.e. the municipality and the district level authorities both have roles in the operation and maintenance of infrastructure and utility services. In most cases it is the municipality that is responsible for investments, but in some instances, i.e. for the sidewalks the district administration has limited responsibilities.

Table 2 Split of functions between Municipality and District administration

GCAP sectors	Ulaanbaatar municipality	District level administration
Land use (including green space)	Urban planning; Construction; Landscaping in public areas; Establishing new property and new infrastructure Protection and rehabilitation of nature Housing	District landscaping, recreational areas and children’s playgrounds Protection of nature within the district

Transport	Roads; public transport; Infrastructure	Development and maintenance of sidewalks
Water and wastewater	Water supply, sewage and drainage, storm water	
Building	Capital maintenance of infrastructure owned by the municipality	Operation and maintenance of street lighting
Energy	Development and operation of local distribution networks, local small-scale energy production facilities	
Waste and hygiene	Waste removal and street cleaning in public areas	Waste removal and street cleaning

Economic status

Economic activity in the country has been based on herding and agriculture, although development of extensive mineral deposits of copper, coal, molybdenum has emerged as a driver of industrial production. Thus, the mining sector is a major contributor to Mongolia's economy and its importance is expected to grow in the future. According to the World Bank press release, the economic growth has been slowing down since 2012, lowering to 11.6% in 2013, 7.9% in 2014, 2.4% in 2015, and 1.2% in 2016.

Ulaanbaatar dominates the Mongolian economy, accounting for more than 60% of the country's GDP. The GDP per capita in Mongolia was last recorded at 4,861.97 US dollars in 2017 (12,894.2 thousand tugriks), as per the Mongolian Statistical Yearbook for 2017, and 11,840.80 US dollars when adjusted by purchasing power parity. In 2015, the gross national income (GNI) per capita was 3,830 US dollars, which is classified as a lower-middle-income country.

Recent Municipal Budget

The **main sources of the budget revenue** are tax income, non-tax revenues and other revenues. The Capital city budget **tax revenues** consist of the following: capital city tax, land fees, immovable property taxes, vehicle and self-movable carriage taxes, charges for communal services and industrial water users, personal income tax, inheritance and gifts taxes, some state stamp taxes, etc. It has to be noted that corporate income tax is collected at national level and thus does not constitute an income to the MUB.

The **non-tax revenues** consist of dividends from fully and partly locally owned legal bodies, charges for the usage of local property and revenue from the sale of local property, revenue from interest and fines, and other. **Grant and aid revenues** consist of special purpose transfers, revenue generated by development organizations and the general local development fund. Special purpose transfers are made to certain public service organizations including health and education. In other words, the budget will be transferred from the line ministries to schools, kindergartens and hospitals through the MUB.

The following table presents an analysis of the Capital City Budget's trends for the period 2017-2019.

Table 3 Capital City Approved Budget for the period 2017-2019

In thousands of tugriks:

Item	2017	2018 (forecast)	2019 (forecast)
Total budget revenue of the capital city (Fiscal and Assistance revenue)	538,304,523	647,253,847	796,166,474
Fiscal revenue out of which:	523,582,082	630,667,364	773,005,216.2
Tax revenue	461,038,900	565,368,100	628,488,210.0
Non-tax revenue	62,543,182	65,299,264	144,517,006.2
Assistance revenue	14,722,441	16,586,483	23,161,258
Governor of the Capital City, out of which:	549,002,082	657,167,364	798,505,216

Revenue accumulated from sub-departments ² and agencies	538,942,200	633,724,600	785,483,810
Revenue of the organizations	10,059,882	23,442,764	13,021,406
Total expenditure of the Capital City			
Operating expenses of the Capital City	308,755,495	338,031,762	270,522,377
Chairman of Citizens' Representative Meeting	10,508,532	9,178,608	11,976,903
Governor of the Capital City	298,246,963	328,853,154	258,545,474
Investment of the Capital City	159,969,900	137,690,800	227,047,000
Revenue transfer from the Capital City to State Budget	151,467,250	208,528,889	289,146,856
CROSS-CHECK			
Revenue (revenue of the city + Governor revenue)	1,087,306,605	1,304,421,211	1,594,671,691
Grand total expenditures + transfer to State budget	928,948,141	1,022,283,212	1,057,238,609
Difference between grand total revenue and grand total expenditures	158,358,464	282,137,999	537,433,082

Capital investment in the MUB budget is financed by the Local Development Fund for which the Budget Law allows the following sources of financing: (i) Transfers from the (national) General Local Development Fund, (ii) transfer from surplus of the lower level budgets, (iii) additional tax revenue, (iv) domestic and foreign grants and donations, etc. It has to be noted that LDF is used mainly for small-scale projects while larger capital projects are financed by the City budget and the line ministries.

The following table indicates a few examples of the capital projects to be financed by the City own budget in 2019:

Table 4 Examples of Capital Investments Projects of the Capital City, 2019

In million tugriks (1 EUR = 2,978.19 MNT; 1,000,000 MNT = 335.73 EUR, as of 1 Jan 2019)

	Project name and activities, capacity and location	Project duration	Estimated project budget
58.1.2	City/Urban planning, construction and building new infrastructure (A + B)		
	A. Rollover, out of which:		
	Construction of the new sub-center of the municipal and local administration complex building	2018–2020	96,311
	Phase 1 & 2 of infrastructure work of auto trade complex in Songinokhairkhan district	2018–2020	11,768
	B. New projects		
58.1.8	Water, sewerage and wastewater treatment development (A + B)		
	A. Rollover, out of which:		
	Establish integrated monitoring centre for wellfields, reservoir, wells and pump stations and install distance monitoring, communication and alarm devices	2018–2020	2,500
	B. New projects, out of which:		

² Source of revenue: Tax Office of MUB; Land Authority of MUB; Property Relations Office of MUB; Environmental Agency of MUB; Mayor's Office; Traffic Policy Office; Police Office of MUB; Special Duty Agency of MUB; Inspection Office of MUB; Registration Office of MUB; Road Development Agency; Road Maintenance Agency of MUB; State Audit Office of MUB; Internal Audit Office of MUB; Transportation Office of MUB.

	Construction work of 5.4km pipe for the first phase of the 4th section for the Ulaanbaatar wastewater collector "Tuul-1"	2019–2020	6,842
58.1.11	Public transportation services (A + B)		
	A. Rollover, out of which:		
	Second phase of bus parking construction for "Passenger Transportation Three" public service company	2019–2021	12,000
	B. New projects, out of which:		
	Equipment for bus wash centres of "Passenger Transportation Brigade" public service company	2019	900
58.1.14	Environment protection and preservation:		
	Project activity to reduce air pollution as part of the "No Smog Ulaanbaatar Program"	2019	3,400

The largest ongoing project in Ulaanbaatar, financed by the City budget, is the construction of the new sub-centre of the municipal and local administration complex building as part of the efforts to reduce air pollution and traffic and to reduce the centralization of the city, with an estimated budget of 96,311 million tugriks and a deadline set for 2020.

The second largest ongoing project is the parking construction for "Passenger Transportation" public service company, with an estimated budget of 12,000 million tugriks and a deadline set for 2021.

Social overview

The city is the most populated administrative area in Mongolia with a population of around 1,491.3 thousand persons as of 2018 (Mongolian National Statistical Office). In the last decade, the city's population growth significantly outpaced the national growth rate, generally attributed to inward migration from rural areas. UB's growth stands out not only for the population growth, but also for the substantial expansion of the city. Density is low, encouraged by the former land administration policy which provided free plots of land of up to 700 m² per registered resident of the city. Though many plots are in practice smaller, this is one of the most generous entitlements in any world city.

The development pattern has divided the city in two distinctly different areas. The first is the formal or urban core area, consisting mainly of large apartment blocks. The second is the so called Ger areas, located on the periphery of the city, characterized by their unplanned nature, lack of infrastructure, limited utility services. Due to the lack of a centralized heating system, the majority of households use stoves for cooking and heating that are fuelled by the burning of coal, wood and other combustible materials and waste. Ger areas and apartment type areas represent 58% to 42%, respectively, of the city.

The city faces several key challenges in ensuring broad access to basic services. Demand for social services generally exceeds supply, leading to overcrowding and poorer quality of services. Access to basic services differs greatly among both dwelling types and poverty levels. For example, nearly all apartments have access to piped water while only less than 4% of those living in Ger areas or detached dwellings have coverage. A dozen factors affect the quality of life in Ger districts, such as: poor waste management and lack of hygiene; insufficient infrastructure (road, lighting, etc.); poor drinking water supply; unemployment; lack of services (district heating).

Policy landscape of Ulaanbaatar

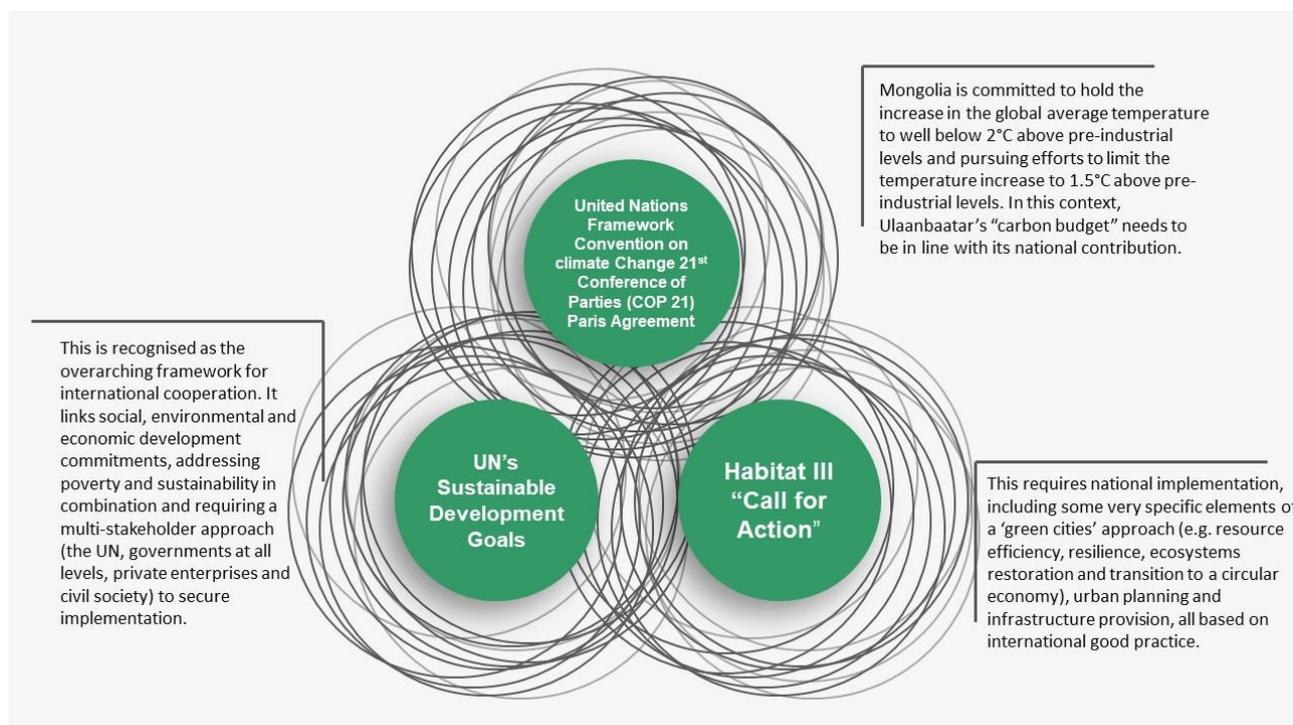
This section provides a summary of international legislation and policy relevant to the GCAP. The policy landscape of Ulaanbaatar is complex, having a lot of commitments towards green targets on national and local level. Out of the approximately 400 existing policy documents in Ulaanbaatar, roughly 150 are approved and ongoing implementation. Out of these, 68 were considered relevant for the GCAP and 42 policy documents were analysed in detail (see Annex 2).

In 2013 a **Partnership and Cooperation Agreement** has been signed between the EU and Mongolia, and it is in force since 2017. It provides the legal framework for further activities in the areas of trade, development

assistance, agriculture and rural development, energy, climate change, research and innovation, education and culture. However, it has no legally binding obligations for Mongolia to comply with EU directives, which are approximated into Mongolian law through national legislation.

Currently the EU is Mongolia’s third largest trading partner after China and Russia. As an EU trading partner Mongolia enjoys GSP+ status under the Generalized System of Preferences, providing preferential access to markets to countries which ratify and implement international conventions, including on the environment and good governance.

Figure 3 International Policy



In what follows, we resume the most important documents for the GCAP development. Mainly legislation is reviewed here, since the programmes and policies are largely sector relevant.

Table 5 Environmental quality and cross-sector policies

Sustainable development	Law of Mongolia on Development Policy Planning (2015). The purpose of this law is to determine stages of planning, implementation, monitoring and evaluation of the Development Policy of Mongolia, to set out guiding principles, to outline rights, duties and responsibilities of the engaged parties and to build up a unified development policy planning system.
	2030 Sustainable Development Agenda. It was adapted based on the Sustainable Development Goals. It declares ten main targets (economic, environmental, social) to be achieved by 2030, through implementing a sustainable development vision.
Climate change	Paris Agreement (ratified 21 September 2016). In the Intended Nationally Determined Contribution (INDC) Mongolia has outlined a series of policies and measures that the country commits to implement up to 2030, in the energy, industry, and agriculture and waste sectors.
Environmental quality	Environmental protection law of Mongolia was put into force in 1995 and amended lastly in 2012.
	Law on Air was adopted in 2012 and regulates the protection of the atmosphere to provide environmental balance for present and future generations.

Law on Fees and Fines for Air Pollution was adopted in 2010 and it regulates the registration of air polluters; physical factors to determine air pollution fees and fines; exemptions and discounts of fees.

Law on Hygiene was adopted in 2016, it warrants the constitutional right of every citizen to live in healthy and safe environment.

Law on Soil Protection and Prevention of Desertification was adopted in 2012. It regulates matters related to the protection against soil deterioration, reclamation, and prevention from desertification.

National Program on Reduction of Air and Environmental Pollution 2017-2025 addresses pollution reduction in urban areas, especially in fighting against air pollution in Ulaanbaatar.

Green City sector policies

The Law on Development Policy and Planning was approved in 2015 to establish an integrated system for development policy and development of Mongolia and define the steps of development policymaking, policy implementation, monitoring and evaluation, principles and stakeholders' rights and responsibilities.

According to the law, there are three types of development policy documents depending on whether the goals and objectives of the document are set for the long-term, mid-term or short-term.

- The long-term policy planning horizon is between 15 to 20 years; such is for example the Mongolian Development Concept.
- The mid-term policy may be implemented in 8-10 years such as the State Policy, Regional Policy and Development Policy of the Provinces and Capital city, or in 3-5 years, such as the Government Action Plan, Governors Action Plan, National Programs and Sub-programs, and State Investment Program.
- The short-term development policies are to be implemented within one year; examples of such documents are the General Direction of Socio-Economic Development of State, General Direction of Socio-Economic Development of Province, Capital City, Soum and District, and State and Municipal Budget.

Table 6 Sectoral policies

Urban planning and land use	Action Plan for Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 was the main document to consider when developing the GCAP. UB City Green Development Master Plan
Buildings	Housing and Infrastructure Development of Capital City Sub-program is a comprehensive mid-term program, which defines retrofitting of existing housing and development of new housing in conjunction with infrastructure development. However, due to the lack of financial resources and funding, the implementation of the actions is slow and there is a need to unlock solutions at a faster pace for new settlement areas, including solutions for green and energy efficient housing, infrastructure development and retrofitting of the existing housing stock. Building Code Norms and Standards (especially the three new norms revised through the UNDP GEFF Building Energy Efficiency Project)
Energy	Energy Master Plan of Ulaanbaatar was adopted in 2017 in order to model optimized energy systems for the city. Renewable energy promotion is on the good track with the existing programs. The biggest challenge and contribution at city level in this field are the energy efficiency improvement of central heat distribution network of UB, retrofitting old soviet type concrete panel apartments and providing mortgage loans for energy efficient detached houses in sub-urban areas. National Air and Environmental Pollution Programme (2017-2025) National Energy Efficiency Programme (2018-2022) Law on Renewable Energy (revised in 2019) State Energy Policy

	<p>Green Development Policy of Mongolia and Action Plan Law on Energy Conservation (2015) Nationally Determined Contributions Subsidy Payment Policy prepared by EBRD</p>
Industry	<p>Industry and Technology Park Development Program of Capital City Policy adopted in 2015. Documents on industry mainly focus on creation of cluster type industrial zones for construction materials, coal chemical industry, leather processing industry, waste recycling industry and IT technology parks. However, a clearer focus is needed on improving brown fields and environmental practices at existing polluting industry.</p>
Transport	<p>Municipal Policy on Public Transportation and Implementation Action Plan, adopted in 2014 and the Sub Program of the Public Transportation Development of Capital City by 2020, adopted in 2013, in order to promote safe, fast, sustainable public transportation network, which meets public demand.</p>
Water	<p>Implementation Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar, adopted on 2018. It reflects highest priority actions for water supply and sanitation facilities. These are in line with the GCAP objectives. National Water Program (2015)</p>
Solid waste	<p>Ulaanbaatar Waste Management Improvement Strategy and Action Plan adopted in 2017. It addresses the current challenges in solid waste and hazardous waste management and related air, soil and water pollution issues, which are very relevant to identified key environmental challenges in GCAP. Mongolian Law on Waste (2017) National Air and Environmental Pollution Programme (2017-2025)</p>

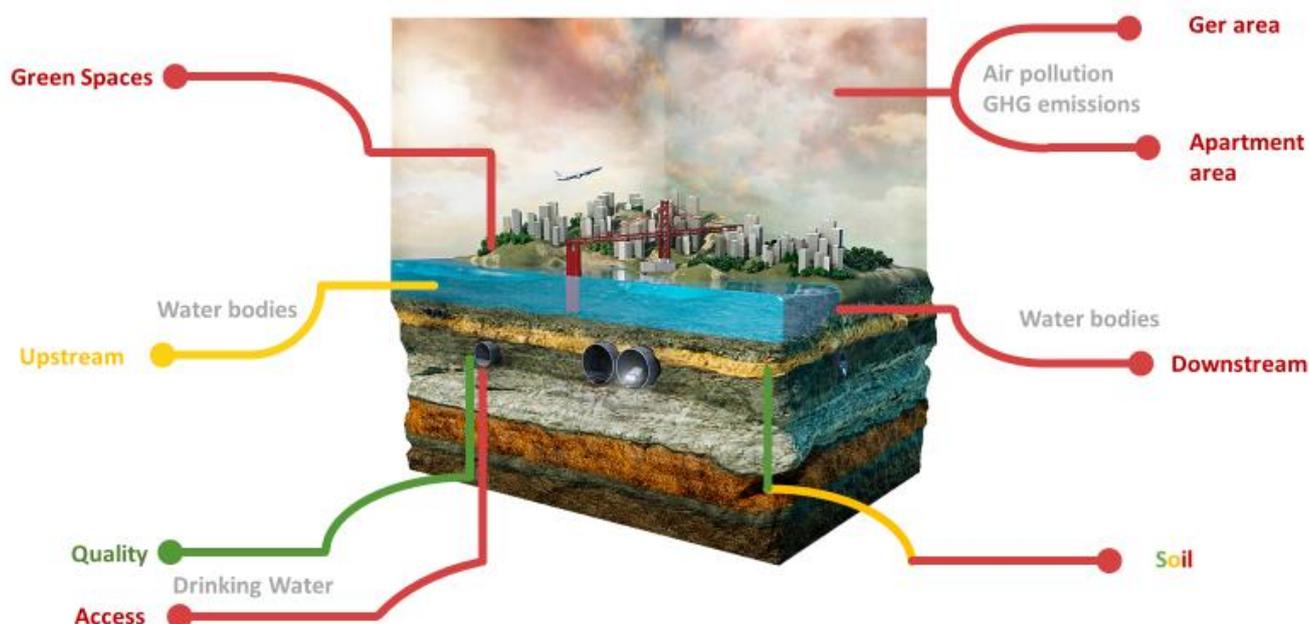
2.2. Ulaanbaatar Green City baseline: key findings of the technical analysis of the indicators' database

Following the data collection on indicators and technical analysis, we present below a series of key findings on the state of the environment and pressure factors affecting environmental aspects of the city.

Key findings on the state of the environment

An overview of the current state of the environment in UB, as resulted from comparing the latest UB indicators for the quality of environmental assets (air, water, land/soil and biodiversity) with established international benchmarks is schematically presented in the figure below. Indicators were aggregated per topic as to provide a simpler snapshot of the city's environmental performance.

Figure 4 Snapshot of Ulaanbaatar's current environmental performance³



Key findings regarding the state of the environment are presented in the table below, grouped by environmental aspects.

Table 7 Key findings regarding the state of the environment in Ulaanbaatar

Air quality	<ul style="list-style-type: none"> • Smog is one of the priority environmental challenge, associated with serious public health concerns. • PM 2.5 and PM10 are both consistently over the highest acceptable threshold.
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³ The traffic light screening assessment resulted in indicators being “coloured”, according to their performance, as per the methodology for this project: Green – high performance; amber – medium performance; red – low performance.

	<ul style="list-style-type: none"> Smoke emissions from the thousands of low efficiency coal-powered stoves and low-pressure boilers of traditional Mongolian dwellings, coupled with high heat demand because of climate and poorly insulated households are one of the most important sources of air pollution. The transport sector is an important contributor to emissions also due to frequent traffic jams.
Water quality	<ul style="list-style-type: none"> Surface water quality issues are linked to poor sanitation infrastructure, industrial pollution and insufficient wastewater treatment. About 1 million litres of water is consumed in the Ger area per day and the resulting wastewater ends up in the ground contaminating soil, underground and surface waters. The lack of sewerage system in ger areas is likely to contribute to a significant extent to surface water pollution. Pit latrines, which are very common, generate seepage into soil and subsequently into water, leading to elevated levels of ammonium and BOD indicators downstream of the city.
Green Space	<ul style="list-style-type: none"> Share of green space per capita is quite low in the centre and extremely low in the Ger area, with an estimated average for 2017 of 0.12 m²/capita overall.
Soil quality	<ul style="list-style-type: none"> Although cadmium or mercury levels in soil were recorded as low in the monitoring points in the city, overall quality of the soil is considered to be poor as indicated in some studies due to poor sanitation infrastructure and depositing of coal ashes in soil in Ger areas.
Biodiversity	<ul style="list-style-type: none"> There is a lack of information regarding biodiversity, yet several indicators inform that biodiversity should be very low and on a declining path in the city, as air, surface water and soil quality are considered to be poor or very poor in UB, and the amount of green spaces being also significantly low.
Climate change mitigation and adaptation	<ul style="list-style-type: none"> The major climate risk in the country is considered to be droughts, which is also causing economic crises and migration to the capital city. It is likely that the population in the Ger areas is more vulnerable to any type of natural disaster (flash flooding, cold waves). Annual precipitation has decreased gradually, and precipitation pattern has changed, with winter precipitation gradually increasing and summer rain decreasing in some regions, which is accelerating desertification. The frequency of extreme weather phenomena has doubled in the last two decades.

The below figure presents the highlights of the key environmental assets under pressure and the key stressors that are putting pressure on environmental conditions in UB city.

Figure 5 Key environmental assets under pressure and key stressors



Given the available data and time series trends for the state indicators, coupled with expert knowledge of the local context, we have identified the following priority environmental challenges for the city and related priority pressures:

- **Air pollution**, caused by low energy performance of buildings, low efficient heating systems and inefficient transportation;

- **Poor surface water quality**, due to poor sanitation infrastructure, industrial pollution and insufficient wastewater treatment;
- **High climate change impact**, due to energy intensive sectors such as buildings, coal-based energy generation, transport;
- **Scarce green spaces**, especially in the Ger areas.

Priority pressures:

- **Energy**
- **Building**
- **Land use**

Key findings in each sector

Key findings are presented based on the analysis of pressures indicators, field observation and consultations with local experts, meetings with MUB departments, as well as relevant stakeholder consultation. The list of key sectoral challenges has been defined, which are the priorities addressed by the actions included in the GCAP.



We aim to introduce and develop a Bus Rapid Transport (BRT) system, to reduce usage of private vehicles and to increase the safety and comfort of public transport passengers. Despite these efforts, the transport sector poses an intensifying pressure on the environment as the economy continues to grow, the number of private cars is increasing and the public infrastructure in terms of road networks, public transport services, non-motorized transport infrastructure is lagging behind. A further challenge is to connect the city centre to the suburbs that are both underserved by public transport and experience a road network which is largely unpaved.

The **key challenges** regarding transport are:

- Low public transport quality and access, due to the lack of adequate road infrastructure in suburbs and increased number of private vehicles;
- Lack of policy planning and coordination between different sectors, which does not promote decentralization, causing people to commute to the city centre daily;
- Aging car fleet and low quality of fuel cause air pollution.

Current response:

Major action taken by the MUB is the Urban Transport Development Investment Program-Tranche 1, ADB, 2015-2020, aimed to introduce and develop Bus Rapid Transport (BRT) system, reduce usage of private vehicles and increase the safety and comfort of public transport passengers. The goal of this project is to reduce traffic congestion and waiting time for public transportation vehicles. However, this project has been delayed, with only an initial section of BRT line 1 now being planned. In addition, the City is currently preparing studies for a new metro line along Peace Avenue corridor, instead of BRT. There are no projects currently to make use of hybrid car fleet in UB for greening the transport sector.



Housing and energy efficiency in housing are an issue for Ger areas but also for the rest of the city. There is a shortage in the supply of quality, affordable housing for low- and middle-income families coupled with poorly targeted housing finance subsidy schemes and products. Pre-cast concrete panel apartments as well as public buildings need thermal insulation and retrofitting.

More investment is needed in the housing development sector in the Ger areas, that is able to attract private investors, to ensure demand from ger area dwellers, and is also in line with the Action Plan for Ulaanbaatar 2020 Master Plan and Development Approaches for 2030. The challenges in the Ger areas include lack of financial resources to provide mortgage loans for energy efficient and affordable detached houses in Ger areas, and lack of properly designed and constructed residential buildings. A considerable number of existing detached houses need to be thermally insulated and retrofitted.

The **key challenges** regarding buildings in Ulaanbaatar are the following:

- There is no evaluation system to assess if buildings are “green” or not and there is a general lack of awareness related to green development;
- Lack of financial resources for energy efficiency measures in the Ger areas;
- Old and outdated norms, rules and standards in the construction sector, which do not include “green” requirements.

Current response:

The Ministry of Urban Development and Construction and the Energy Regulatory Commission (ERC) have signed a Memorandum of Understanding to develop “Green building rating system” including energy saving, well-being and water conservation requirements. The thermo-technical retrofitting (TTR) of the existing pre-cast panel buildings is one of the main potential solutions to improve building energy efficiency. According to the Master Planning Agency, 20% of or around 45,000 households of UB population live in apartments built between 1965–2000, that suffer poor or non-existent maintenance and insulation. The main barrier to the energy efficiency improvement of pre-cast panel apartments is the absence of consumption-based billing or of heat metering. Housing Associations are not sufficiently organized and not bankable. Apartment owners pay a heating bill charged by floor area regardless of the units of heat they consume or of the quality of their heat supply. Consequently, there is no financial incentive for end-users to invest in energy efficiency improvements.

Energy efficiency considerations are built into existing housing development schemes such as ADB’s “Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal project (AHURP)” currently under implementation and running up to 2027 and Ulaanbaatar Urban Services and Ger Areas Development Investment Program (GADIP), ADB (2013-2023) – a ten-year investment in 3 traches designed to connect Ger areas to trunk infrastructure.

Another initiative in energy efficient housing in ger areas is the EBRD’s Green Affordable Housing Project that is being prepared with the cooperation of the city and the Capital City Housing Corporation. The initial costs of the project are estimated to USD 25 million, co-financed by EBRD with a loan. The project aims to build up to 700 energy efficient and climate resilient central-utility-serviced apartments to provide good quality housing alternative to Ger residents.



The industrial sector in UB can be generally characterized in terms of high energy intensity and dependence on coal. Besides this, industry is underperforming also in terms of material efficiency, with very low rates of waste and water reuse/recycling. Lack of water reuse in industry is a particularly relevant challenge in UB, as the city experiences water scarcity.

Lack of awareness of the benefits of sustainable industrial practices and green growth slows progress with the industrial development plans of the city. Donors have also not favoured the financing of industrial projects or platforms.

The **key challenges** regarding the industry sector are the following:

- Lack of funding and planning for sustainable industrial development
- High waste generation rates in industry coupled with low recycling rate
- Missing viable financial solution to initiate reconstruction process of Industry and Technology Park projects (Eco-parks)

Current response:

There is a plan to relocate industrial facilities outside the city and create three Industry and Technology Parks (ITP) together with satellite towns and villages, which will act as development hubs for certain types of industries. These ITPs would be:

- Emeelt ITP for agricultural sector production, mostly animal skin and hide processing factories
- Nalaikh ITP for construction materials producers
- Baganuur ITP for nano and biotechnology sector and heavy industry.

So far, these ITPs have not yet been developed.



Lack of access to the district heating system and poor energy efficiency of homes in the Ger areas are perhaps the most significant issues. In the apartment areas access is likely similar to other major cities. Lack of access to a centralized heating system means that most heating will be performed with raw coal or other highly polluting materials such as waste, causing heavy air and soil pollution. The Energy Master Plan of UB points out that the city's future energy supply has mainly to be based on photovoltaic plants, wind turbines and electric heating since no other relevant local energy sources with low or zero GHG emissions are available. The feasibility of this option needs to be, however, checked.

The **key challenges** regarding energy consumption and production are the following:

- Ger area not connected to the central heating system;
- Inefficient governance in the energy sector;
- Poor capacity of electricity supply network.

Current response:

On the national level, support of renewable energy has been quite productive. For example, according to the Law on Renewable Energy (2007), the price gap between the actual cost of energy production and the regulated end-user tariffs will be compensated by the Government. In recent years, different projects have been developed outside UB, such as: Tsogtsetsii 50MW wind, Sainshand 50MW wind, Darkhan 10MW solar and other smaller PV solar farms. There are some initiations of small-scale renewable energy for households in UB, but no commercial progress has been indicated. Three projects are currently under preparation by the EBRD: Rehabilitation of district heating network – expected to be signed in 2019; construction of substations at building level – expected in 2020; and development of a feasibility study for potential utilisation of waste or renewable heating sources in the district heating network. This latter feasibility study includes a full assessment of different heating sources, such as: biogas, geothermal, solar thermal, waste heat (incineration plants, industrial waste heat, sewage, large cooling plants), heat pumps, rivers or bodies of water, renewable electricity and others.

Starting with this year we have introduced a ban on the usage of raw coal in Ger areas.



In terms of water consumption per capita, there are significant differences between values for the apartment area and the Ger areas. Water consumption is in the normal range in the former, but is extremely low in the latter, signalling lack of connection and difficult access to the drinking water distribution system, all this significantly affecting quality of life. General lack of municipal infrastructure in Ger areas means that wastewater is not collected in a sewage system and subsequently not treated. Pit and wastewater latrines generally have no lining, leading to wastewater infiltration in soil and subsequent pollution of ground and surface waters.

The identified **key challenges** regarding the water sector are the following:

- Lack of an integrated water management system
- Water scarcity, significant discrepancies in water use between apartment and Ger area, insufficient access to water supply in Ger area
- Lack of overall coverage of sewerage system (all over UB, including ger areas)
- Flooding risk, due to old flood protection infrastructure and inadequate construction regulations and practice

Current response:

There are different actions currently ongoing in UB that are part of the National Water Program. These include the rehabilitation of water pipelines with modern technology (Austrian Funds), the Ger Area Development Investment Program which includes water supply and wastewater collection networks (ADB) and public financed actions for extending the water supply networks and improving its efficiency.

Other initiatives influencing the sector include a new WWTP financed by China and a wastewater recycling plant supported by the US Millennium Challenge Corporation. The implementation of these projects has started in 2018 and is scheduled to last until 2021.



The City experiences very high solid waste generation rates compared to the benchmarks, with values above 700 Kg/person/year. Though waste collection services are available, and the indicator is marked as green (high performance) within the Indicators Database, as waste is collected with various degrees of regularity throughout the city, the quality of the service requires improvement. More emphasis has to be given to the suburb areas, where access of waste collection trucks is limited, and affordability of the service is low.

The vast majority of collected waste ends up in the three landfills located outside the city and according to the National Association of Waste Recycling they have approximately 5 years of remaining life.

The **key challenges** regarding solid waste management are the following:

- Poorly performing waste management system due to very low waste collection fees;
- Lack of adequate solution for hazardous and toxic waste management;
- The absence of an eco-park (with designated centre for recycling) also implies that waste collectors do not have clear knowledge on where to take the separately collected recyclables, as recyclables collection centres operate haphazardly throughout the city in rental buildings.

Current response:

Currently, collected fees cover only half of the yearly costs of waste management in the city. Steps have been taken to revise waste collection fees and a methodology was submitted but it is not yet approved. Current projects under implementation: UNIDO is financing a small-scale project on reducing waste open fires; UNEP/Asia Foundation – a project to develop waste legislation and attract investors; ADB – food waste project. Beside the above-mentioned initiatives, EBRD is also providing support to UB city with investments designed to expand the City's landfilling capacity and build a Construction and Demolition Waste ("CDW") plant. Additionally, the machinery and equipment necessary for the landfill and CDW plant operations will be purchased.



Population density on urban land is a challenge for our city in terms of land use. Around 1.4 million inhabitants live currently in Ulaanbaatar on a total surface of about 311 km². This leads to an average density of population of approximately 4,500 persons/km². This density is much lower than the minimum reference values which are of 7000 – 20000 residents/km².

The city's land use policy has historically contributed to its expansive urban form and related problems of infrastructure coverage, deficiencies and pollution. In recent years most of the urban growth of the city has consisted of low-density peripheral expansion. The segmented land use and low-density urban areas contribute to traffic congestion and lengthy commuting times from suburb to city centre.

The **key challenges** regarding land use are the following:

- Insufficient share of green spaces per city inhabitant;
- Unclear roles and responsibilities of the municipality and city governor in terms of land use and regulation;
- Lack of investment in urban infrastructure in Ger areas.

Current response:

At the moment, the only project with considerable area coverage is the ADB financed "Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal project" (AHURP), which is currently under implementation and running up to 2027. The aim is to deliver 10,000 green housing units that are energy efficient, affordable, and designed to maximize the use of renewable energy. 100 hectares of Ger areas will be redeveloped into

eco-districts that are both low-carbon and climate resilient. There are 24 announced projects of re-planning and re-development of the Ger area, but more progress is needed.

Additional considerations

In addition to the above key sectoral challenges, experts involved in developing the GCAP have taken into consideration the following **key challenges**, which have also been addressed in the GCAP actions:

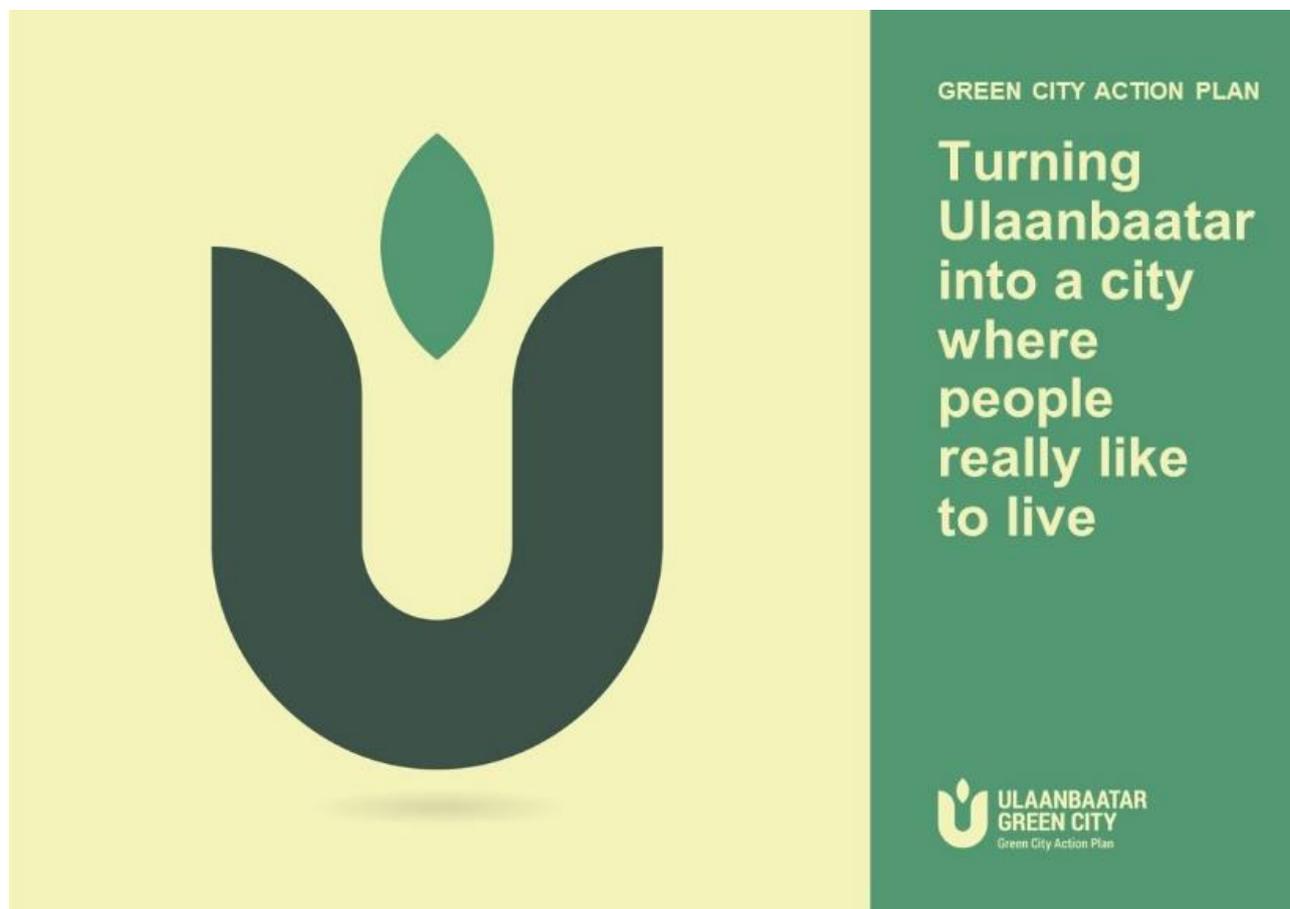
- Lack of prioritization of public transport on main city corridors;
- Low share of renewable energy sources in the energy mix;
- Limited or no options for Ger area residents to switch to alternative fuels;
- Lack of investment and selection of poor building material has led to outdated building stock and low energy performance;
- Low awareness and access to energy efficient and waste reduction technologies in industry.

Section II. Green City Action Plan



Chapter 3. Ulaanbaatar Green City vision, stories and strategic objectives

3.1. Ulaanbaatar Green City vision



Our city is developing fast and we aim at **turning Ulaanbaatar into a city where people really like to live in**. This means that the city should provide citizens with opportunities to fulfil their needs (economic, recreational, social, etc.) and to increase the level of satisfaction related to the standard of living. Our vision is referring to a balanced development for the city where we consider people as the central element. At the same time, we will take care that the environmental and socio-economic conditions will enable citizens enjoy at maximum their time spent in the city.

The vision can be achieved by working towards strategic objectives and actions identified in the key areas of development in the next section.

3.2. Ulaanbaatar Green City stories and strategic objectives

All the challenges presented in the previous chapter can be tackled one by one, or in a more integrated manner. The approach chosen was the latter since the environmental and socio-economic issues that UB is facing are complex and in order to be able to solve them, we need to have multi-purpose interventions and actions that contribute to more than one challenge.

There are 4 recurrent 'stories' being told in UB, which incorporate all or some of the issues presented: the story of air quality, the story of story of climate change, the story of climate resilience and the story of how to

have a happy city. These stories have led to 4 strategic objectives (images below) for addressing the issues and turning Ulaanbaatar into a city where people really like to live.



STRATEGIC OBJECTIVE

1

improve air quality

by changing the energy and transport paradigm

ULAANBAATAR GREEN CITY
Green City Action Plan



STRATEGIC OBJECTIVE

2

mitigate climate change

while maximizing livelihood co-benefits

ULAANBAATAR GREEN CITY
Green City Action Plan



STRATEGIC OBJECTIVE

3

enhance climate resilience

through nature based solutions

ULAANBAATAR GREEN CITY
Green City Action Plan



STRATEGIC OBJECTIVE

4

creating happy city

through an attractive, green environment and enhanced community cohesion

ULAANBAATAR GREEN CITY
Green City Action Plan

The strategy for reaching these objectives is reflected in the proposed 14 actions, which are multi-purpose, inter-sectorial and interconnected with the 4 Strategic Objectives.

The story of air quality in Ulaanbaatar



Air quality is the number one environmental problem in Ulaanbaatar and a serious threat to public health. The most important pressures causing and aggravating this problem are the **inefficient energy system** in the city; **burning of raw coal** as a source of heat in the ger areas and in the 3 coal based thermal power plants, combined with high energy consumption due to climate and low energy performance of buildings.

The energy from power plants fuels energy intensive industries. The electricity demand of the industry is at 73% out of the Central Region integrated power grid. The share of the industry on the heat demand supplied by the city network is at 42%.

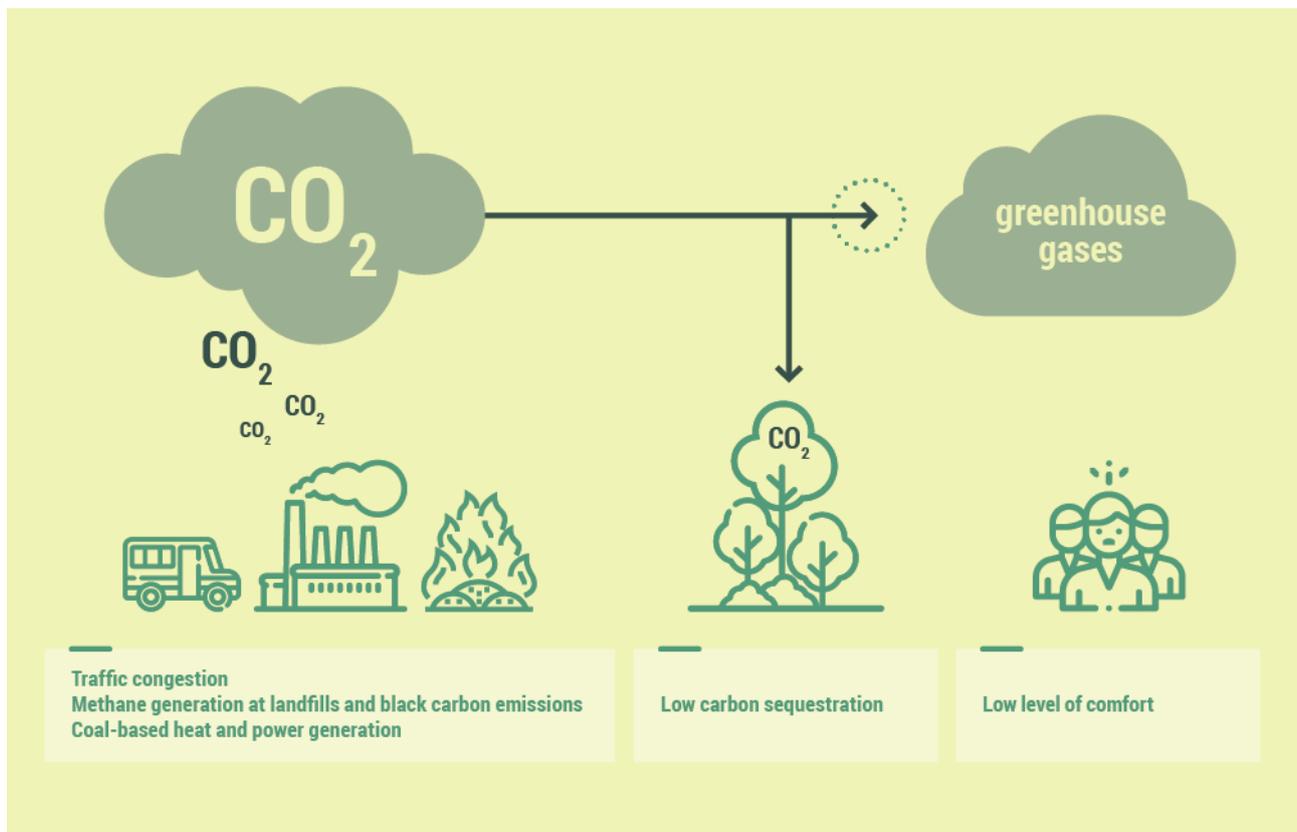
As a first step and main strategy to unlock the opportunity for renewable energy in Ulaanbaatar, green electrification is proposed, that is the use of highly efficient electrical applications in all possible sectors, including heating, transport, storage and renewable energy. These solutions will strengthen the resilience of the grid, will help limit heat demand and will increase renewable energy penetration. The introduction of renewable energy solutions such as heat pumps which can directly connect to the district heating network or be stand-alone units, will supply additional heat and ensure more resilience in distribution. Energy efficiency measures in buildings and industry will reduce demand considerably. This package of solutions will help transform the energy sector in Ulaanbaatar into a flexible, decentralized, reliable system.

At the same time, one cannot talk about air quality in the city without looking at the heavy air pollution hot spots in the ger areas generated by the burning of raw coal as source of heating. These hot spots are expected to worsen, unless there are measures taken to offer affordable and decent energy efficient housing in the area and solutions for heating. If left untouched, the trends in these areas are expected to worsen as population increases, consequently heat demand would also increase in these areas.

The story of air quality also includes **heavy traffic congestion**, **open burning of waste** and **poor standards regarding fuel**. These aspects are addressed through the proposed actions which will significantly improve air quality.

Strategic objective 1: Improve air quality by changing the energy and transport paradigm

The story of climate change impacts intertwined with livelihood issues in Ulaanbaatar



The causes of climate change impacts are almost entirely congruent with the air pollution causes. Nevertheless, the impact of climate change deserves separate attention in the context of Ulaanbaatar. **Inefficient coal-based heat and power generation** has a high GHG emission impact. The losses in the distribution and the lack of demand-side energy efficiency are significant contributors too.

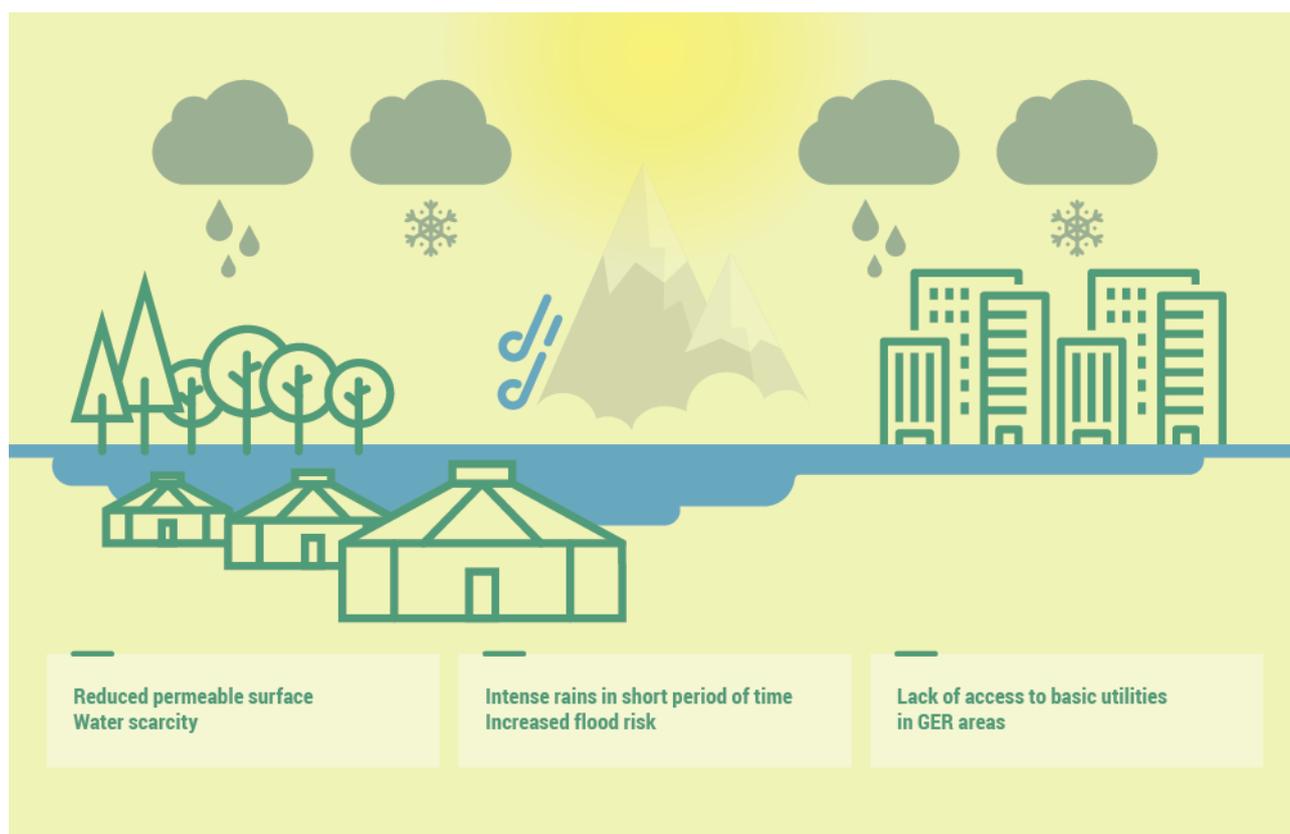
Climate change impacts are worsened by **traffic congestion**, and non-compliant quality of fuel sold on the market. The lack of adequate **waste management** leads to methane generation at landfills, but also to black carbon emissions due to the open burning of waste mixed with hot ashes from coal-based heating in the ger area.

Strategies for mitigating climate impact in Ulaanbaatar need to go hand in hand with maximizing co-benefits. This is the strategy of climate finance organizations, moving away from blindly financing narrow mitigation projects and investing into projects that are able to generate paradigm shifts in sectors and change the livelihood of people. In Ulaanbaatar any effort to combat climate change needs to go hand in hand with measures aimed at increasing the level of comfort of the people living in ger areas and focusing on the productive use of energy to create livelihoods. The actions related to affordable green housing and utility development in ger areas, the developments based on industrial symbiosis in eco-parks, the increased recycling and circular economy solutions fit very well in this paradigm change.

To complete the package of actions for mitigating climate change impacts, a modal shift in **transport** is needed towards public transport and active means of transport. Encouragement of car and bike sharing for the most cost-effective solutions in transport will positively impact climate change mitigation and livelihoods as well.

Strategic Objective 2. Mitigate climate change while maximizing livelihood co-benefits

The story of climate resilience in Ulaanbaatar



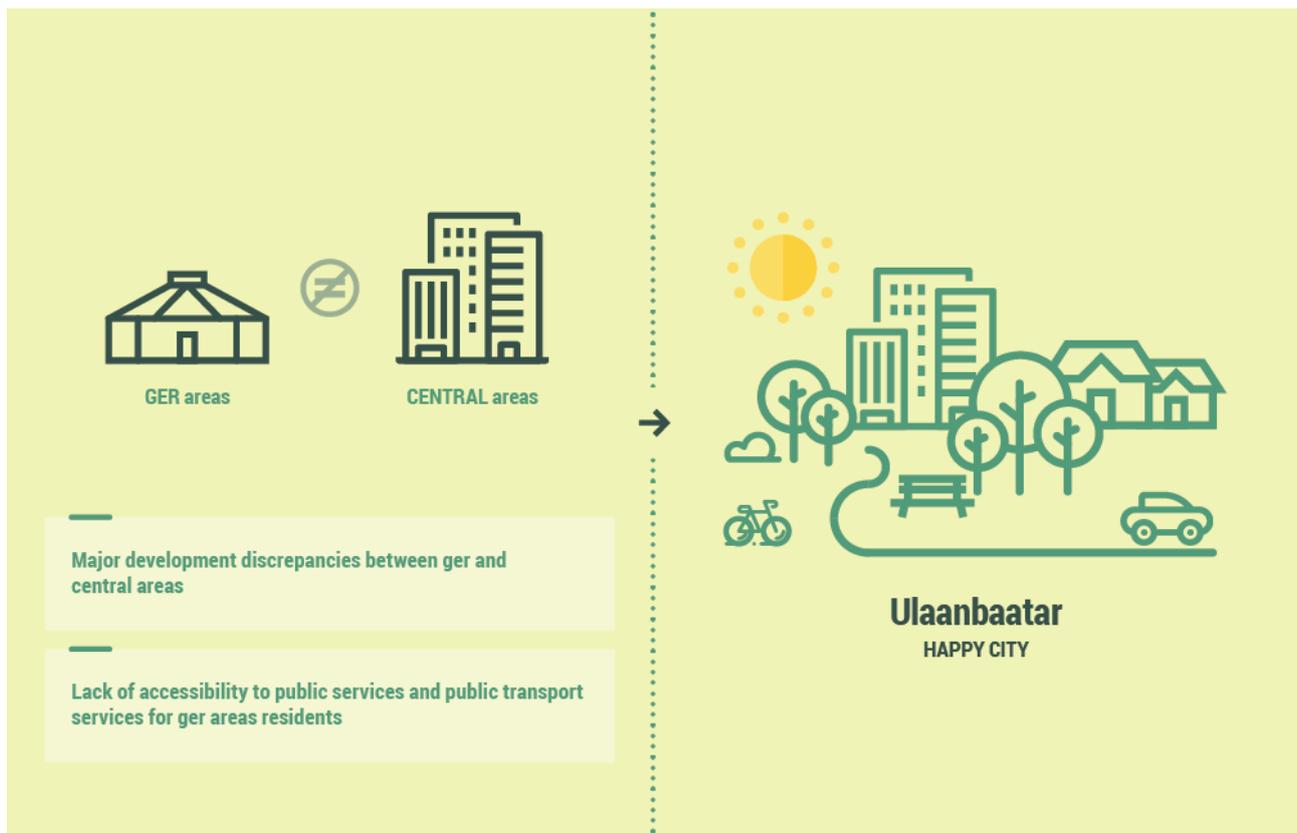
Ulaanbaatar is a city located in a water scarce environment, yet regularly facing severe **flooding**. Future climate projections indicate that this situation is only going to intensify, as there will be fewer, but more extreme rain and storm events. Meanwhile, people living in Ger areas are most vulnerable to these climate extremes, as they live in ground-level houses/gers with lack of access to water supply and sewerage. **Lack of access to drinking water and sanitation** is currently tackled on a limited scale, with a view of immediate relief, without a longer-term vision in place.

The climate profile of UB, although challenging, presents a series of opportunities which are currently missed. Rainwater harvesting is one of those missed opportunities, which is easy to implement (collection from rooftops, paved roads, etc.) and it can be done on various scales and for several uses (residential or industrial consumption). The main benefit of rainwater harvesting is the decrease of the pressure on the drainage system, thus the reduction of flood risk; moreover, following basic purification, collected water can be used for drinking, thus creating more self-sustainable households in the Ger areas.

The city is currently tackling flood risk with the classic 'grey infrastructure' approach of building concrete embankments along the river and its tributaries in the city. Nature-based solutions for riverbank rehabilitation aimed at flood protection are already tried-and-true solutions throughout the world. Increasing soil permeability through opting for and increasing green areas, and replacing concrete or pavement, where possible, further decrease flood risk. These solutions, while proving more efficient and cheaper than grey infrastructure in the medium and long term, also provide important ecosystem services. They benefit air and water quality and increase biodiversity, as well as the climate resilience and wellbeing of citizens.

Strategic Objective 3. Enhance climate resilience through nature-based solutions

The story of how to have a happy city



Ulaanbaatar is home to about 1.5 million people. The city is considered a place offering various opportunities and an enhanced lifestyle as compared to the rural areas of Mongolia. According to international best practice, the level of comfort and accessibility to municipal services contributes to the happiness of citizens and to the way they are perceiving their living environment.

The current level of urban development in Ulaanbaatar shows **major differences between Ger areas and the city centre area**. The socio-economic disparities between the two areas of the city add to the causes of the dissatisfaction of citizens. This is mostly visible in relation to accessibility of services and **public transportation**, existence and maintenance of green infrastructure and **waste management**.

Via a set of combined measures, we will strive for working towards creating modern infrastructure for supporting and promoting the use of soft mobility, such as bicycles. These measures go hand in hand with the establishment of green areas along the city, which could be used for recreational purposes as well as for increasing the accessibility to certain areas. Green areas (such as parks, children’s playground areas, etc.) are also important zones within the urban environment due to their social cohesion function.

Based on World Bank estimations, the **poverty rate** in Ulaanbaatar is of 24.8%. The city is also considering adopting measures that aim at reducing poverty rate. One of such measures is focusing on the reduction of food waste (thus diminishing the organic fraction from total municipal solid waste quantities) via introducing a new system of collection and usage of near-to-term food products. All these would be transferred to social canteens and poor people would have access to freshly cooked meals.

While the GCAP is primarily aiming at improving the environmental conditions of the city, the measures envisaged under this strategic objective are also aiming at strengthening the social cohesion of citizens by creating a much greener living environment and supporting the poverty reduction goals.

Strategic Objective 4. Creating happy city through an attractive, green environment and enhanced community cohesion

Chapter 4. GCAP actions

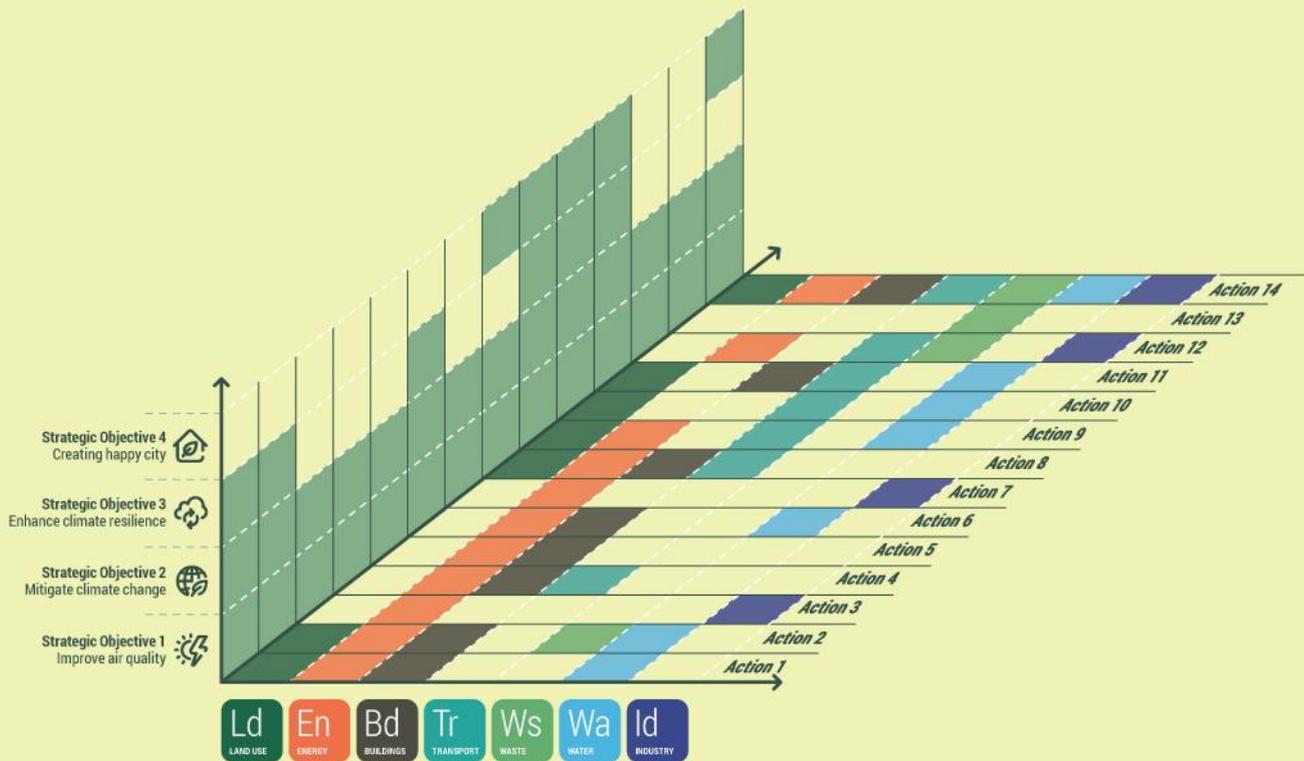
A total number of **14 actions** (Table 8 below) have been defined and included in this GCAP. The actions are presented randomly in individual sheets of the same structure, and not according to their priority of implementation. However, two aspects are our top priorities: to reduce the air pollution and to manage the redevelopment of the Ger areas. Therefore, we have started the stories with the air quality story and the first two actions focus on Ger areas.

Table 8 GCAP actions

1. Develop green affordable housing in Ger areas
2. Develop infrastructure in Ger areas
3. Modernizing district heating
4. Implement cross-sectorial Green Energy solutions
5. Energy Efficiency in buildings
6. Water availability and efficiency
7. Pollution control
8. Sustainable Urban Mobility for Ulaanbaatar, with focus on public transport system
9. Urban Safety and Accessibility
10. Develop multipurpose green areas in the city
11. Piloting nature-based solutions towards a climate resilient 'sponge city'
12. Waste collection in Ger areas with source separation of ashes
13. Improve secondary waste collection, transfer and disposal
14. Recycling, industrial symbiosis and circular economy initiatives

Within each action, more than one measure has been defined. We consider the actions, and their embedded measures, as being **trans-sectorial** and **multi-purposed**, meaning that each of them is referring to more than one sector and contributes to more than one strategic objective. The below figure presents an overview image on the GCAP's actions and emphasises the interlinkages between the 14 actions, the 7 sectors that GCAP is focused upon and the 4 strategic objectives.

Figure 6 Interconnection between strategic objectives, defined actions and GCAP sectors



Furthermore, the actions (and their measures) included in the GCAP are inter-dependent and sometimes one is a pre-condition for other action(s). Thus, one should read all the actions and acknowledge the cross references that are made between actions and corresponding measures. The measures are presented in two stages: short term (meaning all the activities that can be implemented in 5 years) and long-term actions (with a timeframe up to 15 years).

The Action Sheets are structured as follows. First, the context is briefly introduced considering the baseline assessment presented in Chapter 2. The investment costs (CAPEX) and operational costs (OPEX) for each measure are indicated. The next section of each sheet outlines in a tabular format the implementation framework (steps, timelines, targeted results, correlation with existing policies). Finally, the expected qualitative and quantitative benefits are presented.

It is to be noted that the progress and impact indicators that are envisaged to measure the results of each action are presented in the monitoring and benchmark framework (Chapter 6).

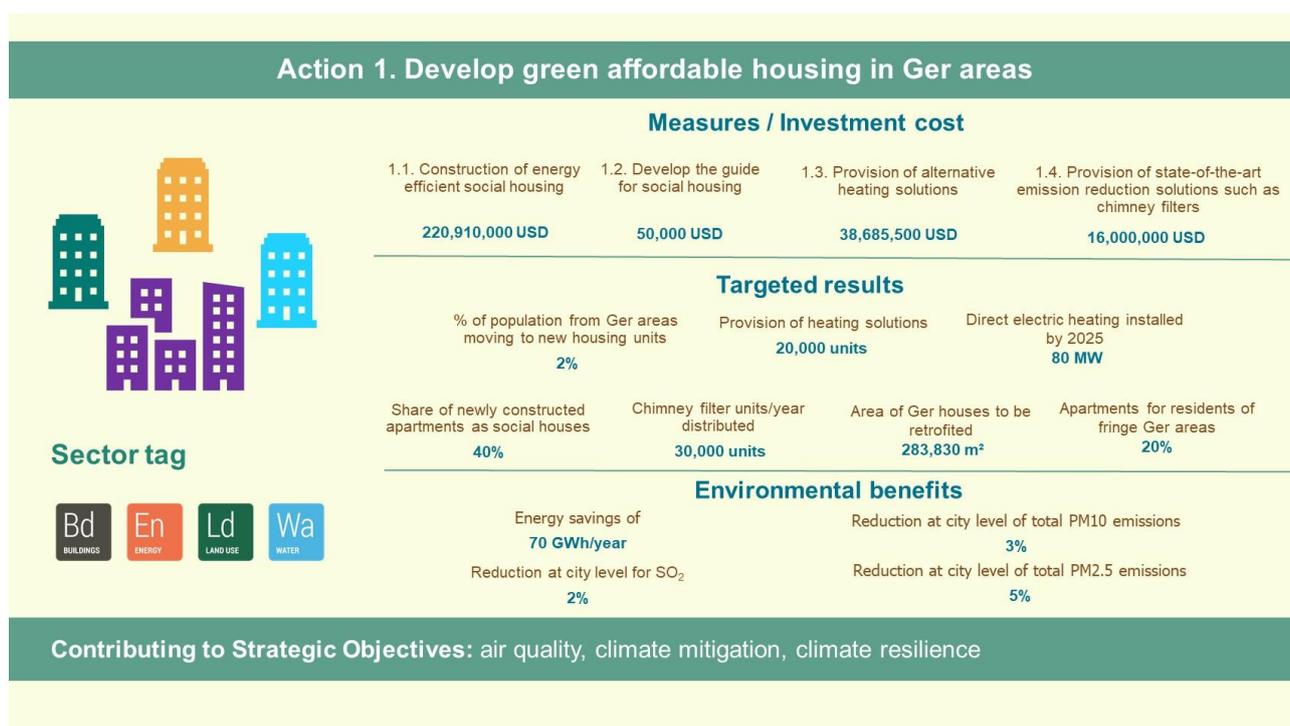
Action 1

Develop green affordable housing in Ger areas



Action 1

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience



Context and proposed measures

Ulaanbaatar has a total population of about 1.4 mil persons. About 60% of the City's population, or 850,000 people, live in informally built houses and "gers", that is a form of traditional Mongolian tents or low-quality brick-built houses in large peri-urban areas, the so called Ger area. This area is characterized by the lack of proper housing conditions and lack of access to municipal services such as district heating, water, wastewater and waste management and public transport. Also, the administrative and social infrastructure is largely lacking from these areas.

We aim at polycentric development of the city, by which the burden that is currently on the city centre – due to the high concentration of administrative, cultural, educational and health facilities – will be distributed to other areas around the city centre. Our vision is to redevelop the Ger area, transforming it into functional urban zones with centres including municipal services, residential and educational facilities, production / technology / economic development facilities, multi-purpose green spaces, health centres, accessibility features, in other words multiple cities within a city.

The main goals of this action are to decrease the environmental pollution to air, soil, water, to reduce the carbon footprint from heating in the Ger area, and to increase the quality of life for UB citizens. Also, the economic development of Ger areas and creating job opportunities in these areas will contribute significantly to the zonal development. The proposed actions refer to housing and municipal infrastructure development, as well as social, educational, health and safety infrastructure development. Since the topics are quite complex and interdependent, they are included in two separate actions: Action 1 - focusing on housing and Action 2 - on associated municipal and social infrastructure for Ger areas. The division is purely for practical purposes helping us to define the details and costs of each action. Ger areas redevelopment is complex and requires joint efforts and strong coordination from different sectors.

The redevelopment of the Ger area has been ongoing for some years already, good experience being accumulated in this respect. For example, a relevant ongoing project is the **Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal Project (AHURP), ADB, 2019-2027**. The project will cover 100 ha of Ger areas and in total will develop 10,000 new green affordable housing units in the timeframe of 8 years. Also, starting with this year we have introduced a raw coal ban for the entire Ger areas.

The following short-term measures have been defined:

- 1.1. **Construction of energy efficient social housing regime apartments and apartments for sale or rent in commercial regime.**

Action 1

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

The new buildings will have to take into consideration the energy and resource efficient technologies, renewable energy options, resilience to climate change, gender-responsiveness and affordability level for future beneficiaries. The new buildings (apartments) will have to follow enhanced technical specifications: including - but not limited to - advanced energy efficiency, renewable energy, such as PV solar panels, passive solar technologies, improved insulation of roof, façade and basement, LED lighting and motion sensors, apartment level heat metering, controlled ventilation with heat exchanger, improved air tightness, improved resistance to water intrusion, water harvesting system and grey water reuse and climate adaptation design elements. Thereby, energy performance of buildings shall try to go beyond at least 20% of current norm and practices.

Also, the new buildings will have to provide access to all municipal services such as drinking water, sewage system, district heating, social services, schools, kindergartens etc. In the same time, all newly developed areas will consider creating parking spaces for cars, pedestrian walking area, cycling lanes and access to improved road infrastructure. The development will have to be done following detailed zonal plans designating plots of land to specific use such as multipurpose green areas, recreational areas, buffer zones for reducing the climate change impacts such as flooding and public spaces with social functions such as providing space for gathering, organizing community events, etc. Thus, such green areas will be integrated in the design of the projects.

1.2. Develop a guide for social housing and the financial schemes which will enable the residents of Ger areas to access housing.

We will develop a guideline for the criteria of social housing development and allocation. It is envisaged that about 40% of newly constructed housing within the ger redevelopment programme to be allocated as social houses for residents of ger areas. Currently, residents of Ger areas have limited access to new housing since there are limited options for them to obtain a loan /mortgage system that is affordable. Thus, the guide will analyse the affordability level of residents of Ger areas and will also develop proposals for feasible financial schemes. The financial schemes will be developed in close cooperation with state /governmental agencies and will need approval by Mongolian Government prior to application.

1.3. Provision of alternative heating solutions and/or implementing energy efficiency measures for houses in the Ger area such as retrofitting, replacing windows, doors, wall insulation, roof insulation, retrofitting of houses to reduce reliance on inefficient coal-based stoves and reduce the energy losses.

This should focus on electric heating appliances. Alternative heating solutions have already been initiated (electric heaters) and we will continue to promote these technologies. The technologies are on the market but need policy push and subsidy support for full market penetration. We aim at having at least 20,000 housing units in the Ger area shifting from coal-based heating to electric heating solutions. In addition, this measure must consider the need for a cooking system. As of today, the coal-based stoves have a double role serving as both heating and cooking devices. Via this measure, we are only tackling the first feature of the coal-based stove. In order to be able to have no coal-based stoves in the Ger areas, alternatives for cooking systems will be designed and implemented. We are aiming at having a total installed capacity at city level of about 80 MW⁴ by 2025 generated by direct electric heating systems (DEH). This can be further incentivised via increasing the amount of free electricity provided to Ger areas during night-time.

Retrofitting activities are also proposed for houses in Ger areas. These are referring to replacing windows, doors, wall insulation, roof insulation, retrofitting of houses to reduce reliance on inefficient coal-based stoves and reduce the energy losses. According to the Energy Master Plan for Ulaanbaatar (2018) the target for retrofitting actions was set at 20% reduction in heat loss. We are aiming at including in our retrofitting programme about 5% (5,161 houses) of total houses located in Ger areas, which translates into approximately 283,830 m² as surface to be retrofitted within 5 years. The retrofitted houses will not be subject to relocation.

1.4. Provision of state-of-the-art emission reduction solutions.

These may be chimney filters applied at individual houses for coal-based stoves or the use of semi-coke briquettes. The latter technology was already piloted in the winter of 2018/2019 yielding good results in

⁴ Source: Frankfurt School UNEP Collaborating Centre, Financing Household Clean Energy Solutions, Climate and Clean Air Coalition funded study, June 2018

Action 1

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

pollution reduction at relative cost efficiency.⁵ We aim at continuing providing semi-coke briquettes⁶ of at least 80,000 tonnes/year and at providing and installing individual chimney filters or emission reduction technologies to at least 10,000 households per year.

For long-term measures, the city will consider the following:

- Continuing to develop new housing options for residents of Ger areas. The development of the Ger areas will consider a balance between single and multi-family buildings.
- Develop feasible alternatives for cooking devices to avoid the usage of coal-based stoves. This can include either electrical cooking devices and/or gas-based cooking devices (gas cylinders).
- Support the development of economic activities such as technological parks and manufacturing industry in the Ger area in order to maximize the job opportunities for residents and reduce commuting.

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
1.1. Construction of energy efficient social housing			International donors / Grants and loans / Local budget contribution
Feasibility study, financing scheme, tender specification, etc.	110,000 USD		
Construction cost at annual rate of 55,200,000 USD For 0.5% of the population in the Ger areas or 1,150 flats at unit price per m ² of:	220,800,000 USD		
<ul style="list-style-type: none"> • market price conventional construction – 660 USD/m², and • energy efficiency and blue green measures – 140 USD/m² 			
1.2. Develop the guide for social housing and the financial schemes which will enable the residents of Ger areas to access housing	50,000 USD		International donor
1.3. Provision of alternative heating solutions and retrofitting of houses			International donors / Contribution from locals (beneficiaries)
Provision of alternative heating solutions for 20,000 units (at unit cost of 515 USD)	10,300,000 USD	100,000 USD/year	
Retrofitting of houses (283,830 m ² – 5,161 houses)	28,385,500 USD		
1.4. Provision of state-of-the-art emission reduction devices			International donors / Contribution from locals (beneficiaries)
Filters (10,000 units)	16,000,000 USD	16,000 USD/year	
OR			
Semi-coke briquette (10,000 households/year with 3 ton/household/year)		2,190,000 USD/ year	

⁵ www.adb.org/sites/default/files/linked-documents/511001-sd-01.pdf

⁶ Semi-coke briquette is a type of clean coal technology in which moisture contents in the raw coal is substantially reduced through carbonization process to produce semi-cokes which is mixed with hydrated lime and clay to form semi-coke briquette. It contains higher calorie value (4,500 kcal at least) than raw coal currently in use for cooking and heating in ger districts (3,370 kcal in average) and can significantly reduce particulate matter emission up to 89%. In addition to lower emissions, semi-coke briquettes have a higher energy content than raw coal, approximately 25% more energy per kilogram of fuel. As a result, less fuel is necessary for the same amount of heat. (Source: ADB, Ulaanbaatar Air Quality Improvement Program (RRP MON 51199), 2019, <https://www.adb.org/sites/default/files/linked-documents/51199-001-sd-01.pdf>, accessed on 22nd of September 2019)

Action 1

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

Implementation framework

Measure	Steps to be taken
1.1. Construction of energy efficient social housing	<p>Develop the Feasibility Study that will include the technical, environmental and social aspects related to the investment. Social baseline assessment and assessment of demand for apartments in high rise EE buildings in Ger areas in the proximity of the center.</p> <p>Review of existing building code, requirements related to land use planning (parking spaces, green areas, etc.) in line with international best practices.</p> <p>Select pilot locations for redevelopment and establish integrated green urban development solutions with livelihood elements.</p> <p>Define criteria for allocation of social housing – minimum criteria to be used – proximity to new building – residents of fringe Ger areas will have priority access to at least 20% of all apartments.</p> <p>Define financing scheme for EE buildings with a mix of social housing and private development for sale of apartments, learning from existing pilot projects.</p> <p>Define tender specifications for housing development in pilot areas.</p>
1.2. Develop the guide for social housing and the financial schemes which will enable the residents of Ger areas to access housing	<p>Prepare a tender for the development of the guide.</p> <p>Select the consulting team.</p> <p>Approve the guide.</p>
1.3. Provision of alternative heating solutions and retrofitting of houses	<p>Prepare tender dossier for acquisition of electric heating devices / state-of-the-art emission reduction devices and provide electric heating devices to population.</p> <p>Define criteria for provision of devices to population.</p> <p>Prepare tender for acquisition of services for retrofitting houses in Ger areas.</p> <p>Implement the first phase of the retrofitting programme</p>
1.4. Provision of state-of-the-art emission reduction solutions	<p>Awareness raising to population about the use of electric heating devices/ emission reduction devices, their technical specification, operation mode, costs</p> <p>Provide state of the art emission reduction devices to population</p> <p>Monitor and evaluate project implementation</p>

Measures	Implementing entity	Targeted results	Contribution to existing policies
1.1. Construction of energy efficient social housing	<p>UB Mayor's Office through NOSK</p> <p>Cooperating stakeholders: The Housing Infrastructure Department of the MUB, private utility companies, private landowners</p> <p>Other stakeholders: NGOs, construction companies and real estate developers, suppliers of technologies for energy efficient</p>	<p>At least 2% of total population currently residing in Ger areas will move to new housing units in the coming 5 years. On long term (15 years) at least 35% of Ger area residents should relocate to improved housing units</p> <p>Energy performance of buildings shall aim to go beyond at least 20% of current norm and practices</p>	<p>Ulaanbaatar 2020 Master Plan and Development Approaches for 2030</p> <p>Housing and Infrastructure Development of Capital City Sub-program, 2018</p>

Action 1

contributing to **Strategic Objectives:** air quality, climate mitigation, climate resilience

Measures	Implementing entity	Targeted results	Contribution to existing policies
1.2. Develop the guide for social housing	measures, electric heating and cooking devices, etc.	40% of newly constructed housing within the ger redevelopment programme to be allocated as social houses for residents of Ger areas Define criteria for allocation of social housing	
1.3. Provision of alternative heating solutions	UB Mayor's Office through NOSK	At least 20,000 units from Ger areas will shift from coal-based heating to electric heating solutions At least 5,000 houses (283,830 m ²) located in Ger areas will be retrofitted	
1.4. Provision of state-of-the-art emission reduction solutions	The Housing Infrastructure Department of the MUB	At least 30,000 chimney filter units/year distributed to households situated in fringe ger areas	

Action 1

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

Outcomes

Quantitative assessment

Measure	Environmental outcomes
1.1. Construction of energy efficient social housing	CO ₂ emissions savings of 25,000 tonnes of CO ₂ /year and a total of 1.2 mil tonnes of CO ₂ for 50 years lifetime for the new buildings.
1.2. Develop the guide for social housing	Energy savings of 70 GWh/year SO ₂ reduction is of 99% at project level, which translates into 2% reduction at city level (considering that households in ger areas contribute with 18% of total SO ₂ emissions)
1.3. Provision of alternative heating solutions ⁷ and retrofitting of houses	PM10 reduction is of 95% at project level, which translates into 3% reduction at city level (considering that households in Ger areas contribute with 39% of total PM10 emissions) Cross reference with Action 2 – CO ₂ benefits of RES penetration are calculated for the outcomes of this action. These outcomes are complementary, thus the CO ₂ benefits presented in there are also valid for this measure.
1.4. Provision of state-of-the-art emission reduction solutions	PM2.5 reduction is of 89% at project level, which translates into 5% reduction at city level (considering that households in ger areas contribute with 60% of total PM2.5 emissions)

Qualitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
All measures presented in Action 1	Air quality improvements Lower GHG emissions such as CO ₂ and black carbon due to improved energy efficiency of housing and reduced use of coal Lower energy consumption in buildings Improved soil quality due to reduced use of coal and generation of waste ashes Improvement of landscape	Promotion of the construction industry and creation of jobs especially for SMEs, which represent the major share of enterprises active in the sector Enhanced quality of life and life expectancy for citizens due to improved housing conditions, access to public services and social infrastructure Reduced vulnerability and risks for ger residents

⁷ Nan Zhao, Yixiang Zhang, Bowen Li, Jiong Hao, Deying Chen, Yuguang Zhou, Renjie Dong. Natural gas and electricity: Two perspective technologies of substituting coal- burning stoves for rural heating and cooking in Hebei Province of China, November 2018

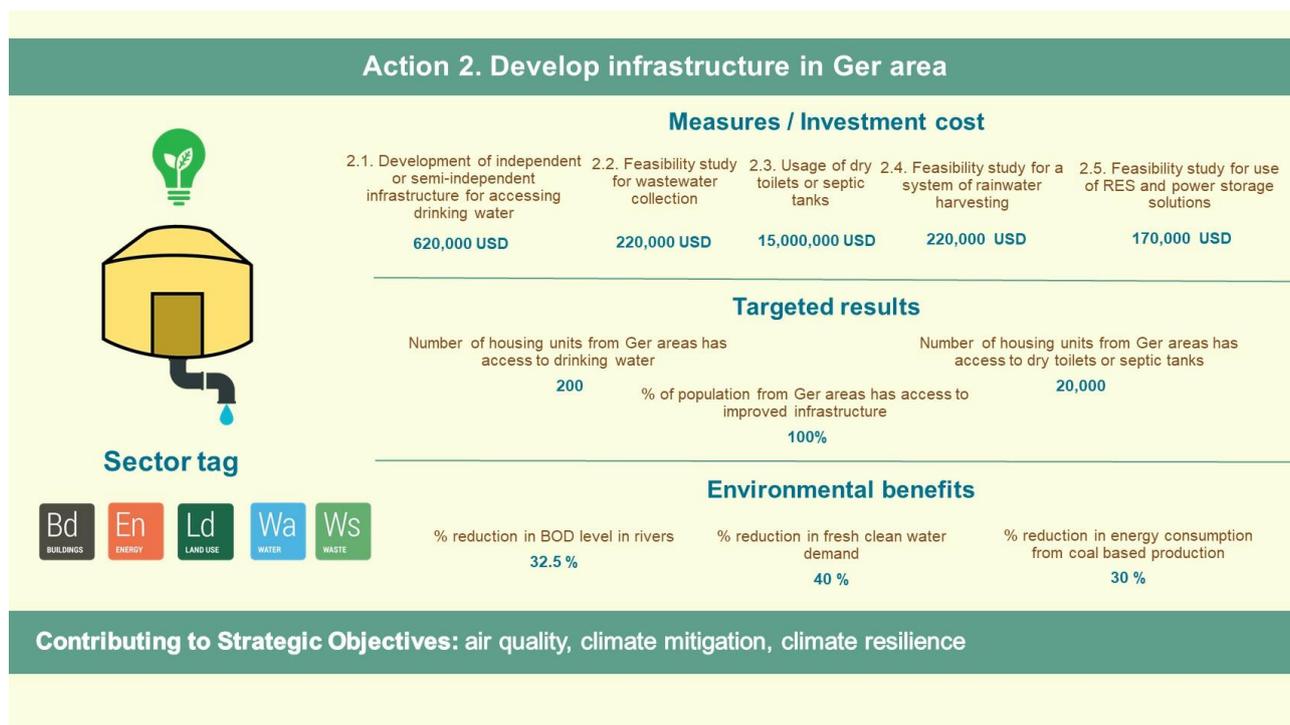
Action 2

Develop infrastructure in Ger areas



Action 3

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

As indicated in Action 1 the second action is complementary to the first one. It is presented separately for more clarity and distinction between improving housing in the Ger areas on the one hand and providing access to municipal and social infrastructure on the other hand.

The goal of this action is to increase the quality of life for UB citizens and especially the residents of the Ger areas. Currently, the disparity between the residents of the central area of UB and those in the Ger areas is high. Access to municipal infrastructure is limited and sometimes lacking in the latter. This action proposes to reduce and gradually close the gap between Ger areas and the city centre in terms of availability and quality of public services and infrastructure.

The lack or the inadequacy of infrastructure in the Ger areas causes environmental pollution, public health hazards and a low quality of life. The proposed solution builds on the experience of the Ger Development Department and the ADB GADIP project. Our aim is to work towards the development of green and suitable infrastructure for public utilities and to develop the Ger areas based on a polycentric vision. Thus, development of social infrastructure will also play a significant role and will contribute to the enhancement of the quality of life.

The measures envisaged within this action are to be implemented mainly in the fringe and relatively remote Ger areas. Still, there are no limitations for adopting any of the above measures in Ger areas situated close to the centre. For the development of a system for rainwater harvesting and reuse of grey water, the projects will target high flood risk areas and/or areas where new buildings are constructed.

The proposed actions are in line with and have the potential to enact several acts, city policies and strategic plans, especially the **Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar, 2018**. It includes a series of actions and measures, e.g. the improvement of protection of deep well water sources; the improvement of hygiene situation of water sources; the secure functioning of drinking water delivery/distribution pipelines; securing water resources, delivery and hygiene to Ger areas; strengthening the role of water distribution kiosks, water delivery transport and hygiene situation etc.

The following short-term measures have been defined:

2.1 Development of independent (small scale drinking water catchments, treatment and distribution that works at the level of cluster of houses used in remote areas) or semi-independent infrastructure for access to drinking water

Action 3

contributing to Strategic Objectives: air quality, climate mitigation

The current practice is the use of kiosks to provide water that is a form of semi-independent infrastructure. This system is quite successful, and people appreciate this service. Still, the long-term goal is to connect as many households as feasible to the centralized drinking water system and for the rest to provide alternative access to safe drinking water.

Since this is still very difficult to achieve on the short term for all residents, there is a need for adopting transitional solutions such as independent or semi-independent water drinking systems. As an alternative option the water kiosk system can be expanded. This will mean the need to develop the necessary infrastructure for water kiosks in fringe Ger areas and for other small-scale drinking water catchments, treatment and distribution networks. A feasibility study will be conducted in order to determine the most suitable technical solution for this measure in all areas. Also, in the first 5 years we are aiming at testing the small-scale solutions for about 200 housing units.

2.2. Development of a wastewater collection system and community scale wastewater treatment plant

This measure targets fringe ger areas where the current centralized wastewater collection network is not available. The measure aims at developing a feasibility study regarding wastewater collection systems in remote areas from a cluster of households based on proximity principle, and the transportation of wastewater to a community scale wastewater treatment plant, if it is not feasible to access the centralized system. This should also cover the analysis of outlets/opportunities for waste from septic tanks and dry toilets usage.

The measure is complementary to measures envisaged in Action 11.

2.3. Usage of dry toilets or septic tanks

As of today, 95% of the households in Ger areas do not have access to wastewater collection system. This means that the toilets are pit latrine type, consequently the soil quality and water quality in these areas are negatively impacted. In order to mitigate this impact, we propose to introduce dry toilets or septic tanks for houses located in the fringe Ger areas, with a target of 20% coverage in the first 5 years. A feasibility study included in measure 2.2 will determine the most suitable solutions for the short term and long term.

2.4. Feasibility study for rainwater harvesting and reuse of grey water for supplementing water needs to reduce water scarcity and to enhance flood protection

This will include, but not limit to, rainwater harvesting from roads/hard surfaces, as a complementary flood protection measure, and drought relief and ground water use to top off water needs in fringe areas. The measure includes an analysis of rainwater storage in underground public open spaces. We will also consider economic incentives such as water tariff reform to support rainwater and grey water use/water saving.

2.5. Feasibility study for use of RES and power storage solutions

Promoting renewable energy solutions and developing energy efficiency measures for houses in the Ger areas are among our priorities. We will prepare a feasibility study for transforming a household in fringe area to a passive energy building. We are aiming at analysing the potential use of RES in fringe areas. This will be done via a feasibility study developed for understanding the opportunities for increasing the RES in areas that are situated further away from existing electricity and district heating networks. This feasibility study will also consider potential power storage solutions.

Action 2 includes also two soft overarching measures. One is focusing on awareness raising and will be focused on promoting the results of measures 2.3, 2.4 and 2.5. The other is focusing on capacity building of local authorities on use of RES in ger areas. A capacity building programme will be developed as part of the feasibility study included in measure 2.5 and implemented during a period of one year. The capacity building programme will be defined based on the needs identified during the feasibility study stage (institutional analysis).

Beside the above-mentioned measures, there are two additional measures included in other actions within the GCAP:

- Access to waste collection –reducing the negative impact of illegal waste disposal currently taking place in Ger areas. Action 12 presented in the GCAP includes a detailed description of the development of the waste collection system in the Ger areas.
- Access to public transport – introducing public transportation to all Ger areas is covered under Action 8. Develop Sustainable Urban Mobility Plan.

Action 3

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Regarding long-term measures, we will expand the drinking water and wastewater networks. Also, in parallel to green housing, public infrastructure and services, we will develop social infrastructure such as schools, kindergartens, health care units, large green areas with multi-purpose functionality, recreational areas, buffer zones for reducing the climate change impacts such as flooding and social functions such as providing space for gathering, organizing community events, etc.

As described in Action 1, the final goal of Ger redevelopment is to have functional urban zones with centers, including municipal services, residential and educational facilities, production / technology / economic development, multi-purpose green spaces, health centers, accessibility features etc. ("city within a city").

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
2.1. Feasibility study for development of independent or semi-independent infrastructure for accessing drinking water	220,000 USD		International donor organizations / Local budget
Infrastructure elements such as: water tank and pipes for 200 households	400,000 USD	10,000 USD	
2.2. Feasibility study for development of wastewater collection system and community scale wastewater treatment plants	220,000 USD		International donor organizations / Local budget
2.3. Usage of dry toilets or septic tanks for approx. 20,000 house units	15,000,000 USD		International donor organizations / Local budget
2.4. Feasibility study and tender dossier for development of a system for rainwater harvesting	220,000 USD		International donor organizations / Local budget
2.5. Feasibility study for use of RES and power storage solutions	170,000 USD		International donor organizations
Awareness raising campaigns for promoting the results of actions 2.3, 2.4 and 2.5		25,000 USD	Local budget

Implementation framework

Measure	Steps to be taken
2.1. Development of independent or semi-independent infrastructure for accessing drinking water	Conduct a feasibility study for the two options presented in order to analyze the optimal solution for providing all Ger area residents access to safe drinking water. Implement the solution that is determined by the feasibility study as optimal. Tender out the construction work services. Monitor and evaluate the project implementation.
2.2. Feasibility study for wastewater collection system and community scale wastewater treatment plants	Feasibility study Based on the outcomes of the feasibility study, prepare the tender documentation for construction work and the tender for acquisition of equipment
2.3. Usage of dry toilets or septic tanks	Prepare the tender dossier Procurement of equipment via tendering process Monitor and evaluate the project implementation Conduct one awareness raising campaign for promoting this type of solutions
2.4. Feasibility study for rainwater harvesting	Prepare a feasibility study for water harvesting. Assess areas under flooding risk. Conduct a technical, economic and social assessment of proposed first phase of the project.

Action 3**contributing to Strategic Objectives:** air quality, climate mitigation

2.5. Feasibility study for use of RES and power storage solutions	Develop a feasibility study for analyzing the technical, economic, environmental and social aspects related to use of RES and power storage solutions.
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Measures	Implementing entity	Targeted results	Contribution to existing policies
2.1. Development of independent or semi-independent infrastructure for accessing drinking water	Owner: MUB, Housing Infrastructure Department Cooperating stakeholders: Department of Urban Planning, Master Planning Agency, Districts and Khoroo administration in the Ger area, USUG, Green Space Municipal Enterprise, NOSK	Access to improved municipal infrastructure for about 200 housing units in fringe areas	Action Plan for Ulaanbaatar 2020, Master Plan and Development Approaches for 2030, 2016 Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar, 2018
2.2. Feasibility study for wastewater collection system and community scale wastewater treatment plants	Citizens Associations and NGOs for awareness raising campaigns for 2.3, 2.4 ad 2.5	Decision on the most appropriate type of wastewater collection system	
2.3. Usage of dry toilets or septic tanks		20,000 housing units located in fringe Ger areas	
2.4. Feasibility study for rainwater harvesting		Decision on the most appropriate type of rainwater harvesting and grey water reuse systems	
2.5. Feasibility study for use of RES and power storage solutions		Decision on the most appropriate solution for use of RES	

Outcomes

Quantitative assessment

Measure	Environmental outcomes
2.1. Development of independent or semi-independent infrastructure for accessing drinking water	Access to safe drinking water is one of the key sustainable development goals. The implementation of this measure will increase the water demand and most probably, the Water Exploitation Index figure as well. Still, the overall environmental and socio-economic benefits of this measure are to be quantified at system level (water and wastewater system).
2.2. Feasibility study for wastewater collection system and community scale wastewater treatment plants	Wastewater collection is the backbone of the entire wastewater management system. On short-term, the development of the feasibility study will not have direct environmental outcomes. By implementing the outcomes of the feasibility study and introducing a wastewater collection system in the Ger areas the pollution with nitrates will be reduced. Thus, the total BOD level in rivers (Tuul river and its tributaries) will be significantly reduced. Still, the direct benefits are to be considered only if the wastewater treatment plant of the city will be fully functional. On long term we are aiming at reducing the BOD level from rivers in UB with approximately 30%. This measure is complementary to Action 6.
2.3. Usage of dry toilets or septic tanks	Usage of dry toilets or septic tanks eliminates the risks for water pollution (groundwater and surface water) and soil pollution. Considering that 20% of the BOD in water is determined by the households in Ger areas and that we are aiming at providing solutions to 20,000 households, this translates into a contribution of 2.5% reduction in BOD in rivers and lakes.
2.4. Feasibility study for rainwater harvesting	On short term there are no direct environmental outcomes. Still, if the feasibility study will be implemented, then there is a high potential for reduction in fresh clean water demand ⁸ with 37-66%. Considering that the total water demand for Ger areas is projected to be of 14 mil m ³ /day in 2020, and we calculate a reduction of 40% in demand, this will translate into daily savings of approximately 5.6 mil m ³ /day of water if this measure is implemented all over the Ger areas.
2.5. Feasibility study for use of RES and power storage solutions	On short term there are no direct environmental outcomes. On long term, this has a potential for avoiding CO ₂ emission of 35 tonnes ⁹ . Households will reach 30% self-sufficiency rate, that means reducing the energy consumption from coal-based production with about 30%.

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 2 – all measures	<ul style="list-style-type: none"> Improved air, water and soil quality in the Ger areas Resource, energy and water efficiency Increased availability of water Lower CO₂ equivalent emissions Increased resilience of Ger areas infrastructure and communities living in the area Improvement of landscape 	<ul style="list-style-type: none"> Enhanced quality of life for citizens due to improved living conditions, access to public services and social infrastructure Improved health and safety conditions for ger residents Increased life expectancy or quality of life and decreased morbidity rate due to water-related diseases for ger residents

⁸ Hydro-economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap, 2030 Water Resources Group, 2006

⁹ This has been calculated for the scenario when about 5,000 households (could be correlated with measure 2.4 focusing on retrofitting) are switching from coal-based heating to electric heating systems using electricity generated by RES and power storage solutions.

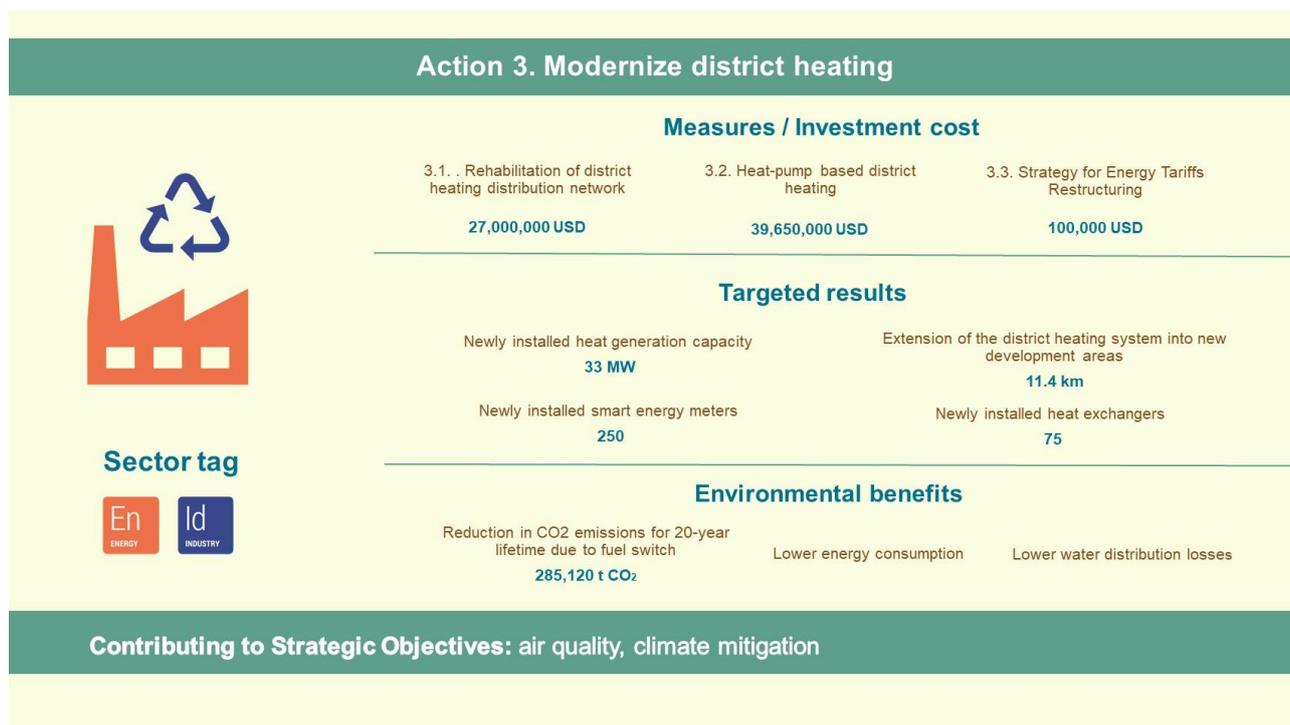
Action 3

Modernize district heating



Action 3

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

The central heat distribution network in Ulaanbaatar is old and the heat losses are much higher than comparable large networks in Western Europe, resulting in significant heat and energy losses. Share of thermal network losses on demand were at 25% in 2015. This action will reduce high energy losses along the distribution networks, through the rehabilitation of the district heating network and its expansion towards areas where new residential buildings, including new apartment buildings for ger residents, are to be developed and connected to the district heating system.

EBRD has recently prepared a project for Ulaanbaatar District Heating Company, aiming at improving the quality of the district heating company’s services, by modernizing the central district heating infrastructure and tariff setting, and by introducing the Subsidy Payment Policy. This action is largely based on that initiative.

In addition to the reduction of losses and energy efficiency, it is important to introduce renewable energy as a response to increasing heat demand. One of the ways to do that is through heat pumps connecting these directly to the district heating system. Heat pumps are an important way to reduce Ulaanbaatar’s reliance on coal and diversify the source of energy thereby reducing air pollution and mitigating climate change.

Reducing energy losses in the district heating sector is a complex and continuous process, which requires extended resources, therefore, measures were separated into short- and long-term actions.

On the short term, the measures will focus on the following areas:

- For analysing the potential of heat pump-based district heating, a cogeneration, state-owned plant is targeted, in order to improve its efficiency and introduce heat pump-based district heating, if feasible.
- The Strategy for Energy Tariffs Restructuring will consider both electricity and heat consumption, for the entire city of UB and its citizens. The Strategy will analyse tariffs for RES as well, taking into account prosumers potential, for both private companies and individual household owners.

Action 3

contributing to Strategic Objectives: air quality, climate mitigation

The following short-term measures have been defined:

3.1. Rehabilitation of district heating distribution network

The rehabilitation and modernisation works will cover district heating transmission networks from heat generation sources, CHP 2, CHP 3, CHP4 and Amgalan Heating-only Boiler, to district heating distribution system. Renovation works will be grouped in two packages, based on the owner/coordinator of works, as suggested by the Feasibility Study¹⁰ prepared as part of the EBRD project, as follows:

- a) Ulaanbaatar District Heating Company (UBDHC) works include replacing existing old pipelines and adding new pipelines to expand the supply area of the district heating system, in total 11.4 km (trench length) of district heating pipe network. Rehabilitation works will also include an additional new booster pump, replacement of obsolete valves and installation of 250 smart meters.
- b) Housing and Public Utilities of Ulaanbaatar City (OSNAAUG) works include supply and installation of new mixing loops, a new central substation, 151 energy meters for secondary side piping, replacement of clogged heat exchangers, a pilot project for demonstration of modern heating technology and thermostatic radiator valves and heat cost allocators.

3.2. Analyse the potential of heat pump-based district heating and implement a pilot project

To start with, we will carry out a demonstration project, aiming at 33 MW installed capacity. Based on the experience of the demonstration project a strategy will be drawn up to gradually increase the installed capacity of heat pumps. Heat pumps will be placed both at individual buildings, such as public buildings in the outskirts of the city that have no possibility to access the district heating network, but also in strategic places connected to the district heating network, extending the network's capacity and improving its resilience. This action will be supported by the outcome of the upcoming study on District Heating Renewable Heating integrating currently being undertaken.

3.3. Cooperate with state authorities in developing the Strategy for Energy Tariffs Restructuring

Present energy tariffs do not reflect the true costs of energy production and delivery and it is often the case that energy invoicing is not directly proportional to the energy consumption. They hinder energy transition, compromise many of the possible business opportunities for clean energy infrastructure, renewable energy and energy efficiency, and demand side management. Low energy tariff regulated and heavily subsidized by the Government makes the whole sector economically inefficient, technologically outdated, and unattractive for investments. Currently, heat is invoiced on per unit area basis, without reflecting real measured consumption values. This does not drive efficiency, as the final bill does not directly relate to real on-site consumption. A structured program to revert this situation, to one where true energy costs and consumption are reflected, is a major pillar of energy transition. UBDHC and OSNAAUG will cooperate with the Energy Regulatory Commission in order to develop a Strategy for Energy Tariffs Restructuring, including a thorough assessment of risks and benefits, covering risk reduction measures as well as social and environmental effects. Information and awareness raising components are imperative and they will be implemented from the very beginning of the strategy development, in order to reach end users and make them understand the real situation and necessary tariff restructuring measures.

For long-term measures, the city will consider the following:

- Further extension of the district heating network and supply, towards areas where new residential buildings are to be developed and connected to the district heating system, especially in those areas that are located relatively close to the city centre and the existing network. This measure will be cross-referenced with Action 1.
- Rolling out the smart metering programme for all users
- Introduction of thermal storage facilities at one of the cogeneration plants, which will provide the flexibility for use of alternative heat sources.
- Rolling out investments into integrating renewable energy and waste heat sources into the current district heating system as defined through the relevant ongoing EBRD financed study.

¹⁰ ULAANBAATAR DISTRICT HEATING - FEASIBILITY STUDY, FINAL REPORT, June 2019, EBRD, developed by COWI

Action 3contributing to **Strategic Objectives**: air quality, climate mitigation

Cost estimate for short term measures

Measure	CAPEX	OPEX	Source of finance
3.1. Rehabilitation of district heating distribution network a) UBDHC package b) OSNAAUG package	15,000,000 USD 12,000,000 USD	270,000 USD	EBRD ¹¹
3.2. Heat-pump based district heating Feasibility study and implementation of 33 MW capacity of heat pumps Strategy to increase heat pump share in the district heating network	39,600,000 USD 50,000 USD	400,000 USD	IFI, state budget, local budget
3.3. Strategy for Energy Tariffs Restructuring	100,000 USD		Local budget, state budget

Implementation framework

Measure	Steps to be taken
3.1. Rehabilitation of district heating distribution network	Perform renovation and modernization works according to the implementation plan Monitor implementation and evaluate performances through indicators mentioned below
3.2. Heat-pump based district heating	Development of the Feasibility Study for a pilot project of heat-pump based district heating. The FS will include a project implementation plan. Roll out investments to achieve the target for installed capacity
3.3. Strategy for Energy Tariffs Restructuring	Support the ERC in developing the Strategy for Tariffs Restructuring supplying specific knowledge regarding UB citizen preferences, affordability regarding heating.

Measures	Implementing entity	Targeted results	Contribution to existing policies
3.1. Rehabilitation of district heating distribution network	Owner: MUB, through the Ulaanbaatar District Heating Company (3.1); Housing and Public Utilities of Ulaanbaatar City (OSNAAUG) (3.1, 3.2); The Ministry of Energy, Energy Regulatory Commission (ERC) (3.3);	Reduce the share of network losses on distribution	Ulaanbaatar Energy Master Plan
3.2. Heat-pump based district heating		Extension of the district heating system into new development areas (ger areas)	National Air and Environmental Pollution Programme (2017 -2025)
3.3. Strategy for Energy Tariffs Restructuring	Other stakeholders: Owners of the CHPs, private companies developing the market for heat-pumps and looking to connect to the DH network	33 MW installed heat generation capacity by heat pumps	National Energy Efficiency Programme (2018 -2022)

¹¹ <https://www.ebrd.com/work-with-us/projects/psd/ulaanbaatar-district-heating-project.html>

Outcomes

Quantitative assessment

Measure	Environmental outcomes
3.1. Rehabilitation of district heating distribution network	CO ₂ emission reduction due to energy saving 197,482 t CO ₂ / year (UBDHC package) 67,068 t CO ₂ / year (OSNAAUG package)
3.2. Heat-pump based district heating	CO ₂ emission reduction due to fuel switch, RES penetration 14,256 t CO ₂ /year, assuming a lifetime of 20 years, 285,120 CO ₂ (33 MW capacity)
3.3. Strategy for Energy Tariffs Restructuring	This action has no direct outcomes but is needed for the implementation of all energy sector related measures that result in RES penetration, energy saving, air pollution reduction and CO ₂ emission reduction.

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 3 – all measures	Lower energy consumption, efficiency gains in distribution and RES penetration reduces air pollution from coal-based energy generation. Improved availability of water due to lower water consumption related to distribution network losses	Reduced maintenance costs (EUR/year) Improved cost-efficiency of the system allowing for reduced subsidies from national and local budgets The measures will demonstrate the benefits of energy and water conservation and will promote the expansion of energy efficiency investments. Promotion of the construction industry and creation of jobs especially for SMEs, which represent the major share of enterprises active in the sector.

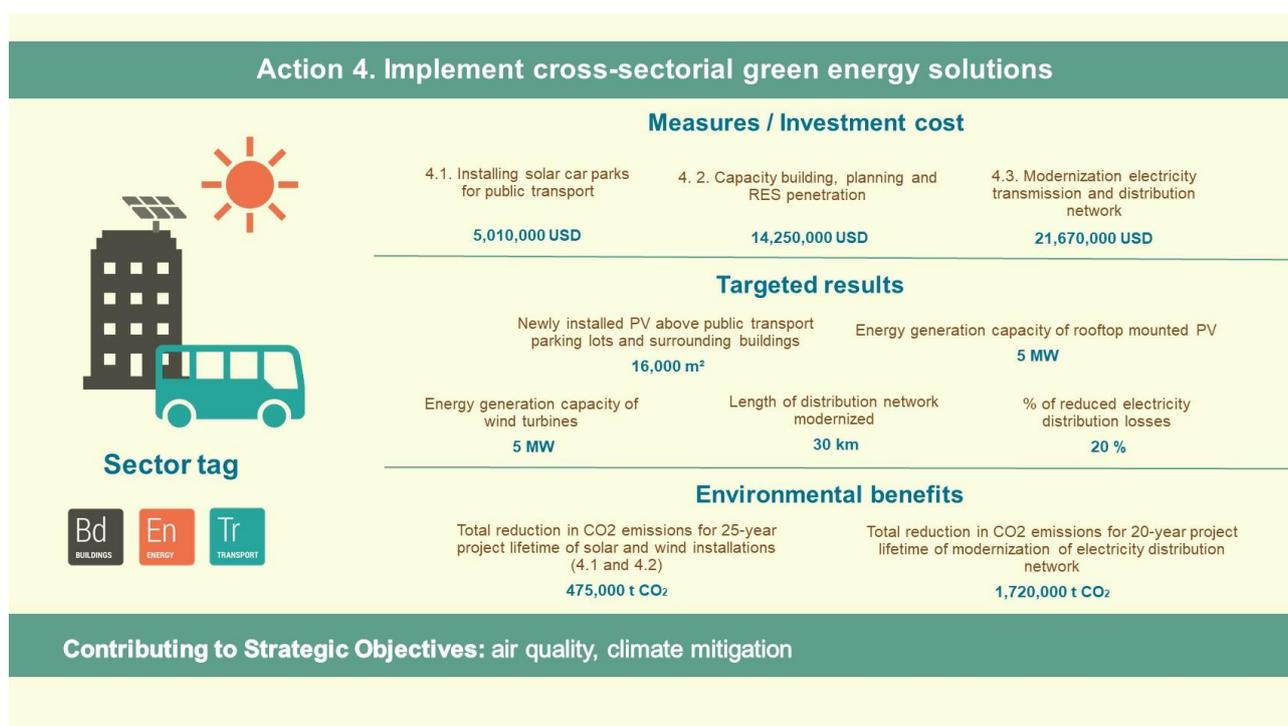
Action 4

Implement cross-sectorial green energy solutions



Action 4

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

Energy intensive sectors, like buildings, energy intensive industry, coal-based energy generation and transport are concentrated in the city as Ulaanbaatar contributes with about 75% to the country's GDP. Increasing heat and electricity demand associated with urban growth results in high greenhouse gas emissions and severe air pollution, especially during the winter months. GHG emissions and air pollution will increase in time, proportionally. Addressing air pollution and associated health risk is one of the most stringent problems to be tackled by city.

Cross-sectorial Green Energy measures will reduce dependence on coal and increase resilience and flexibility of the system. Therefore, we focus on high penetration of RES and green solutions for the energy generation and distribution technologies. Due to high levels of solar irradiation and wind speed as well as the large land area of UB City and the steppe around the city, UB City benefits from an abundant solar and wind potential. Complementary to this Action are those measures focusing on electric heaters (Action 1) and electric mobility (Actions 8 and 9) that also add to green electrification. Integrating PV panels in the decentralised newly built housing areas will be analysed and a pilot project is planned as part of Action 1. Action 3 includes a measure for tariff restructuring that is also needed for all the green energy measures.

In spite of the high potential for RES penetration, the knowledge and capacity for implementing RES projects still needs to be improved at our municipality. For example, in 2017 about 1.5 million USD was invested into solar panels for district level public buildings but the solutions did not work in an optimal way. Therefore, the buildings switched back to coal-based heating. In the future, to avoid these types of problems, more knowledge on best available technologies and capacity building is needed.

The policy framework is increasingly supportive of sustainable energy solutions with one of the pillars of the Energy Conservation Law focusing on incentives. Also, the Energy Regulatory Commission has a feed-in tariff for RES generators and is considering other facilities such as VAT exemption or lower fee for electricity sold at night-time to RES generators.

The **Law on Renewable Energy** (revised on June 2019) regulates issues related to the generation of energy using renewable energy sources and the uptake and distribution of renewable energy. In the **State Energy Policy**, the strategic goal is to scale up energy generation by using renewable energy resources, reducing adverse environmental impacts of conventional power systems and GHG emissions. Mongolia aims to increase the share of renewables in total installed capacity to 20% in 2020 and 30% in 2030.

The following short-term measures have been defined:

Action 4

contributing to Strategic Objectives: air quality, climate mitigation

4.1. Installing solar car parks for public transport

As a first demonstration project for the PV, we will study the feasibility of installing solar car parks for public transport and implement a pilot project. Parking areas are unexploited brownfields, which have a high potential for generating renewable energy. Buildings roofs and solar carports can enhance parking lots and improve the economic and environmental performance of the area. By installing photovoltaic panels above the bus depot (6,000 sqm PVs) and surrounding buildings (10,000 sqm PVs), clean electricity will be generated, that can be used for trolleybuses, to charge electrical buses and to provide additional sunshade over the car fleet overcoming surplus heat, resulting in less energy use. The study will consider integration of this project with the ongoing modernization of the depot and the fleet modernization, as well as possibility for connecting the power to the grid. This measure is cross-referenced with Action 8 – Sustainable Urban Mobility Plan (SUMP) for Ulaanbaatar: acquisition of electrical vehicles for public transport, development of infrastructure for electric charging stations (potential of using electricity generated from RES) and full integration with any planned depot works, which requires coordination between different departments and utility companies of the MUB.

4.2. Capacity building, planning and investment for RES penetration

This measure starts with a study, complementing currently available studies on RES potential with a Best Available Technologies (BAT) study to achieve that RES potential. The focus will be on BAT that is applicable to the specific weather conditions and energy system in Mongolia. The study will include feasibility study for a series of pilot projects for demonstrating solar and wind technologies. The pilot projects will be used as capacity building exercises for the relevant MUB departments and their utility companies as well as other stakeholders relevant for market development. The pilot projects in total aim at 5 to 10 MW investment within the 5-year planning period of the GCAP.

4.3. Modernisation of the electricity transmission and distribution network

Most power lines in UB are between 35 and 50 years old, resulting in high energy losses in the electricity transmission, caused by overloading of the distribution network. Previous lack of investment and maintenance requires urgent rehabilitation and modernisation works. Modernisation of the electricity distribution network will cover the power lines in UB city and will include replacing worn out electrical outlets and power lines, increasing the electricity network capacity (for an area covering 30 km of power lines) considering possible future grid integration of RES-electricity.

In addition, a substation is needed in the centre of the city to relieve the load on the substations on the Southern part of the city and to ensure that electricity distribution towards the outskirts is feasible. This will reduce the distance on which electricity has to be transmitted and will further reduce losses in the system. As there is limited space in the centre the substation will need to be underground.

Modernisation of the distribution networks will also take into consideration the potential for installing an automated system and end users control systems and consumption meters. For the implementation of this measure strong cooperation is needed with the Ministry of Energy and Energy Regulatory Committee.

For long-term measures, the city will consider the following:

- Analyse the potential of waste-based heat supply into the district heating network and implement a pilot project (mid-term);
- Increase the share of clean energy (generated by PVs and turbines), according to specification developed by the Energy Master Plan for Ulaanbaatar¹²;
- In the long-term increasing storage capacity for energy is very important, the Action package in the GCAP makes a first step in this direction through various measures, such as electric public transport and car park, heat pumps and battery storage at fringe Ger areas (cross-reference to Action 2).

¹² Energy Master Plan for Ulaanbaatar, Final report, Fraunhofer Institute for Solar Energy Systems ISE, October 2018

Action 4

contributing to Strategic Objectives: air quality, climate mitigation

Cost estimate for short term measures

Measure	CAPEX	OPEX	Source of finance
4.1. Installing solar car parks for public transport 10,000 sqm on building roofs, PV module without frame – at 300 USD/m ² 6,000 sqm above parking areas, PV module with frame – at 335 USD/m ²	5,010,000 USD	25,000 USD	Donor or blended finance
4.2. Capacity building, planning and investment for RES penetration			State budget, IFI, donor financing for technical assistance and capacity building
Study on Best Available Technology and mini-feasibility studies for RES pilot projects	500,000 USD	325,000 USD	
Implementing up to 10 MW RES pilot project investments	13,000,000 USD		
Strong capacity building component	750,000 USD		
4.3. Modernisation of the electricity transmission and distribution network			IFI financing, local budget, national budget
Feasibility Study on the rehabilitation of electricity distribution network	220,000 USD	50,000	
Rehabilitation of grid capacity and power lines (30 km)	6,450,000 USD	75,000	
Substation in the central part of the city	15,000,000 USD ¹³		

Implementation framework

Measure	Steps to be taken
4.1. Installing solar car parks for public transport	Develop a Feasibility Study for installing solar car parks for bus depot and surrounding buildings, integrated into the depo-rehab concept. Explore potential to use solar car park for the charging of electric public transport vehicles. Implement integrated pilot project for solar car park over the bus depot and surrounding buildings
4.2. Capacity building, planning and investment for RES penetration	Using as a starting point existing positive and negative experiences and studies already available or underway for capacity of Renewable Energy Sources, conduct a study with practical guidance on the Best Available Technologies for Mongolia. Identify pilot projects and conduct feasibility studies for up to 10 MW of capacity installed, focusing mostly on wind and solar energy. One such pilot could be rooftops of selected public buildings. Implement pilot projects while defining and carrying out a strong capacity building component, including on the job training for various market players and municipal staff involved.
4.3. Modernisation of the electricity transmission and distribution network	Develop a Feasibility Study for the rehabilitation of electricity distribution network including a substation in the central area of the city. The FS will include a project implementation plan and details regarding phasing of works.

¹³ Source: <http://www.anaheim.net/DocumentCenter/View/2356/Park-Substation-Fact-Sheet-PDF>

Action 4

contributing to Strategic Objectives: air quality, climate mitigation

Measures	Implementing entity	Targeted results	Contribution to existing policies
4.1. Installing solar car parks for public transport	Owner: MUB, through the Mayor's Office (4.1), Ministry of Energy, Energy Regulatory Committee (4.2, 4.3)	30 kilometres of rehabilitated electricity distribution networks	Law on Renewable Energy State Energy Policy Ulaanbaatar Energy Master Plan Green Development Policy of Mongolia and Action Plan
4.2. Capacity building, planning and investment for RES penetration		Reduced annual operational costs for the electricity distribution network	
4.3. Modernisation of the electricity transmission and distribution network		Introduce renewables into the total energy consumption used by the public transport fleet	
	Cooperating stakeholders: Ulaanbaatar Electricity Distribution Network Company and Public Transport Company, National Power Distribution Company	Reduce electricity distribution losses by 20%	
	Other stakeholders: National Centre for Renewable Energy	Higher share of tolerable intermittent renewable energy	

Outcomes

Quantitative assessment

Measure	Environmental outcomes
4.1. Installing solar car parks for public transport	5,000 tCO ₂ /year emission reduced from fuel switch to solar energy, 125,000 tCO ₂ emissions reduced for 25 years lifetime of operation;
4.2. Capacity building, planning and investment for RES penetration	14,000 tCO ₂ /year emission reduced from fuel switch to solar and wind energy, 350,000 tCO ₂ emissions reduced for 25 years lifetime of operation;
4.3. Modernisation of the electricity transmission and distribution network	86,000 tCO ₂ /year emission reduced from fuel switch to solar and wind energy, 1,720,000 tCO ₂ emissions reduced for 20 years lifetime of operation;

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 4 – all measures	Improved air quality in UB and improved public health due to avoided air pollution Diversified energy supply and reduced dependence on coal-based fuels Increased grid efficiency and resilience to unexpected events	Reduction of energy costs through substitution with the green energy sources Increased security and reliability of energy supply Increased life expectancy or quality of life due to decrease in pollution Increased energy independence Promotion of the construction industry and creation of jobs especially for SMEs, which represent the major share of enterprises active in the sector.

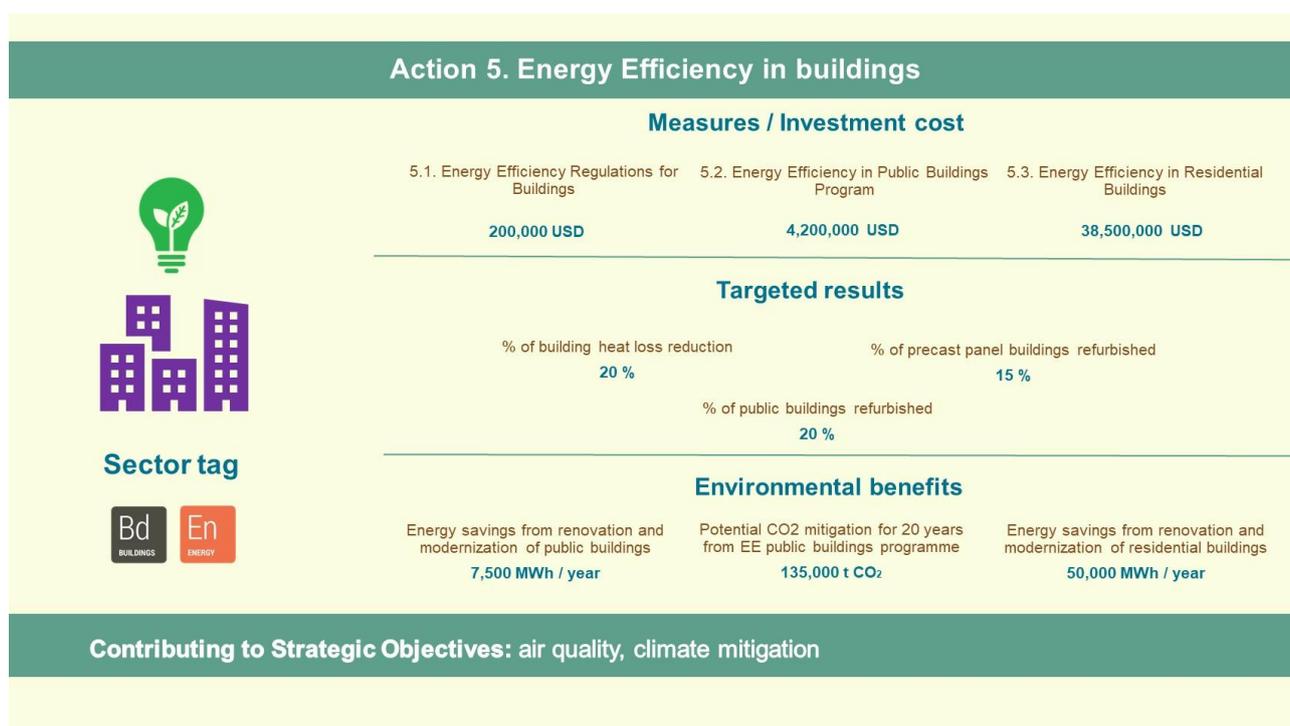
Action 5

Energy Efficiency in buildings



Action 5

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

The Buildings sector is energy intensive and highly polluting due to inefficient and low-quality buildings that include the mostly poor-quality new buildings as well. Poor air quality and smog are directly related to coal based heating and intensive use of raw coal in inefficient stoves, especially in the Ger areas.

This action promotes the implementation of energy efficiency retrofit measures in existing buildings such as heating, hot water, ventilation, lighting or thermal insulation, through a set of measures provided by the Municipality and minimum requirements for new buildings for green design and energy efficiency. The project promotes the retrofit of buildings with measures targeting energy efficiency and thermal refurbishment, including energy meters and control systems at individual user level. It also promotes installation of solar electricity generation systems and non-EE measures such as drainage, asbestos roofs replacement, ventilation systems etc. Our aim is to acquire the energy certification of the retrofitted and of the new buildings, qualifying as highly efficient buildings.

The project will be supported by information and awareness campaigns and complemented by credit lines to local banks for on-lending to individuals, households, groups of residents, housing associations, condominiums and cooperatives as well as housing management companies (HMCOs) and other mechanisms for financing eligible energy efficiency improvements.

These actions will encourage building owners, developers and investors to include energy efficiency measures in the retrofit of the existing building stock and in the construction of new buildings, creating a positive impact on the natural environment, while also preserving natural resources and improving users' quality of life by reducing energy consumption, air pollution and costs for the users.

The actions come to complete and work with a series of existing responses in the sector. One such response is an economic instrument available for large energy consumers, including some public buildings from the central administration on that list. This gives the listed entities the possibility to enter into ESCO contracts for energy efficiency investments, while the ERC caps tariffs at the moment of contract signature. Other recent responses include GIZ financed energy efficiency projects, that include a variety of building types and have managed to demonstrate energy savings as high as 60%.

Furthermore, MUB through GIZ has been selected to prepare a full project proposal for the NAMA Facility by March 2019. The title of the project is "Energy Performance Contracting for Residential Retrofitting in

Action 5

contributing to Strategic Objectives: air quality, climate mitigation

Ulaanbaatar¹⁴. This program covers 375 buildings and a total number of over 15,000 foreseen beneficiaries. The aim of the project is to increase energy efficiency investments in the building sector through physical interventions for retrofitting, financial intervention, introducing and facilitating the EPC market and through awareness raising and technical capacity. The details of the project are still being defined and investments are expected to start in 2020.

The existing legislation enables financing instruments for projects related to energy efficiency. According to the Article 6.1 of the Law on Energy Conservation (2015) the State Central Administrative Authority shall exercise powers with regard to energy conservation and efficiency, thus the municipality will need to cooperate with the Energy Regulatory Committee (ERC) for implementing measures related to increasing energy efficiency standards for buildings.

The Building Code Norms and Standards (BCNS) originate from the 1960s and 1970s and contain 517 norms and standards. These are out-dated, but 60 of these were improved and revised between 2010 and 2013 by through the UNDP GEF Building Energy Efficiency Project (BEEP) leading to three new standards/norms. The BCNS 23-02-2009 clearly determines limits for thermal resistances of buildings, heat transfer coefficients, specific thermal energy consumption, air permeability and others while distinguishing between different building types and applications. For instance, different buildings are categorised by various efficiency levels (A: <51% to E: >76%; deviations from normative) and new residential buildings already have to meet the classes A or B. This regulation is followed in case of high-rise buildings and developers but may be more loosely observed by those building single family houses. Moreover, minimum values for thermal resistances for different building components are determined, as well as air exchange rates and maximum specific heat consumption limits for different floor spaces and storey numbers. These targets need to be further revised and implemented in order to meet green requirements and targets.

The following short-term measures have been defined:

5.1. Energy Efficiency regulations for buildings

This document will be a local strategy/regulation for buildings, and it will focus on:

- Reviewing existing building codes and establishing energy efficiency regulations for new buildings and building retrofits; imposing energy specific consumption limits, in kWh/m²/year for any new construction and major renovation; including buildings' energy certification as mandatory for new buildings and deep retrofit of existing buildings;
- Setting up an enforcement system for the energy consumption limit through permitting and audits. This relates to the building norms and energy performance requirements.
- Develop Financial and Administrative Incentives to promote and support construction and renovation of highly energy efficient buildings, and integration of RES in private buildings. These mechanisms will incentivise investment in energy efficiency actions helping develop energy efficiency market for interested developers and investors. The programme will be coordinated and initiated by the Municipality, in close collaboration with Energy Regulatory Committee and will provide support for citizens, through a dedicated phone line.
- Develop General Design Guide for Retrofit of Buildings, which includes energy-efficiency and RES targets and measures. The guide will provide minimum requirements, technical and financial information regarding energy efficiency and renewable energy solutions. The Municipality will disseminate the guide with the help of the Policy and Planning Department, Urban Planning Department and its website, through an information campaign and trainings for managers of public buildings.

The Municipality will tailor the regulation to target public buildings and private buildings, other than residential (commercial buildings, office buildings), setting an example through own buildings and empowering construction investors towards energy efficient and green behaviour. Imposing specific consumption limits for new construction and major renovation projects will be enforced through conditioning the building and occupancy permits. This policy action is expected to trigger action in the market and kick-start the retrofitting and energy efficiency market. The segments targeted by the policy measures are pre-cast high-rise buildings

¹⁴ Source of the project: <https://www.nama-facility.org/projects/mongolia-energy-performance-contracting-for-residential-retrofitting-in-ulaanbaatar-city/>

Action 5

contributing to Strategic Objectives: air quality, climate mitigation

and public buildings in the first instance with targets of 10% and 20% retrofitting rate from the total building stock in these categories.

This measure is complemented by measures introducing and rolling out heat meters as part of Action 3.

5.2. Energy Efficiency in public buildings programme

The project aims to promote the retrofit of municipal public buildings (except for educational public buildings, which are covered by the Global Green Growth Institute programme) with measures targeting on energy efficiency, thermal refurbishment, green technologies and occupants' comfort, resulting in highly energy efficient retrofitted buildings. Rehabilitation of public buildings will cover three main aspects: analysis of current situation and energy mapping of the existing municipal buildings stock & development of an inventory, pilot project for rehabilitation of a number of municipal buildings, aiming at a total of 30,000 sqm. Besides, an Energy efficient users' guide for all occupants of public buildings will be developed. It is expected that the results of the actions in the public buildings have a demonstration effect so that they will be used as showcases in information and awareness campaigns in order to promote the involvement of privates and market expansion. The programme will be continued on the long term, with the rehabilitation of all municipal buildings, as resulting from the analysis.

5.3. Energy Efficiency in residential buildings programme

This measure aims to promote the retrofit of residential buildings with measures targeting energy efficiency and thermal refurbishment, including energy meters and control systems at individual user level; these may include heat cost allocators and thermostatic valves. It also might include the installation of solar electricity generating systems and non-EE measures such as drainage, roofs replacement, ventilation systems etc. It is aimed that the retrofitted buildings improve their indoor air quality and energy certification, in a minimum of two levels. In the short term, additionally to the measures described above, we are aiming to cover roughly 700 buildings. In order to get applications from Housing Associations an awareness raising campaign will be carried out. The initiatives that are ongoing and are already near implementation are expected to inform the technical solutions and the financing mechanisms so that these additional retrofits can be carried out in the 5-year planning horizon.

For long-term measures, the city will consider the following:

- Energy Efficiency in Public Buildings Programme, which will be a follow-up of the first short-term components and will cover the rehabilitation of the existing municipal buildings stock.
- Energy Efficiency in Residential Buildings Programme, which will be a follow-up of the short-term components and will cover the rehabilitation of the existing residential buildings stock.

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
5.1. Energy Efficiency Regulations for Buildings Retrofitting targets associated with this policy measure are not costed, they are expected to result from policy implementation.	200,000 USD	Not relevant	Local and national budget, grant financing from IFI
5.2. Energy Efficiency in public buildings programme 140 USD/m ² ; @ 10,000 m ²	4,200,000 USD		IFI loan
5.3. Energy Efficiency in residential buildings 110 USD/m ² @ 700 buildings @ 500 sqm each	38,500,000 USD		Private sector, IFI loan

Action 5

contributing to Strategic Objectives: air quality, climate mitigation

Implementation framework

Measure	Steps to be taken
5.1. Energy Efficiency Regulations for Buildings	<p>Define tender specifications and launch the public tender for development of the Energy Efficiency Regulations for Buildings</p> <p>Define Financial and Administrative Incentives and an implementation plan for these in close consultation with the local banks in order to understand their preferences and conditions under which they will invest in EE.</p> <p>Develop a dedicated phone line, operated by the Municipality, to support potential beneficiaries of the programme.</p> <p>Review and approve the Regulations in close cooperation with the Ministry of Energy, Ministry of Construction and Urban Development and the Energy Regulatory Commission.</p> <p>Enforce the Regulations and conduct information and awareness raising activities.</p>
5.2. Energy Efficiency in Public Buildings Programme	<p>Prepare a tender for the analysis/energy mapping of existing municipal buildings stock.</p> <p>Develop a Feasibility Study for the Pilot project rehabilitation of 30,000 sqm. The FS will include a project implementation plan and details regarding phasing of works.</p> <p>Perform renovation and modernization works according to the implementation plan.</p> <p>Monitor implementation and evaluate performances through indicators mentioned below.</p>
5.3. Energy Efficiency in Residential Buildings	<p>Review the financing mechanisms and solutions identified and used in the on-going residential retrofit programmes (GIZ, GCF, NAMA Facility) and select best approaches.</p> <p>Set up the necessary application procedure and allocate budget from local/state budget for a residential energy efficiency programme (potentially attract additional financing, though most sources are already tapped for that).</p> <p>Implement an energy efficiency program for 700 residential building as an intermediary between the Housing Associations, banks and as co-financers through any subsidies (facilities) made available.</p>

Measures	Implementing entity	Targeted results	Contribution to existing policies
5.1. Energy Efficiency Regulations for Buildings	Owner: MUB, through the Mayor's Office		
5.2. Energy Efficiency in Public Buildings Programme	Cooperating stakeholders: Policy and Planning Department, Urban Planning department and its Master Planning Agency	20% building heat loss reduction	Law on Energy Conservation, 2015
5.3. Energy Efficiency in residential buildings programme	Other Stakeholders: Construction State Commission and the Green Building Council when it comes to the General Design Guide for Retrofit of Buildings	15% precast panel buildings refurbished as a cumulative impact of policy and investment	Energy Master Plan for Ulaanbaatar
		20% public buildings refurbished	Nationally Determined Contributions
			Green Development Policy and Action Plan of Mongolia

Outcomes

Quantitative assessment

Measure	Environmental outcomes
5.1. Energy Efficiency Regulations for Buildings	This is a soft measure that has no direct impact; however, it is essential to enable the energy efficiency investments in the sector.
5.2. Energy Efficiency in Public Buildings Programme	7,500 MWh/year of energy saving (50% savings on heat); 2,700 tonnes CO ₂ emissions avoided per year and 135,000 tonnes CO ₂ over the investment's lifetime of 20 years;
5.3. Energy Efficiency in the Residential Buildings programme	50,000 MWh/year of energy saving (50% savings on heat); 17,700 tonnes CO ₂ emissions avoided per year and 880,000 tonnes CO ₂ over the investment's lifetime of 20 years;

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 5 – all measures	Improved air quality Lower CO ₂ emissions associated with energy use (CO ₂ eq)	Reduced costs for energy consumers Increase in property values Increased life expectancy or quality due to the decrease in the need for coal-dependent energy production for all citizens Business opportunities for building developers, investors and construction companies Opportunities in the construction industry and creation of jobs especially for SMEs, which represent the major share of enterprises active in the sector Improved energy performance of the housing stock will secure a good indoor air quality, a better quality of life for occupants and lower operational costs

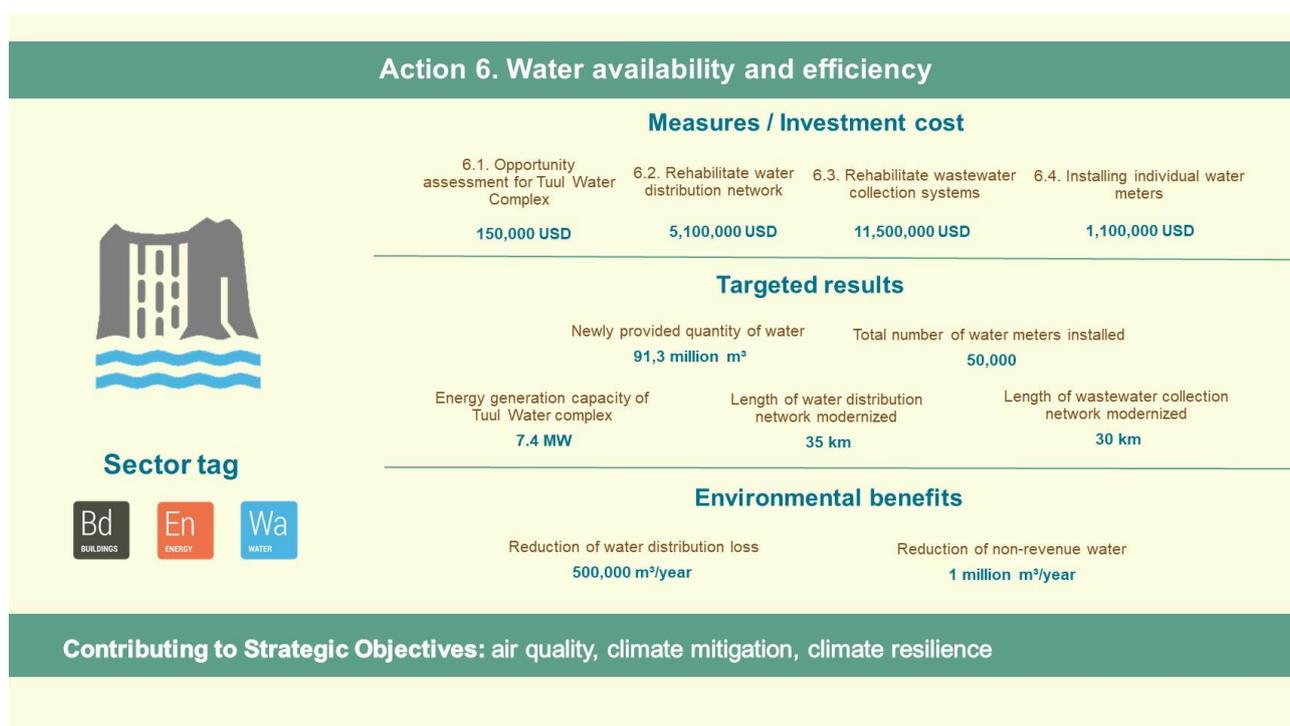
Action 6

Water availability and efficiency



Action 6

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience



Context and proposed measures

Water scarcity is a major concern in Ulaanbaatar, largely determined by the extensive use of groundwater resources in an uncontrolled manner, insufficient water reuse and poor enforcement of water pollution fees. Another factor which puts pressure on the water sector is the limited number of water meters installed in apartments, office buildings and industries, which also results in ineffective water tariffs. Water/energy nexus is particularly meaningful, as water consumption relates directly to energy consumption, influencing the environmental quality.

This action foresees the analysis of the water sector in Ulaanbaatar and proposes integrated solutions in order to address water availability in the future and water sector insecurities in the context of climate change. Water efficiency measures will cover the entire area of Ulaanbaatar, including the city's outskirts. This action is focusing on reaching security levels for water availability by the development of new solutions for water supply, water treatment, distribution of drinking water, wastewater collection, treatment and reuse.

Greywater is a safe and beneficial source of water for irrigation in a yard or garden and can also be reused inside a household for toilet flushing. Instead of releasing greywater into the riverbeds, reusing it would help reduce water consumption and directly related energy use. Greywater collection, treatment and reuse systems will be analysed and implemented in the coming years in Ger areas (covered under Action 2).

Regarding the legal framework to this action, the following need to be considered. The **Law on Natural Resource Use** regulates the relation relations between citizens and private entities and organizations on imposing fees for pollution of water or use of natural resources and payment of fees to state budget. Payment for water use is also an incentive for efficiency in water extraction and supply as long as the true cost of water use is paid. Furthermore, as part of the **National Water Program** (2010), the improvement of water supply, control and improvement of the efficiency of the system is foreseen, together with extending of the network and increasing of capacities for wastewater treatment. The **Implementation Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar, 2018**, foresees among others 14 measures to ensure secure working of drinking water delivery/distribution pipelines; 6 measures to secure water resources, delivery and hygiene to Ger areas; 8 measures to strengthen work of water distribution kiosks, water delivery transport and hygiene situation which are all relevant measures also for energy efficiency in water sector.

The following short-term measures have been defined:

Action 6

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

6.1. Opportunity assessment for Tuul Water Complex (Dam no. 3)¹⁵

This is one of the major investments that we would like to further analyse in order to be able to understand the necessity of this investment as well as for attracting international attention and donors to be able to define the most suitable financial model for such an investment. The construction of the new dam on Tuul river will provide a total of 91.3 million m³/year that will ensure a sufficient quantity of water for the future population increase projections and water demand. A feasibility study was already prepared for this measure. One of the major co-benefits of this measure is that the Tuul Water Complex is designed so that includes also hydro-power generation capacity of 7.4 MW.

6.2. Rehabilitation of water distribution network

In the first phase the rehabilitation and modernisation works will cover 35 km of networks and will focus on solutions meant for reducing the non-revenue water and the energy losses associated with the distribution of water in the city, like replacement of old leaking pipes and connections, elimination and prevention of illegal connections, rehabilitation/upgrading of pumps, installation of pressure regulators, installation of demand-based stations etc.

6.3. Rehabilitation of wastewater collection systems

In the first phase the rehabilitation and modernisation works will cover 30 km of network and will include solutions meant for reducing the wastewater infiltration in soil and subsequent pollution of ground and surface waters, like renovation of old sewerage systems, extension of the wastewater collection system, development of wastewater treatment solutions and analysis of the potential for treated wastewater reuse.

6.4. Installing individual water meters

Currently, water is invoiced on number of inhabitants in a household basis, without reflecting real measured consumption values, resulting in uneven bills. A pilot project for installing 50,000 water meters in residential buildings, at user level, will be developed, followed by a results analysis and extension of the programme in other areas.

The results achieved via all the above mentions measures will be promoted through information and awareness campaigns.

On-long term, the following measures are envisaged:

- The investment foreseen for the development of Tuul River Complex is to be implemented on long-term. Nevertheless, we have included estimated costs for the assessment for this investment opportunity based on the existing feasibility study. We are committed to start the construction work once the investment is confirmed.
- Rehabilitation of all water and wastewater distribution and collection network.
- Develop and implement water saving solutions for industry.

Cost estimate for short term measures

Measure	CAPEX	OPEX	Source of finance
6.1. Opportunity assessment for Tuul River Complex	150,000 USD		International donor, multi-funding sources
6.2. Rehabilitation of water distribution network	5,100,000 USD	48,000 USD	International donor, multi-funding sources
6.3. Rehabilitation of wastewater collection systems	11,500,000 USD	112,000 USD	International donor, multi-funding sources
6.4. Programme for installing individual water meters	1,100,000 USD		Contribution from beneficiaries / loans

¹⁵ All the information about the Tuul Water Complex are retrieved from Hydro-economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap, 2016, Water Resource Group

Action 6

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

Installing 50,000 individual water meters

Implementation framework

Measure	Steps to be taken
6.1. Opportunity assessment for Tuul River Complex	Engage an international consultancy team to analyse the existing Feasibility Study and decide on the investment opportunity.
6.2. Rehabilitation of water distribution network	Develop the Feasibility Study for the rehabilitation of 35 km of water distribution network. The FS will include a project implementation plan and details regarding phasing of works. Perform renovation and modernization works according to the implementation plan.
6.3. Rehabilitation of wastewater collection systems	Develop the Feasibility Study for the rehabilitation of 30 km of wastewater collection systems. The FS will include a project implementation plan. Define tender specifications and launch the public tender. Select contractor and carry out renovation and modernization work, according to the implementation plan.
6.4. Installing individual water meters	Tender for procurement of equipment and services Installing the water meters

Measures	Implementing entity	Targeted results	Contribution to existing policies
6.1 Opportunity assessment for Tuul River Complex	MUB, through the Water Department, Sewerage and Drainage Department, together with USUG	Decision related to the opportunity for development of Tuul River Complex. On long term this has the potential to eliminate the gap between the water supply and demand ¹⁶	National Water Program, 2010
6.2. Rehabilitation of water distribution network	and	Reduced non-revenue water (2016 vs 2024)	Implementation Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar, 2018
6.3. Rehabilitation of wastewater collection systems	Housing and Public Utilities Authority of Ulaanbaatar City (OSNAAUG)	Lower maintenance costs for the water and wastewater distribution/collection network	
6.4. Programme for installing individual water meters		Installed 50,000 water meters	

¹⁶ According to Hydro-economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap, 2030 Water Resources Group, by 2021, water demand will not be met with the available water resources in the high and medium water demand scenarios. By 2030, a water demand supply gap is estimated in all scenarios. In concrete, it has been estimated that 3% (4 mn m³/yr) and 28% (34 mn m³/yr) of total water demand will not be met with the given water supplies by 2030 in the low and medium water demand scenarios respectively. In the high-water demand scenario, 43% of the total water demand (92 mn m³/yr) is estimated to not be met with given supplies by 2030. It is assumed that all surface water resources will be utilised and that the current groundwater yield will remain until 2030. If this is not the case, the water supply demand gap is expected to occur earlier and higher across all scenarios.

Action 6

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience

Outcomes

Quantitative assessment

Measure	Environmental outcomes
6.1 Opportunity assessment for Tuul River Complex	On short term, this measure has no direct environmental outcomes. On long term, this has a potential for avoiding CO ₂ emissions of about 40,000 tCO ₂ /year (4 mil tCO ₂ during the project lifetime) ¹⁷
6.2. Rehabilitation of water distribution network	In 2015, losses from the 540 km water supply network were at 14% which translates into 7,665,000 m ³ /year. By rehabilitating 35 km of network the losses will be reduced with about 500,000 m ³ /year.
6.3 Rehabilitation of wastewater collection systems	About 147 km of sewerage pipeline network is available in Ulaanbaatar. The network is old, and the pipelines are leaking. By rehabilitating 30 km of the main wastewater collection network, the leakages will be reduced on these segments.
6.4. Installing individual water meters	Non-revenue water is estimated about 2.2 million m ³ /year. This is due to water leakages and lack of water metering. About 67% of total apartments in Ulaanbaatar have already water meters installed. By continuing the programme of installing the water meters and the network rehabilitation, we are aiming at reaching a reduction of 1 million m ³ /year from the non-revenue water.

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 6 – all measures	Improved climate resilience at city level, in case of droughts or extreme water events, due to water reuse technology and more efficient water distribution networks Improved water quality (percentage of water samples in a year that comply with national potable water quality standards)	Improved water availability (no of hours of uninterrupted water supply/year before and after rehabilitation works) Improved quality of life due to availability of water and sanitation services and improved standards of hygiene leading to reduced health problems Reduced costs for individual consumers due to the standardization of the water consumption

¹⁷ Hydro-power plant capacity of 7.4 MW. total energy produced per year: 43.1 mn kW.hr, project lifetime of 100 years. The CO₂ emissions have been calculated using EBRD emissions factors

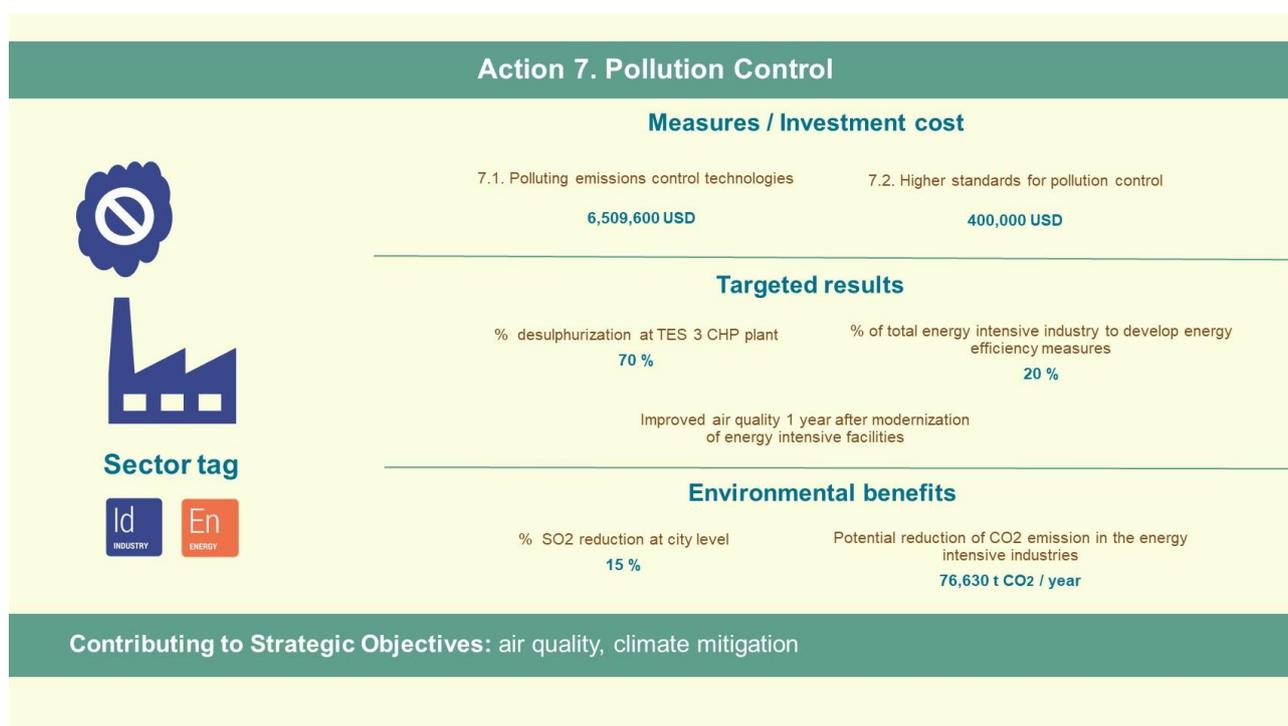
Action 7

Pollution control



Action 7

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

The industrial sector is characterized by high energy-intensity and dependence on coal. Industry represents 60% of total electricity demand at the level of Ulaanbaatar and 42% of heat demand from the district heating system of the city. Although gains resulting from energy efficiency investments are possible and likely feasible, total energy demand in the industrial sector is still expected to increase as the city expands and the economy is growing.

Installing pollution control technologies at the existing power production facilities will remove and reduce pollutant emissions to the atmosphere. Besides, imposing higher standards for pollution control in industry and heating facilities will help tackling air pollution challenges on the long term. This action is of major importance for reducing air pollution and improving air quality in Ulaanbaatar.

The Ministry of Energy has a major role in both energy generation and energy consumption by the industry. We will engage in a constructive dialogue with the Ministry and steer decision-making towards the implementation of the measures detailed below. The Municipality and associated companies will play an active role in promoting cleaner solutions and technologies in the city.

As regarding the legal framework of the below measures, the existing legislation enables financing measures for projects related to energy efficiency. According to Article 6.1 of the Law on Energy Conservation (2015), the State Central Administrative Authority shall exercise powers with regard to energy conservation and efficiency. Moreover, the Energy Conservation Law has determined thresholds for energy consumers to be declared as large energy consumers. These large energy consumers are mandated by the Energy Conservation Law to annually submit reports about their energy consumption and their plans to reduce it. In addition, energy audits and the appointing of an Energy Conservation Manager are mandatory.

The following short-term measures under this action have been defined:

7.1. Polluting emissions control technologies

Analyse the potential for implementing polluting emissions control systems at the existing power production facilities through a feasibility study and implement phase one of the pollution control plan. This is defined as desulfurization at the TES 3 CHP plant, which has no desulfurization facility in place, while the SO₂ concentration was estimated to be 1,290 mg/Nm³, much higher compared to the European limit is 200 mg/Nm³. Estimates show that emissions from TES 3 are equivalent to 1,434 ton SO₂/year.

Action 7

contributing to Strategic Objectives: air quality, climate mitigation

7.2. Higher standards for pollution control

We will work together with the Ministry of Environment and Tourism to develop higher standards and stricter rules for pollution control measures, to be applied by the industries, heating facilities etc. Standards will consider facilities location and vicinity of residential or/and inhabited areas. The potential for implementing pollution prevention and control systems will be analysed according to BATs, and standards will include advice on possible technologies to be implemented. Pollution control standards focus on air quality but include other state indicators such as water and soil pollution.

This measure includes working with ERC in strengthening the implementation of the mandatory auditing scheme for energy intensive industry active on the territory of the Municipality. Following the audits, the companies will need to draw up a plan for implementing energy efficiency measures including yearly targets. The audit will be repeated after a few years of implementation and the plan adjusted. Beside significant gains in energy efficiency in the industry, this will lead to the development of the energy audit market and in time of the market for the Energy Service Companies.

The implementation of energy efficiency regulation for large consumers is ready to start, 270 entities, including industry and buildings are already registered. These entities will undergo audits and energy efficiency plans for the next 5 years will be drawn up. Additionally, we will cooperate with the local bank to develop and promote green loans for SMEs. An initiative of this sort already exists, such as EBRD supporting industrial energy efficiency through the “MonSEFF” project.

For long term measures, we will consider elaborating a thorough assessment of risks and benefits of the full range of possible measures focusing on pollution prevention and control systems and identify and assess financing opportunities. The study could analyse measures such as: using highly efficient HOBs; cleaning coal through chemical processes; integrated gasification combined cycle potential - clean coal power plants; potential for using coal bed methane for Ger areas; etc.

Also, we will focus on renewable energy and green energy solutions.

Cost estimate for short term measures

Measure	CAPEX	OPEX	Source of finance
7.1. Polluting emissions control technologies			Private sector
Feasibility Study	200,000 USD		
Flue-gas Desulfurization unit	6,309,600 USD	400,000 USD	
7.2. Higher standards for pollution control			Donor / state budget
Study on identifying potential for pollution control in industries (BAT)	100,000 USD		
Strengthen implementation of auditing scheme and co-finance initial third-party energy audits	300,000 USD		

Action 7

contributing to Strategic Objectives: air quality, climate mitigation

Implementation framework

Measure	Steps to be taken
7.1. Polluting emissions control technologies	Development of the Feasibility Study that will include the technical, environmental and social aspects for implementing polluting emissions control technologies at power production facilities and a pilot project at the TES 3 CHP plant. The FS will include a project implementation plan.
7.2. Higher standards for pollution control	Develop the local standard for pollution control that will include the technical and environmental aspects and guidance for implementation of pollution control technologies. Define a roadmap for the implementation of the mandatory auditing scheme for energy intensive industries. Name and task responsible department in the Municipality's Mayor's Office for working together with ERC for implementing the scheme. Launch auditing according to the scheme. Receive, analyse and approve energy efficiency plans. Repeat energy audits after four years of implementation.

Measures	Implementing entity	Targeted results	Contribution to existing policies
7.1. Polluting emissions control technologies	Owner: Ministry of Energy (7.1 – CHP3), MUB through the Mayor's Office, ERC (7.2) Cooperating stakeholder: Ministry of Environment and Tourism; Ministry of Energy, CHPs owned by the Government	Desulphurization of at least 70% at CHP3	Energy Conservation Law Ulaanbaatar Energy Master Plan
7.2. Higher standards for pollution control		20% of the energy intensive industry will implement energy efficiency measures Improved air quality after 1 year after modernisation of energy intensive facilities (PM10, PM2.5)	

Outcomes

Quantitative assessment

Measure	Environmental outcomes
7.1. Polluting emissions control technologies	SO ₂ reduction is of 70% at project level, which translates into 15% reduction at city level (considering that CHP3 contributes to total SO ₂ pollution in the city with 21%)
7.2. Higher standards for pollution control	This action has no direct outcomes, but implementation of regulation can lead to potential reduction of 76,630 tCO ₂ /year considering that 20% of the industry implements 20% energy savings (in case of a 20-year lifetime of the project, this amounts to 1,500,000 tCO ₂ reduction)

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 7 – all measures	Improved annual concentration of Air quality indicators including PM 2.5, MP10, NOx Reduction of pollution hot spots and contaminated sites Improved BOD in rivers and lakes	Increased life expectancy, health, quality of life and decreased morbidity rate due to pollution related diseases Market development and business opportunities in energy auditing and energy efficiency investments

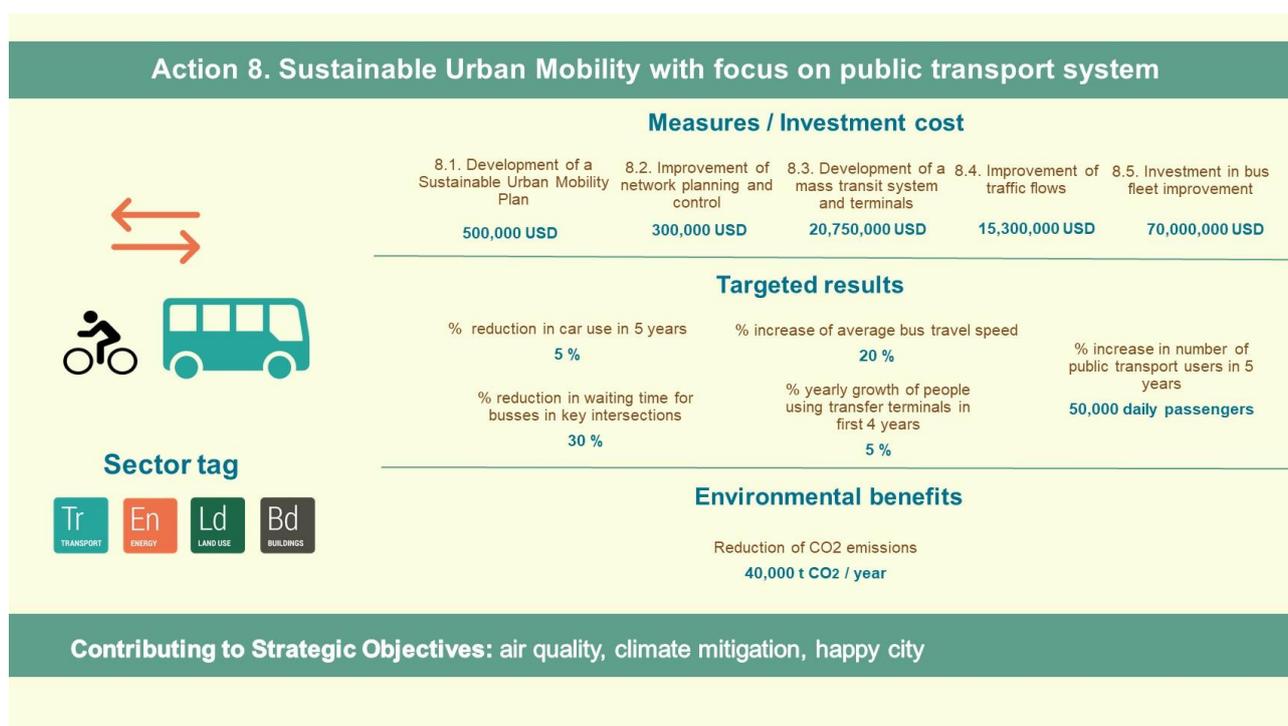
Action 8

Sustainable Urban Mobility for Ulaanbaatar with focus on public transport system



Action 8

contributing to Strategic Objectives: air quality, climate mitigation, happy city



Context and proposed measures

Ulaanbaatar is facing major challenges when it comes to transport and mobility. Economic growth causes an increase in number of motorized vehicles and intensifies the pressure on the environment and the quality of life. Public infrastructure in terms of road networks, public transport services and non-motorized transport infrastructure is lagging. A particular challenge is to connect the city centre to the suburbs that are both underserved by public transport and have a largely unpaved road network (link with Action 1).

To face these challenges, an effective transport system is essential to ensure sustainable mobility in Ulaanbaatar. Drafting a Sustainable Urban Mobility Plan (SUMP) is instrumental in defining a long-term vision and implementing a precise action plan.

The public transport system in UB is struggling with service quality and technical, financial and institutional challenges and cannot keep up with the growth rate of the city. Therefore, attention should be paid to operational actions and implementation measures regarding public transport, such as the improvement of network planning and monitoring, the realization of transport hubs based on a mass transit system, and the upgrade of the public transport fleet. Bus prioritization at certain intersections will be key to upgrade the comfort, punctuality, speed and overall quality of public transport.

The most relevant policies for UB regarding this action are the Municipal Policy on Public Transportation and Implementation Action Plan (2014) and the Sub Program of the Public Transportation Development of Capital City by 2020 (2013) which aim to implement targets of Ulaanbaatar City Master Plan and to promote safe, fast, sustainable public transportation network, which meets public demand through improving legal framework of the sector, introducing advanced technology, using of environmentally friendly vehicles and implementing projects and programs.

Thus, the following short-term measures have been defined:

8.1. Development of a Sustainable Urban Mobility Plan (SUMP)

The challenges that UB is facing and the complexity of urban mobility make it necessary to deal with mobility planning in a more integrative way. A SUMP is aimed at the creation of effective and inclusive transport system ensuring equal accessibility and sustainable mobility to and within the city by following a long-term vision and clear implementation plan. The SUMP will provide short-, medium- and long-term strategies to improve the efficiency of UB's transportation system.

Action 8

contributing to Strategic Objectives: air quality, climate mitigation, happy city

8.2. Improvement of network planning and control, by making optimal use of available public transport data

Currently, passenger data from public transport (GPS and smart cards) is being processed manually. Being able to process and analyze these data sets is an important prerequisite for public transport planning. Visualizing information at the UB dispatch/traffic control center will allow informed decision making towards improved mobility in the city. This requires the development of data analytics and visualization skills and tools. It is an innovation-driven measure to 'gain wisdom' out of the data streams that already are being generated by the GPSs and smart cards.

8.3. Development of a mass transit system (BRT/metro), and specifically transfer terminals based on this system

Based on the strategy of the sustainable urban mobility plan, and the proposed restructuring of the collective transport system, a rapid transit "backbone" for UB will be developed (BRT/metro). We are considering the development of transfer terminals / transport hubs for the BRT network - 2 locations on the eastern and western edge of the city are the most plausible to develop first. These hubs will be designed based on international best practices, and can integrate Park & Ride facilities, bike parking stations, and charging stations for electric cars / e-bikes. These will also function as power storage capacity for electricity (cross-reference with Action 4).

8.4. Improvement of traffic flows, with a focus on bus prioritization

To improve traffic flows, a traffic control system should be implemented. In the short term, these actions can be taken at key intersections in UB: resolving specific infrastructural issues, implementing specific restrictions on traffic movement and optimizing traffic light operation. These actions should contribute to the implementation of a public transport priority system.

8.5. Investment in bus fleet improvement¹⁸

The overall goal is to increase comfort, reliability and safety of the public transport system in UB. Crucial aspects to reach this goal are fleet management and fleet replacement strategies, to enhance the use of CNG, hybrid and electric vehicles. This measure is also proposed in the context of low-emission vehicles and green electrification (Action 4).

As regarding the area of implementation, the measures 8.1 and 8.2 cover the entire city. For the measure 8.2 and 8.3 the location of the transport hubs and key intersections will to be selected by the MUB. These measures cover both a larger area of UB (location study), as well as 2 specific areas where the transfer terminals will be developed. The location of electrification of bus routes, on measure 8.4, are to be made together with the development of charging stations.

For long-term measures, the city will consider the following:

- Create a city-wide network of transport / mobility hubs on different scales;
- Adapt payment and subsidy system for public transport concessions based on data analysis;
- Implement a full-scale traffic control system for UB.

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
8.1. Development of a Sustainable Urban Mobility Plan (SUMP)	500,000 USD		International donor
8.2. Improvement of network planning and control, by making optimal use of available public transport data	300,000 USD	120,000 USD	International donors / Local budget contribution

¹⁸ EBRD (February 2019). Ulaanbaatar City Bus Project. Final Due Diligence Report

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Measures	CAPEX	OPEX	Source of finance
8.3. Development of a mass transit system (BRT/metro), and specifically transfer terminals based on this system			International donors / Grants & Loans / Local budget contribution
Preparatory studies for transport hubs (feasibility study on proposed locations, masterplans and conceptual design)	750,000 USD		
Construction cost for transfer terminal (including design cost, PM cost)	20,000,000 USD	200,000 USD	
8.4. Improvement of traffic flows, with a focus on bus prioritization			International donors / Grants & Loans / Local budget contribution
Internal programme management and expertise + cost of external support	300,000 USD		
Adapting intersections according to prioritization (estimate for 5 intersections)	15,000,000 USD		
8.5. Investment in bus fleet improvement ¹⁹ (400 buses)	70,000,000 USD		International donor/loans

Implementation framework

Measure	Steps to be taken
8.1. Development of a Sustainable Urban Mobility Plan (SUMP)	<p>Prepare a tender for the development of the SUMP</p> <p>Approve the SUMP</p>
8.2. Improvement of network planning and control, by making optimal use of available public transport data	<p>Setting up a specific unit within the Transportation Department, in collaboration with the Ministry of Road and Transport development and the Ulaanbaatar Smart Card LLC. This unit brings together people with different profiles but a common interest in using data analytics to improve the public transport planning process.</p> <p>Set up partnerships (using public tendering) with specialized consultancy and technology firms for data analytics, software development and transport planning models.</p> <p>Work side by side with these consultants to develop analytics and visualization tools and test them on small-scale projects. This should allow an effective transfer of technology and knowledge.</p>
8.3. Development of a mass transit system (BRT/metro), and specifically transfer terminals based on this system	<p>Design of transport network, based on BRT and transfer terminals, adhering to the principles stated in the Sustainable Urban Mobility Plan including other forms of public transport, Park & Ride facilities, possibly bike parking stations, charging stations for electric cars / e-bikes (including mobility study)</p> <p>Feasibility study, including detailed research on the proposed locations for the transfer terminals - one in the east and one in the west part of the city.</p> <p>Masterplan and conceptual design for each of the chosen locations</p> <p>Action plan including:</p> <ul style="list-style-type: none"> • project scoping • project preparation • procurement process & contracting (classical or PPP) <p>Public tendering</p>

¹⁹ EBRD (February 2019). Ulaanbaatar City Bus Project. Final Due Diligence Report

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	Detailed design
	Construction
	Operation + Maintenance
8.4. Improvement of traffic flows, with a focus on bus prioritization	<p>Determine the necessary scope for a study on traffic management: Content (traffic light optimization, general flow optimization, public transport prioritization) Geographical scope (which roads and intersections) Ambition level (ITS and/or more traditional modifications on roads and intersections based on best practices) Phasing</p> <p>Determine the requirements for the Request for Proposal (e.g. traffic modelling)</p> <p>Find external support (using public tendering) for specific expertise (technical, legal)</p> <p>Phased rollout of the programme</p>
8.5. Investment in bus fleet improvement	Implementation of fleet replacement programme starting with the first stage of about 200 new buses.

Measures	Implementing entity	Targeted results	Contribution to existing policies
8.1. Development of a Sustainable Urban Mobility Plan (SUMP)	Owner: Urban Planning and Development Department, MUB	Aim to reduce car use by 5% in 5 years, by modal shift from cars to public transport, by optimizing the public transport system	Municipal Policy on Public Transportation and Implementation Action Plan (2014) Sub Program of the Public Transportation Development of Capital City by 2020 (2013) Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 Housing and Infrastructure Development of Capital City Sub-Program
8.2. Improvement of network planning and control, by making optimal use of available public transport data	Guiding the implementation process: Transport Department of MUB	Aim to decrease commuting time between the suburbs and UB city centre, in the short term by increasing average travel speeds for buses on the major thoroughfares by 20%	
8.3. Development of a mass transit system (BRT/metro), and specifically transfer terminals based on this system	Cooperating stakeholders: Ministry of Road and Transport Development, Policy and Planning Department, MUB Master Planning Agency of Ulaanbaatar	Aim for 5% yearly growth of number of people transferring at the transfer terminals, compared to baseline year before commissioning of terminals, in the first 4 years after commissioning	
8.4. Improvement of traffic flows, with a focus on bus prioritization	Land Use Department, MUB Road Department, MUB	Aim to reduce waiting time for buses at selected key intersections by 30%	
8.5. Investment in bus fleet improvement	Ulaanbaatar electricity distribution network company Ulaanbaatar Smart Card LLC Government Authority for Communication and Information Technology	Aim to increase number of public transport users with 50,000 daily passengers in 5 years	

Action 8

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Outcomes

Quantitative assessment

Measure	Environmental outcomes
Action 8 – all measures	40,000 tonnes CO ₂ / year reduced ²⁰

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 8 – all measures	<p>Creation of an integrated transport system with a well-defined hierarchy between the modes, which will reduce the usage of personal transport and implicitly the CO₂ emissions</p> <p>Decrease congestion in the city centre resulting in a decrease in air pollution</p> <p>Increase the share of public transport in the UB city modal split, improving air quality</p> <p>Higher energy efficiency than other on-road vehicles</p>	<p>Increased life expectancy or quality of life and decreased morbidity rate due to traffic pollution related diseases</p> <p>Increased property value for areas that are currently lacking access to public transport and transport infrastructure</p> <p>Decrease in travel time due to the reduction of personal vehicles in traffic</p> <p>Decrease in number of traffic accidents</p> <p>Decrease in operating costs for public transport</p> <p>Increased recreational value due to less parked vehicles in the city center</p>

²⁰ The CO₂ emissions avoided were estimated using CO₂ emission ratio (per passenger kilometer) by mode, passengers per mode in UB, average trip distance in UB and population growth rate in UB

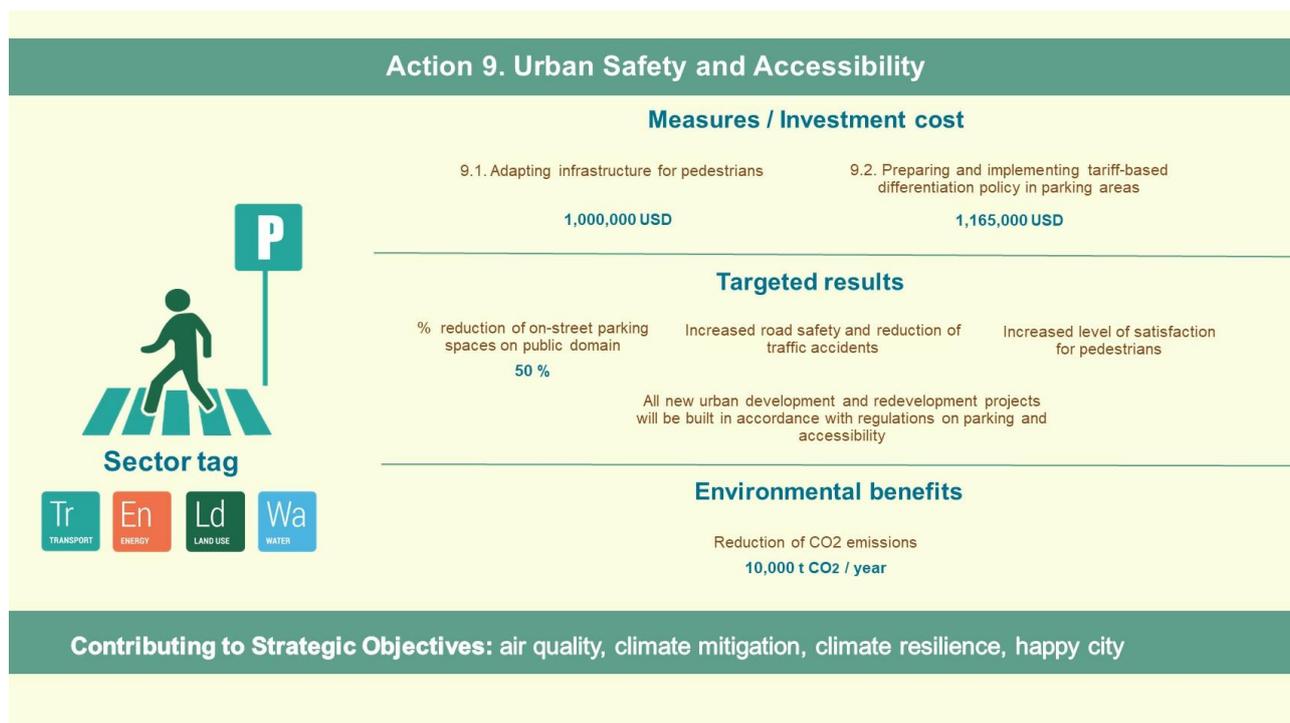
Action 9

Urban Safety and Accessibility



Action 9

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city



Context and proposed measures

UB faces multiple issues related to safety and comfort on the streets and sidewalks. This action is focusing on safety and accessibility of pedestrian infrastructure and parking area. Within the creation of effective and inclusive transport system ensuring equal accessibility and sustainable mobility (Action 8), measures to improve the mobility of pedestrians and adequate parking policy play an eminent role.

The current situation in UB is not always the best when looking at conditions of sidewalks and the walkability of public places (urban design in general). Fast urban growth has resulted in urban developments that tend to forget about accessibility and walkability aspects for residents, visitors and employees. Some sections of sidewalk in the Central Business District (CBD) are in good condition, but this is more the exception than the rule in UB. Vehicle parking on sidewalks further worsens the situation.

MUB is currently implementing policies to regulate car parking in the city centre. This encompasses the development and management of parking lots and the enforcement of parking regulations, including private development permitting on parking. Furthermore, the construction of underground parking lots & parking buildings is stimulated by the municipality. Nevertheless, parking remains an issue for the city's mobility system. Double parking and other parking violations slow down traffic, contributing to the endemic congestion in the city centre. Narrow streets are filled by parked cars and they offer little space for pedestrians, cyclists, greenery and street furniture.

Measures included in this Action do not only improve the quality of life for the people walking the streets of UB but also contribute to reduce traffic congestion, as disorganized on-street parking and traffic accidents are prominent causes of congestion.

The following short-term measures have been defined:

9.1. Adapting infrastructure for pedestrians

This measure includes the development and implementation of a programme to improve safety and accessibility for pedestrians and developing a guideline with 'universal design' principles for pedestrian infrastructure, to be used when (re)constructing infrastructure (roads, intersections, crossings, squares, etc.), including walkability and filtered permeability in the (re)design of urban neighbourhoods.

The implementation of the first stage of the programme will be done in the coming 5 years and will include rehabilitation of pedestrian walks and adaptation of road crossings (up ground and underground crossings in order to reduce traffic jams). Selection of the areas to be annually redeveloped will be done when the programme development will take place.

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There is also a link with the design of transport hubs (Action 8) and bus station surroundings, to improve last mile connectivity and the urban street lighting strategy.

9.2. Preparing and implementing tariff-based differentiation policy in parking areas

This measure includes the following:

- Assessment of enforcement measures (regulations, capacity, practice) for parking in the city
- Assessment of number of parking spaces provided on own terrain and the target group (for instance: residents, visitors, shoppers), size of developments that should include underground parking spaces, etc.
- An update of the parking regulations for urban developments, based on best practices; an alignment of these regulations with the parking strategy in the city centre; adapt tariffing and licensing for public parking spaces (roadside parking and parking lots), with differentiation of tariffs based on location
- Review of parking tariffs in the city centre
- Implement parking allocation planning
- Define new solutions for enforcement of parking regulations
- Implement the solutions at least in the city centre in the first phase.

The measure is a net revenue generating action because of the revenues from parking and fines.

Both measures cover the entire city. Specific areas of implementation are new urban (re)development projects in UB, and (new) transport hubs and their surroundings. As regarding the legal framework, the action is in line with the Ulaanbaatar 2020 Master Plan and Development Approaches for 2030, which foresees enhanced traffic management, creation of additional parking spaces and better control of parking. The document is currently being updated. The Urban Planning and Design Institute, city-owned entity of MUB, is developing the Concept of Ulaanbaatar Master Plan 2040. Currently, the city is seeking options to improve parking practices and management, including initiatives to engage the private sector through initiatives, such as: recently implemented “UB Smart Parking”.

On a long-term basis, we are committed to implement the following measures:

- Continuing to implement the programme for safety and accessibility of pedestrians all over the city;
- Implement a city-wide parking policy based on lessons learnt from first phase.

Cost estimate for short term measures

Measure	CAPEX	OPEX	Source of finance
9.1. Adapting infrastructure for pedestrians	1,000,000 USD	50,000 USD	Local budget, grant finance
Development of the guideline with ‘universal design’ principles for pedestrian infrastructure			
Development of the Programme for Safety and Accessibility for Pedestrian			
Rolling out the first stage of the programme			
9.2. Preparing and implementing tariff-based differentiation policy in parking areas			Local budget, grant finance
Review of the existing parking regulations	250,000 USD	600,000 USD	

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Implement tariff-based differentiation parking	1,400,000 USD	
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Implementation framework

Measure	Implementation steps
9.1. Adapting infrastructure for pedestrians	<p>Determine the necessary requirements and the scope of the Safety and Accessibility for Pedestrians Programme</p> <p>Develop a Guideline for design of pedestrian infrastructure</p> <p>Phased rollout of the programme</p>
9.2. Preparing and implementing tariff-based differentiation policy in parking areas	<p>Review of the existing parking regulations for urban development</p> <p>Review of parking tariffs in the city centre</p> <p>Assess current enforcement measures</p> <p>Implement tariff-based differentiation policy in the city center</p>

Measures	Implementing entity	Targeted results	Contribution to existing policies
9.1. Adapting infrastructure for pedestrians	Owner: Traffic Planning, Coordination and Engineering Department of the Capital City	Increase road safety for pedestrians, by rehabilitating approx. 5 km of pedestrian sidewalks and road crossings	Ulaanbaatar 2020 Master Plan and Development Approaches for 2030, which is being updated. Housing and Infrastructure Development of Capital City Sub-program
9.2. Preparing and implementing tariff-based differentiation policy in parking areas	Cooperating Stakeholders: Policy and Planning Department; Urban Planning and Development Department; Master Planning Agency, Land-use Department	<p>Decrease the amount of accidents and related pedestrian injuries in UB with 50 %</p> <p>Increase level of satisfaction for pedestrians in UB, on accessibility and walkability (based on surveys)</p>	
	Other stakeholders: Department of Road Development, Information and Technology Authority, Traffic Control Centre	<p>Reduce number of on-street parking spaces on public domain in the city centre by 50%</p> <p>All new urban development and redevelopment projects will be built in accordance with regulations on parking and accessibility.</p>	

Action 9

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city

Outcomes

Quantitative assessment

Measure	Environmental outcomes
Action 9 – all measures	10,000 tonnes of CO ₂ / year reduced ²¹

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 9 – all measures	Decreased air pollution due to decreased use of cars GHG emissions reduced	Decreased number of parked cars on public domain and opportunity to give back space to parks, pedestrian areas, green spaces, etc. Increased revenue for MUB from implementing a parking policy Better access to public infrastructure, higher walkability, increased liveability, reduced congestion Increased life expectancy or quality of life due to increased walking Better community cohesion by people spending more time walking and stopping in the centre Better access to (public) buildings for the disabled Decreased number of traffic accidents in which pedestrians are involved Decrease of parking violations, improving traffic flow Increased property value Increased recreational value Increased revenues for businesses located in the centre of the city, due to an increase in visitors Reduced morbidity risk

²¹ The CO₂ emissions avoided were estimated using CO₂ emission ratio (per passenger kilometer) by mode, passengers per mode in UB, average trip distance in UB and population growth rate in UB

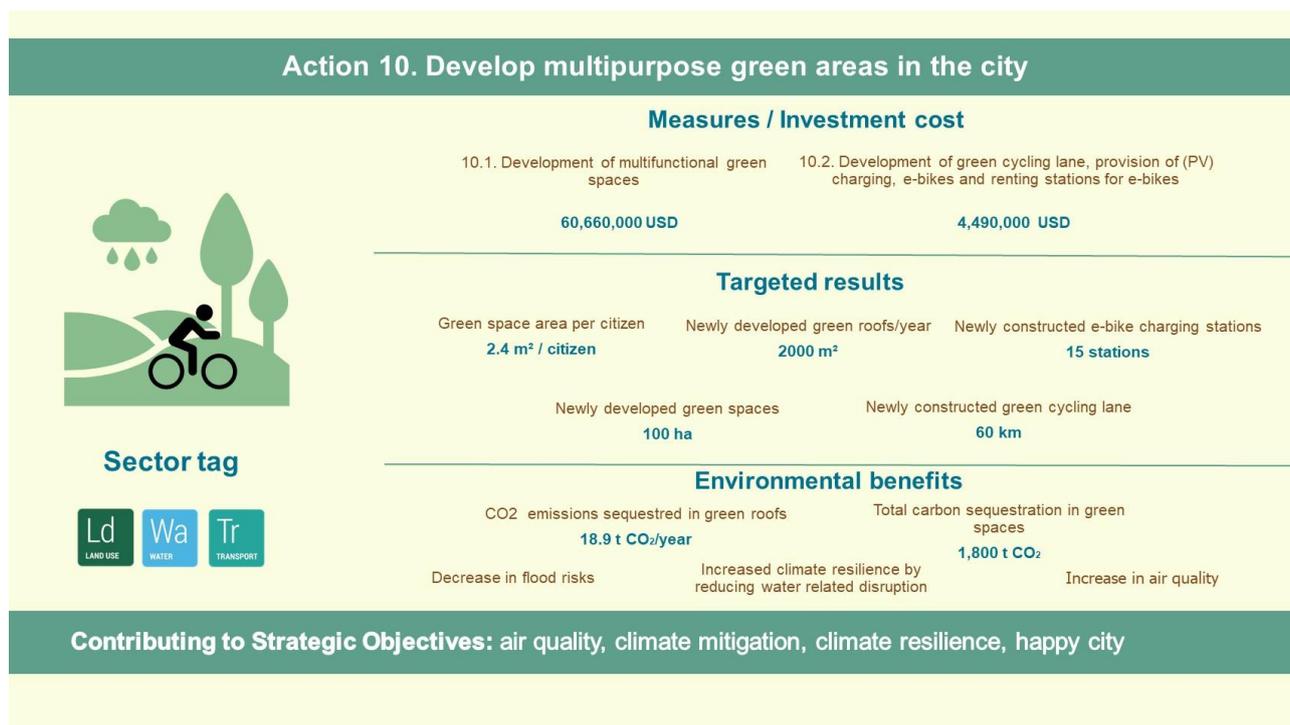
Action 10

Develop multipurpose green areas in the city



Action 10

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city



Context and proposed measures

Ulaanbaatar’s population density is quite low both in the centre, suburbs and in the Ger areas (compared to international benchmarks). Still, the public space dedicated to green surfaces is reduced in both areas. The city faces several challenges which are tackled by this action. These challenges are:

- Insufficient green space, with only 0.12 m² green space per citizen at city level, compared to a satisfactory minimum of 10 m² defined by international benchmarks.
- Vulnerability to extreme weather events (harsh winter conditions, summer droughts) which is a challenge that needs to be tackled. The indicator “estimated economic damage from natural disasters as a share of GDP” is around 2% (2017), compared to a satisfactory level of 0.50% defined by international benchmarks. Moreover, the frequency of extreme weather has doubled in the last two decades, expected to increase by 23-60% by the middle of the century as compared to present conditions. These lead to increased risk of flash floods, which are likely to affect disproportionately the Ger area in UB compared to apartment areas. Developing multipurpose green areas within the city will definitively contribute to climate resilience of the city, especially in areas with the highest risk of flooding.

Our plans are to increase the availability of green spaces in the city ultimately up to 20 m² per inhabitant. This is a long-term goal and we will try to approach it gradually. In the first 5 years, we are aiming at increasing the green spaces from 0.12 m²/inhabitant to 2.4 m². This offers us an opportunity to design future green spaces with multipurpose functions, tackling the issues mentioned above.

We attempt to increase and evenly distribute urban green space, well planned throughout the city, and to provide multipurpose functions - recreational, shading, water retention, flood risk mitigation, biodiversity and air quality improvement. Multipurpose green areas can include soft mobility solutions, green schoolyards, green spaces in parking lots, etc.

The planning, design, implementation and further integration of nature-based solutions in the city and riverine area ideally needs to be integrated into an overall flood risk management plan, that does not only focus on technical solutions, but also includes actions such as preparedness of citizens, risk towards property damage, etc. In this respect, the actions are in line with and are directly relevant for the Action Plan for Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 (2016). The following priority directions, investment projects and actions developed under the priority directions are relevant for this action within the GCAP: 1) Healthy, safe and green city (6 projects), 2) Liveable city (17 actions).

Action 10

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city

The following short-term measures have been defined:

10.1. Development of multifunctional green spaces

Multipurpose green areas can include soft mobility solutions such as bicycle and walking paths lined by trees and shrubs, green schoolyards, permeable pavement and green spaces in parking lots, green roofs, bio swales along roads and sidewalks, green embankments along the rivers, nature based solutions for storm water relief, green lower areas in the city – floodable in case of heavy rain, etc. Expanding green roof is also perceived as local storm water retainers. This is in line with measures envisaged in Action 11. Once implementation in a pilot area is successful and lessons learned are obtained, one could consider further implementation of nature-based solutions at various locations over the city. The first phase may be located on the river Tuul banks since this is providing multiple functions. This is fully covered under Action 11, measure 11.1.

10.2 Development of green cycling lane along the rivers lined by trees/shrubs, green embankments and provision of (PV) charging, e-bikes and renting stations for e-bikes in rest areas and along the cycling path

Developing a green cycling lane along the Selbe and Tuul rivers in connection with nature-based solutions for riverbank reshaping represent a suitable multipurpose solution for the city, contributing to several green development objectives.

For long-term measures, the city should consider further implementation of nature-based solutions at various locations over the city based on lessons learned in pilot areas, aiming for the creation of green corridors, in order to have a high share of multifunctional green spaces per inhabitant and a fully resilient city towards climate change, now and in the future.

For the development of a system for rainwater harvesting, the projects will focus on areas that are under flooding risks, higher sandy soil locations.

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
10.1. Develop multifunctional green spaces			Crowd funding, private sector financing, local budget
Plan urban green space development	100,000 USD		
100 ha of green space	60,000,000 USD ²²	1,000,000 USD	
2,000 m ² green roofs/year	560,000 USD	20,000 USD	
10.2. Development of green cycling lane and provision of (PV) charging, e-bikes and renting stations for e-bikes in rest areas along the cycling path			Crowd funding, private sector financing, local budget
Feasibility study	50,000 USD		
Bicycle lane construction (60 km total)	4,020,000 USD	40,000 USD	
PV charging, e-bikes stations (15 stations in the first phase, up to 30 stations if successful with 5 e-bikes per station)	420,000 USD		

²² Cost of land is not included.

Action 10

contributing to **Strategic Objectives:** air quality, climate mitigation, climate resilience, happy city

Implementation framework

Measure	Steps to be taken
10.1. Development of multifunctional green spaces	<p>Map current parks and green areas. Identify high priority areas and activities, e.g. squares, children playgrounds, areas of local environmental pressures, etc. Plan and implement urban parks and garden development in short, medium and long term. Stimulate private investors to consider the revitalization of the city in the design of open spaces and urban infrastructure, for example through prioritizing approval processes for respective construction projects.</p>
10.2. Development of green cycling lane and provision of (PV) charging, e-bikes and renting stations for e-bikes in rest areas along the cycling path	<p>Conduct a feasibility study. Prepare tender dossier for development of green cycling lane and acquisition of PV charging and renting stations for e-bikes. Implement and construct. Monitor and inform future practices.</p>

Measures	Implementing entity	Targeted results	Contribution to existing policies
10.1. Development of multifunctional green spaces	<p>MUB through the Master Planning Department</p> <p>Cooperating stakeholders: private landowners, local businesses, NGOs</p>	<p>Increase of green space area in the city to at least 2.4 m² green space per citizen at city level</p> <p>Implement at least 2000 m² of green roof per year</p>	<p>Action Plan for Ulaanbaatar 2020 and Development Approaches for 2030</p> <p>UB City Green Development Master Plan</p>
10.2. Development of green cycling lane and provision of (PV) charging, e-bikes and renting stations for e-bikes in rest areas along the cycling path	<p>MUB through the Master Planning Department</p> <p>Cooperating stakeholders: private landowners, local businesses, NGOs</p>	<p>Construction of 60 km of green cycling lane along the rivers with charging, e-bikes and renting stations for e-bikes (30 km on each riverbank).</p> <p>PV charging stations number to reach one per roughly every 3 km, on each side, with more in the city centre (approximately 15 charging stations in total). Implementation could start gradually, with 5 charging stations in the city centre and one every 6 km, supplementing them as needed after a testing period.</p> <p>5 e-bikes per station</p>	

Action 10

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city

Outcomes

Quantitative assessment

Measure	Environmental outcomes
10.1. Development of multifunctional green spaces	Reach 2.4 m ² of green space per citizen from current 0.12 m ² . This means creating an additional 100 ha of green space. Average carbon sequestration potential of trees in urban areas: 0.28 kg C / m ² of tree cover per year ^{Error! Bookmark not defined.} Considering 100 ha of green space achieved, this will translate into 1,800 tonnes CO ₂ emissions sequestered. Annual CO ₂ reduction between 1.70 and 1.89 kg CO ₂ /m ² /year of green roof, from energy savings. If 2000 m ² of green roof will be developed annually, this will translate into a total saving of 18.9 t of CO ₂ emissions.
10.2. Development of green cycling lane	

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 10 – all measures	CO ₂ capture by nature-based solutions (CO ₂ eq); and other benefits estimated (e.g. reduced erosion) Climate resilience by reducing weather-related disruption and damage as excess of water due to climate change extreme events will be infiltrated more easily by these green areas Increase in biodiversity Decrease in flood risks Increase in air quality	The Municipality will engage citizens in the new developments Reduced investment costs (grey versus green solutions) Improved wellbeing and health of citizens Increased property value for property adjacent to green areas Increased recreational value Improvement of landscape Traffic congestion savings due to improved rainwater drainage Increased revenues for businesses located in the proximity of the green areas, due to an increase in visitors

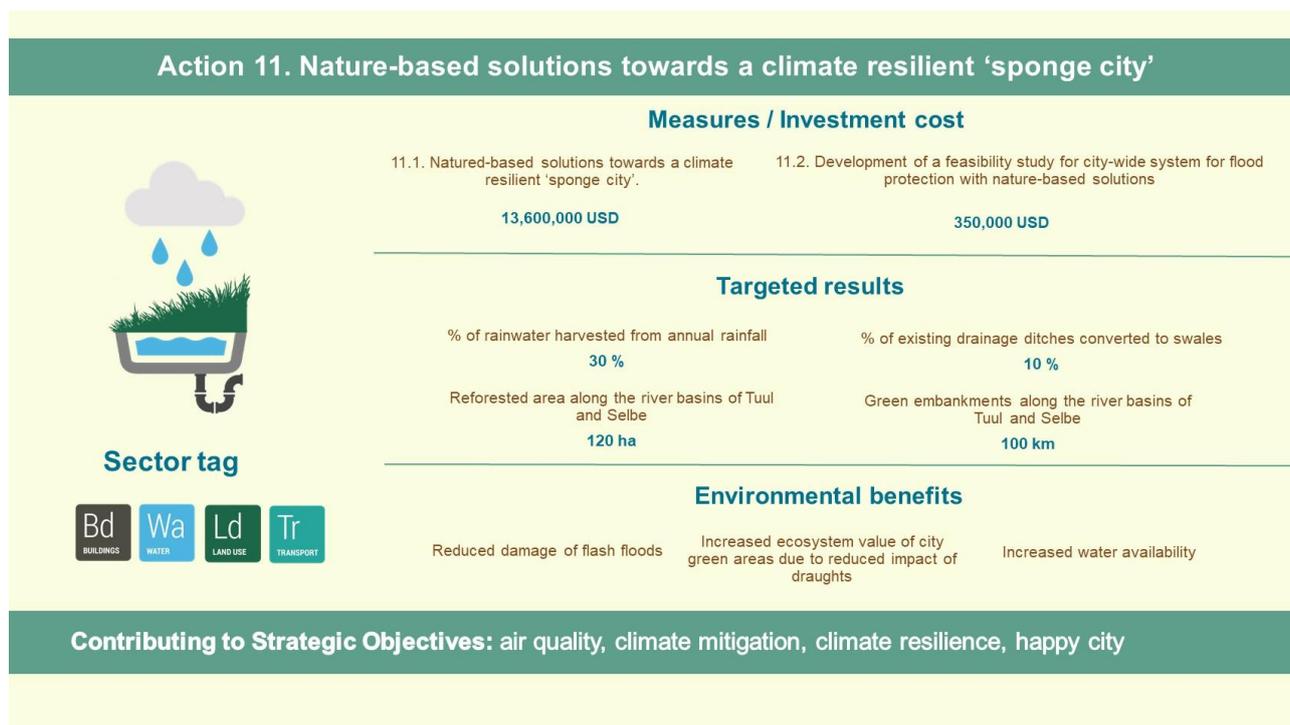
Action 11

Nature-based solutions towards a climate resilient 'sponge city'



Action 11

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city



Context and proposed measures

This action foresees to develop Ulaanbaatar towards a 'sponge city' design, acting as a buffer – decreasing runoff, retaining water during intense rainfall periods and cost-effective flood protection – which means 15% less investment costs in comparison to conventional model²³ and less maintenance costs. Green infrastructure also has carbon sequestration properties, with the less maintenance necessary (perennial shrubbery planted or afforestation), the better the carbon balance.

Conventional engineering measures include building embankments, dams, levees, and channels to control flooding and are sometimes referred to as “hard” engineering or “grey” infrastructure. Nature-based solutions make use of natural processes and ecosystem services for functional purposes, such as decreasing flood risk or improving water quality. Nature-based solutions help mitigate flood but also prevent drought, erosion and landslides. In addition, they help decrease vulnerability to climate change while also creating multiple benefits to the environment and local communities, such as climate change mitigation through carbon sequestration, recreational areas, etc. Green infrastructure measures for flood protection in the city include floodable parks in case of heavy rainfall; SUDS (sustainable urban drainage systems); permeable pavement; bio swales; downspout disconnection; rainwater harvesting; rain gardens; rooftops covered by plants; planter boxes for runoff collection from sidewalks, parking lots and streets; soft lining of bicycle and walking paths.

Water drainage

Drainage of excess of rainwater is a problem in Ulaanbaatar. We have developed engineering solutions including for road and general water drainage, solutions such as concrete drainage canals and dams, but these are not implemented, generally due to insufficient funds. A lot of built area and no greenery is creating a fast run-off for the rainwater and decreasing the absorption potential. This problem of excess of rainwater will only increase in the future due to climate change: the rain intensity will increase and will cause more frequent and more serious problems of rainwater drainage.

There are many areas in the city which have a high flash-flood risk. Only 20% of the citizens of UB are protected against flood risk. In many cases, particularly in Ger areas, existing water drainage systems are poorly maintained, often being clogged due to illegal waste disposal. Improving the drainage is higher on the political agenda considering the increase in floods.

Rainwater harvesting

²³ Assessment of Climate Technology Demands in Chinese Sponge City, Table 1.

Action 11

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Rainwater harvesting has a double function, on the one hand it decreases the pressure on the drainage system during storms, while it provides the collected rainwater for future use, for green space maintenance or other functions, such as aquifer recharge. The aquifer is key for drinking water use for a large part of the citizens, and monitoring indicates a lowering of the aquifer in large parts of the city. By implementing water retention measures to improve the infiltration of rainwater, local floods can be mitigated, and the aquifer can be recharged.

Considered water retention measures are the conversion of hard surfaces into green areas (ideally fitted with native drought resistant trees and plant species) allowing for water infiltration and reduced rainwater run-off. Public areas could be the first focus such as school yards, squares, parking spaces, parts of roads and sidewalks can be considered. In the long-term rainwater harvesting and increased water infiltration in private areas can be considered.

This action can potentially target the downstream of Zuragt zuun Sair area where the project can be implemented. An in-depth analysis of the locations for implementation of measures should consider the entire area of the Bayangol district, as well as upstream, considering the hydrologic flow and rainfall patterns.

The action may include the following components:

- Development of an overall plan for water use, drainage and floodwater protection
- Delineate possible public areas for water infiltration
- Involve municipality workers and stakeholders on possible design, implementation and maintenance of specific measures, including costs and benefits – ensuring the green area has additional benefits on top of the water drainage. This could be done through public contests or debates/voting on a series of solutions/components already deemed by professionals to be suitable and beneficial.

The Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar (2018) includes actions for improved sludge management at Central Wastewater Plant. Within the Action Plan for Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 (2016), the following priority directions, investment projects and actions developed under the priority directions are relevant for this action within the GCAP: 1) Healthy, safe and green city (6 projects), 2) Liveable city (17 actions).

The following short-term measure has been defined:

11.1. Nature-based solutions towards a climate resilient ‘sponge city’

In order to achieve the goal of a ‘sponge city’, two types of interventions can be tested by us: to be completely ‘green’ (i.e. consisting of only ecosystem elements) or to be ‘hybrid’ (i.e. a combination of ecosystem elements and hard engineering approaches). We are committed to try the second one in the coming 5 years. Thus, (re)forestation and green embankments will be applied in the first phase to river basins of Tuul and Selbe in suitable areas, and later on in other suitable designated areas in UB city.

11.2. Development of a feasibility study for city-wide system for flood protection with nature-based solutions, such as: rainwater harvesting, bio-swales along the riverbeds and permeable pavements

In bioswale systems, the water running off from roofs and roads does not flow into the sewer but instead is led into the bioswale via above-ground gutters or ditches. Once incorporated into the green infrastructure it helps to enhance biodiversity and quality of life.

In the long term and based on lessons learned from the pilot actions, we will roll out the solutions for the entire municipality. Lessons learned from the pilot areas would allow further implementation at various locations over the city in order to have a fully resilient ‘sponge city’ towards flood risk, now and in the future.

Cost estimate for short term measures

Action 11

contributing to Strategic Objectives: air quality, climate mitigation, climate resilience, happy city

Measures	CAPEX	OPEX	Source of finance
11.1 Nature-based solutions towards a climate resilient 'sponge city'			International donor organizations / Local budget
(Re)forestation - river basins of Tuul and Selbe in suitable areas (120 ha)	600,000 USD ²⁵		
Green embankments ²⁴ applied to river basins of Tuul and Selbe in suitable areas (approx. 100 km)	13,000,000 USD ²⁶	30,000 USD	
11.2 Development of a feasibility study for city-wide system for flood protection with nature-based solutions, such as: rainwater harvesting, bio-swales along the riverbeds and permeable pavements	350,000 USD		International donor organizations / Local or national budget

Implementation framework

Measure	Steps to be taken
11.1. Nature-based solutions towards a climate resilient 'sponge city' (Re)forestation and green embankments applied to river basins of Tuul and Selbe in suitable areas	Prepare a feasibility study for the reforestation and green embankments, including assessment of risks and benefits of the measures using quantitative criteria, define financing strategy, including future management and maintenance of the solution. Conduct a technical, economic and social assessment of proposed project. Implement solutions. Monitor and inform future practices.
11.2. Development of a feasibility study for city-wide system for flood protection with nature-based solutions, such as: rainwater harvesting, bio-swales along the riverbeds and permeable pavements	Prepare a feasibility study for water-harvesting and bio-swales. Conduct a technical, economic and social assessment of proposed project.

Measures	Implementing entity	Targeted results	Contribution to existing policies
11.1. Nature-based solutions towards a climate resilient 'sponge city': reforestation; green embankments	MUB through the Land Use Department and Water Department Cooperating stakeholders: Sewerage and Drainage Department; Tuul River Basin Management Entity; Municipality workers, schools, public area management bodies, emergency situations management department, NGOs (for awareness raising campaigns)	120 ha reforestation 100 km green embankments Installed capacity for rainwater harvesting: 30% of average total annual rainfall quantity 10% of existing drainage ditches at city level to be converted to swales	National Water Program (2010) Action Plan of Citizens Water Supply, Safety and Sanitation Usage Improvement Sub-program of Ulaanbaatar (2018) Action Plan for Ulaanbaatar 2020 and

²⁴ The precise cost will depend on the location, design and the potential for completing several operations at the same time

²⁵ Source: <https://www.pnas.org/content/pnas/suppl/2014/09/04/1409785111.DCSupplemental/pnas.1409785111.sapp.pdf>

²⁶ Source: <http://www.buildingwithnatureinthecity.com/images/applications/fact-sheet-natural-embankment.pdf>

Action 11**contributing to Strategic Objectives:** air quality, climate mitigation, climate resilience, happy city

Measures	Implementing entity	Targeted results	Contribution to existing policies
11.2. Development of a feasibility study for city-wide system for flood protection with nature-based solutions, such as: rainwater harvesting, bio-swales along the riverbeds and permeable pavements	Other actors: Geodesy and MUB		Development Approaches for 2030

Action 11

contributing to **Strategic Objectives:** air quality, climate mitigation, climate resilience, happy city

Outcomes

Quantitative assessment

Measure	Environmental outcomes
11.1. Nature-based solutions towards a climate resilient 'sponge city': reforestation; green embankments	Cross reference with Action 10. Green space development is a nature-based solution, benefits of this are calculated in terms of carbon sequestration and carbon saving. These outcomes are complementary, thus the CO ₂ benefits presented there are also valid for this measure.
11.2. Development of a feasibility study for city-wide system for flood protection with nature-based solutions, such as: rainwater harvesting, bio-swales along the riverbeds and permeable pavements	No direct environmental outcomes are envisaged on short term.

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 11 – all measures	<ul style="list-style-type: none"> Reduced damage of flash floods Enhanced biodiversity Increased ecosystem value of city green areas due to reduced impact of droughts Increased water availability. Currently, the water consumption per capita is high and the water availability is limited, these will be more in balance when developing water harvesting systems for rainwater, lowering the pressure on the water cycle in Ulaanbaatar Water resource efficiency in extraction and use Enhanced climate resilience 	<ul style="list-style-type: none"> Increased life expectancy or quality of life and decreased morbidity rate due to contaminated water-related diseases Reduced investment cost (natural water retention costs lower than grey infrastructure) Reduced maintenance costs Traffic congestion savings due to improved rainwater drainage Lowered cost for maintenance and grey infrastructure development due to green infrastructure solutions Enhanced share of green space for recreational purposes Health benefit for citizens due to increased green space reducing CO₂ emissions

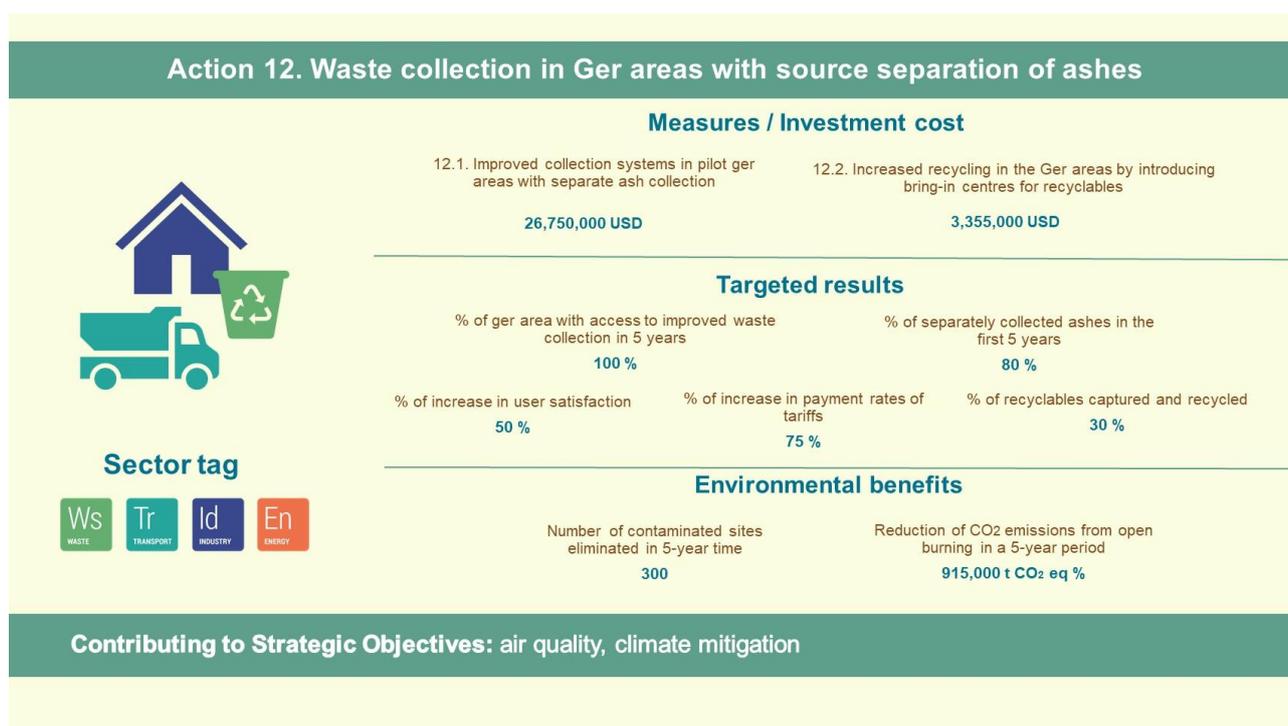
Action 12

Waste collection in Ger areas with source separation of ashes



Action 12

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

The waste collection service is currently not performing at the same standards throughout the city, with several suburban Ger areas lagging behind in terms of proper primary waste collection services, i.e. insufficient frequency, quality and reliability of the service. The frequency of the collection service drops in winter times when the amount of waste generated more than doubles in this area and the service operators lack capacity to carry this amount of waste. This creates a serious public health risk and is hindering our objective of having a “happy city”. In addition, the coal ashes in wintertime pose a safety risk as hot ashes often cause waste in bins and at the landfill to catch fire, thus aggravating the already existing air pollution problems.

The waste collection service currently does not recover costs from tariffs, as both tariffs and payment rates are low in Ger areas. This hinders the further development of the service and enables the general lack of awareness towards waste reduction goals and circular economy. Thus, extending and improving the reliability of waste collection service, in parallel with increasing tariffs, and improving billing is a priority action for the development towards the “happy city” goal.

The actions have the potential of converging with the **Ulaanbaatar Waste Management Improvement Strategy and Action Plan, 2017**, as the latter addresses current challenges in solid waste and hazardous waste management. The expected outputs of certain ongoing donor projects assist the fulfilling of the objectives of the National Air and Environmental Pollution Reduction Program and the Ulaanbaatar Waste Management Improvement Strategy and Action Plan. Such donor projects include the EBRD Solid Waste Management under Green Cities Framework: investments in a new landfill and a plant for construction and demolition waste, and the grant of the Asian Development Bank for waste management and recycling.

To address the challenges the following short-term measures have been defined:

12.1. Improved collection systems in pilot Ger areas with separate collection of ashes

This measure includes providing communal bins for mixed municipal waste and separate metal bins for ashes with grate at inlet point. The frequency of service will be increased to at least once per week in each Service Zone (containing one or several Khoodors). The pilot zones will establish collection schedules and communicate it to service users in a clear way through flyers and posters, by posting it on the collection company’s and MUB’s website/social media channels. Investment shall be carried out to modernize the collection fleet at the Service Zone scale.

Each Service zone will have an operator model appropriate for the zone that may include contracting community-based organizations, micro or small private sector providers or the municipality itself getting

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contributing to Strategic Objectives: air quality, climate mitigation

involved in service operation either through a company or a dedicated department. Regardless of the operator model chosen, most important is to strengthen the role of the municipality as manager of the service. This service will bring the waste to the transfer stations of the service area or communal containers that function as pick up points for the secondary collection service of the MUB. Improving infrastructure and quality of the primary collection service in the Ger area will go hand in hand with improved billing procedures and increased payment rates. Tariff increases will be based on MUB tariffing policies and appropriate billing systems will be established by the district level municipalities.

The pilot area may be appropriate in the highest polluted area on the north side of the city center. As a first pilot, the BGD 10 khoroo may be chosen, located in the north west of UB city center and next to apartments buildings in 3rd and 4th subdistricts of Bayangol district. This khoroo has 8,800 households and a population of 23,000. Following the implementation of the first pilot, the project will be extended to the areas, priority being given to areas highly polluted.

12.2. Increased recycling in the Ger areas by introducing bring-in centres for recyclables

In the short term establishing bring-in centres for recyclables in cooperation with the already existing informal or semi-formal businesses in the recycling value chain makes sense and may increase recycling rates in the entire ger area. The introduction of this new infrastructure will go hand in hand with awareness raising campaigns concerning the health and safety risks related to improper waste management practices and benefits of separate collection and waste reduction. Besides recycling, this system favours the opportunity to reuse certain packaging materials, especially glass bottles, as glass seems to represent a high percent of the waste stream (about 29% out of the total waste quantity). Community actions will be organized for the clean-up of illegal dump areas based on existing positive examples where the Municipality cleaned and transformed certain areas into recreational areas for the community.

For medium and long-term measures, the MUB will consider the following:

- Gradual enforcement of source separation and separate collection practices, with incentives for households which are performing well and penalties on non-compliance
- Gradual increase in the number of fractions and waste flows separated at sources
- Periodical awareness campaigns

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
12.1. Improved collection systems in pilot Ger area with separate collection of ashes: 3 collection trucks; 1200 communal containers for municipal waste; 600 containers for ashes Roll out of the piloted system to all Ger areas, assuming 80% is underserved and needs modernization: 52 collection trucks; 33,800 communal containers for municipal waste; 16,900 containers for ashes	1,140,000 USD 25,610,000 USD	520,000 USD 8,700,000 USD	International donors / Grants and loans / Local budget contribution
12.2. Increased recycling in the Ger areas by introducing bring-in centres for recyclables Roll out of the piloted system to all Ger areas, assuming 80% is underserved and needs modernization Awareness raising campaigns in Khooro 10, Bayangal district for 10 bring in centres	3,355,000 USD	Net zero operation cost to the municipality because of revenues from sale of recyclables 10,000 USD	Municipal budget and private sector

Action 12

contributing to Strategic Objectives: air quality, climate mitigation

Measures	CAPEX	OPEX	Source of finance
including community clean up days of illegal dumpsites			

Implementation framework

Measure	Steps to be taken
12.1. Improved collection systems in pilot Ger area with separate collection of ashes	<p>Conduct baseline assessment and detailed planning for improved quality and frequency of waste collection service in pilot area Khooro 10 of Bayangol district.</p> <p>Acquire the necessary infrastructure for the pilot area.</p> <p>Tender out services for operation.</p> <p>Carry out awareness raising campaign related to benefits of separating ashes.</p> <p>Explore opportunities to increase revenue collection by tying waste collection service payment to electricity bill.</p> <p>Capacity building for the municipality, for the performance-based management of the waste collection service.</p> <p>Monitor results of the pilot action and draw lessons learned.</p> <p>Plan the gradual roll-out of the improved waste collection system in ger areas (years 2 to 5).</p>
12.2. Increased recycling in the ger areas by introducing bring-in centres for recyclables and awareness raising campaigns	<p>Study the recycling chain and the private sector active in recycling.</p> <p>Establish in a participative planning process with stakeholders the recycling infrastructure needed, and placement, layout and equipment needed for the bring-in centres in the khoro.</p> <p>Establish the functioning of the bring-in centres, participation of municipality and private sector in the operation of the centres, contractual arrangements, ownership of traded recyclables.</p> <p>Implement investment and operation through transparent public procurement methods.</p> <p>Carry out awareness campaign for recycling and waste prevention.</p> <p>Monitor results of the pilot action and draw lessons learned.</p> <p>Plan the gradual roll-out of the enhanced recycling in ger areas (years 2 to 5).</p>

Action 12

contributing to Strategic Objectives: air quality, climate mitigation

Measures	Implementing entity	Targeted results	Contribution to existing policies
12.1. Improved collection systems in pilot Ger area with separate collection of ashes	<p>Owner: UB Mayor's Office: Service and Waste Management Division, District level MUB as a service contractor.</p> <p>Cooperating stakeholders: Waste management operator, or the so called TUK in Mongolian (Tohijilt Uilchilgeenii Kompani) appointed to each zone and in charge of waste collection, removal and transportation services, as well as the cleaning of public spaces of their designated districts.²⁷ Khorroos and kheseg level authorities cooperating with district level authority in managing and monitoring the service. TUKs are both private and public.</p> <p>Other stakeholders: Private waste management companies, formal and informal businesses active in the recycling chain, the Mongolian National Recycling Association NGO.</p>	<p>Successful pilot project implementation in the first 2 years</p> <p>Roll-out of improved waste collection service in 100% of Ger areas in 5 years</p> <p>80% separately collected ashes in the first 5 years of the implementation</p> <p>50% increase in user satisfaction towards collection service for ger residents in the first four years of project implementation (monitored through number of complaints and/or surveys)</p> <p>75% payment rate of tariffs in Ger areas</p>	<p>Ulaanbaatar Waste Management Improvement Strategy and Action Plan, 2017</p> <p>National Air and Environmental Pollution Reduction Program</p> <p>Ulaanbaatar Waste Management Improvement Strategy and Action Plan</p>
12.2. Increase recycling in the Ger areas by introducing bring-in centres for recyclables and awareness raising campaigns		<p>30% of recyclable waste streams such as plastics, paper and cardboard, metal and glass captured and recycled in the Ger areas.</p>	

Outcomes

Quantitative assessment

Measure	Environmental outcomes
12.1. Improved collection systems in pilot Ger area with separate collection of ashes	Contaminated sites (state indicator) - Elimination of at least 300 contaminated sites of waste accumulation or illegal dumping in the Ger areas (approximately 3 sites per khoodo) in 5-year time Reduced black carbon from open burning of waste - 183,000 tonnes CO ₂ eq. per year, that is about 915,000 tonnes/ for 5 years.
12.2. Increase recycling in the ger areas by introducing bring-in centres for recyclables and awareness raising campaigns in the entire ger area	45,700 tonnes CO ₂ due to avoided emissions through substitution of high embedded energy virgin materials

²⁷ <https://www.mdpi.com/2071-1050/9/6/896/pdf>

Action 12**contributing to Strategic Objectives:** air quality, climate mitigation**Quantitative assessment**

Measures	Environmental outcomes	Socio-economic outcomes
Action 12 – all measures	Reduced air pollution due to modernized collection fleet Reduced littering and waste accumulation around containers and bins due to improved container infrastructure Reduced GHG emissions due to more efficient collection system Reduced toxic fumes as bin and landfill fires reduces after separate collection of ashes	Quality of life will be positively impacted in the ger area because separate collection of ashes reduces risk of fire and air pollution, while improved collection reduces waste accumulation that causes nuisance, unpleasant odours and may attract pests. Revenues and business opportunity in the recycling value chain Improvement of public spaces due to reduced littering and illegal dumping

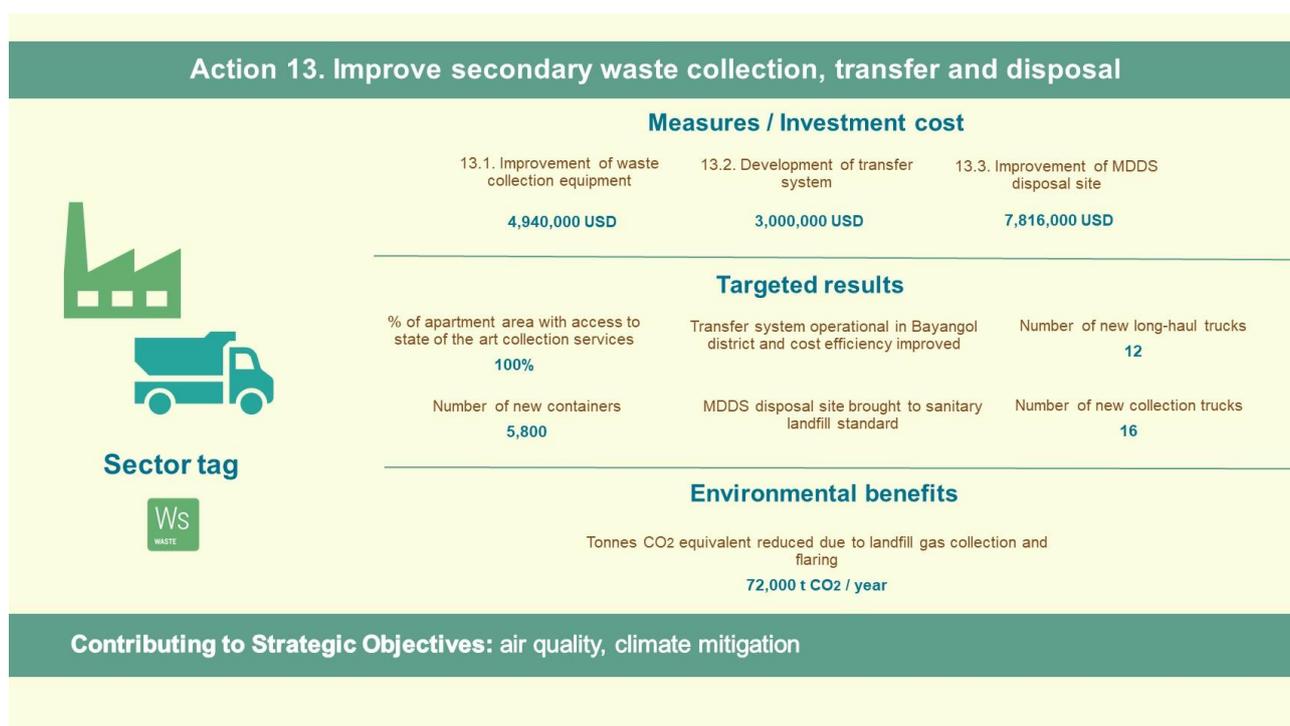
Action 13

Improve secondary waste collection, transfer and disposal



Action 13

contributing to Strategic Objectives: air quality, climate mitigation



Context and proposed measures

The total amount of waste registered at the three municipal solid waste disposal sites of Ulaanbaatar in 2015 was 970 thousand tonnes. The three disposal sites for municipal solid waste (MSW) in UB have varying standards of engineering and management practices and receive different amounts of waste. Narangiin Enger (NEDS) is the largest site receiving 47% of waste, followed by Tsagaan Davaa (TsDDS) receiving 36.8% and finally Morin Davaa (MDDS) receiving 16.2%. MSW includes waste from households (apartment and ger) and streets and public spaces that accounts for 53.9% of total waste registered at weighbridges at these landfills. MSW generation of UB city is 1.12 kg per capita per day (408.82 kg per capita per year). According to literature²⁸, generation rate is higher since recyclables are extracted prior to disposal at place of generation or from containers.

Out of the three sites, NEDS is the most advanced site, an engineered facility that was constructed by JICA, whereas the other two sites are controlled disposal sites. NEDS has adequate access road to the site with paved roads and is better in terms of reception and general site management. However, NEDS is in the vicinity of residential areas causing nuisance to Ger area residents nearby, while the other two are relatively isolated. All the sites can be accessed easily, have weighbridges and keep records of the incoming waste, including waste volumes, weights and categories. Waste is unloaded under the supervision of on-site staff.

There are about 2000 informal waste pickers working at the disposal sites who earn their livelihood from sale of the extracted materials. 300 of these live on the sites. They are thought to set most of the fires at the landfill sites, especially during winter for heating purposes. An Environmental Impact Assessment was carried out at NEDS and MDDS in the initial stages, however none for TsDDS. Only NEDS has a leachate and landfill gas management system. Closure of the NEDS is expected in 2020, as a result of which, the other two sites will receive higher quantities of waste in the future.

Lack of adequate control and management at disposal sites is causing environmental pollution to air, soil and water through landfill fires and GHG emissions.

There are some experiments with waste transfer stations in Ger areas, but none are currently functional. Waste is directly transported to the disposal sites. As for waste collection trucks, there are both open and container types. Most of the vehicles require human labour, especially during winter for the handling of ash from the ger areas.

²⁸ <https://www.mdpi.com/2071-1050/9/6/896/pdf>

Action 13

contributing to Strategic Objectives: air quality, climate mitigation

According to 2019 data provided by UB Waste Management Division, there are 294 waste collection vehicles operated by 18 TUKs (waste management companies). Of these, 7 are private with 81 vehicles. All operate in central 6 districts. A part of the trucks has a GPS system installed for monitoring their location and speed; they also have sensors monitoring fuel expenditure. However, vehicles and machinery are rarely upgraded, due to lack of funding.

An important act regarding this action is **Ulaanbaatar Waste Management Improvement Strategy and Action Plan 2017**, which addresses current challenges in solid waste and hazardous waste management. Its scope is to extend full coverage of waste management services to all parts of the city, including gers and outskirts areas, to minimize the exposure of the environmental components (air, water, soil, flora and fauna) to waste by curbing open and illegal dumping and stopping open burning of waste, etc.

There are ongoing donor projects, the expected outputs of which are expected to assist the fulfilling of the objectives of the **National Air and Environmental Pollution Reduction Program** and the **Ulaanbaatar Waste Management Improvement Strategy and Action Plan**. Such donor projects are the EBRD Green Cities Framework: Improvement of solid waste disposal facility in Ulaanbaatar city, and the grant of the Asian Development Bank for waste management and recycling.

As concerning this action, the first disposal site chosen for upgrade is MDDS, as the above mentioned EBRD project currently under preparation targets this site, aimed at building a construction and demolition waste recycling facility.²⁹ Implementation of proposed measures will be coordinated with this project. Modernization and completion of the capacity of collection equipment running in inner city is proposed here. Piloting transfer station in a location in Bayangal district is proposed with necessary equipment for transport.

The following short-term measures have been defined:

13.1. Improvement of waste collection equipment

- Secondary waste collection fleet improvement for apartment area.
- Additional equipment (trucks, GPS, route optimization) to supplement the existing fleet and replacement (at 50% of full capacity needed)
- Modernizing and replacement of bins in 50% of the apartment area

13.2. Developing transfer system

- Developing transfer stations especially for Ger area
- As a start piloting two types of transfer stations are proposed in Bayangal district.
- Roll out transfer stations to cover the low-density fringe Ger areas that are difficult to access and far from disposal sites based on a feasibility study
- Purchase large capacity long-haul transport vehicles including containers

13.3. Improving disposal site at MDDS to sanitary landfill standards

- Leachate collection and treatment, landfill re-shaping, collection and flaring of landfill gas, improvement of access road
- Compaction, daily coverage, tipping point, acceptance criteria for types of waste
- Closure and after care of cells that are used to capacity
- Monitoring
- Design for extension of landfill capacity and implementing first phases of extension.

Long term actions to improve waste collection transfer and disposal:

- Explore the feasibility of transferring some of the investment and replacement to operators through longer service contracts in the future
- Modernizing and replacement of bins in the entire area
- Implement adequate transfer infrastructure for the entire city

²⁹ <https://www.ebrd.com/news/2018/ebrd-and-eu-improve-waste-management-in-ulaanbaatar.html>,
<https://www.ebrd.com/work-with-us/projects/psd/grcf-ulaanbaatar-solid-waste-modernisation-project.html>

Action 13

contributing to Strategic Objectives: air quality, climate mitigation

- Develop enough capacity for sanitary disposal for the municipality. At MDDS extension up to 2037 is feasible and able to take up about half of the generated waste in the municipality. Another site will also be needed to ensure the full capacity needed
- Work on prevention, reuse, recovery and minimizing waste generation in an effort to move towards circular economy

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
13.1. Improvement of waste collection equipment in the apartment area (assume 50% improvement needed) 5800 containers; 16 collection trucks; GPS software and equipment for route optimization	4,940,000 USD	2,750,000 USD (for 50% of apartment area dwellers)	Municipal budget, national budget, international financing organizations
13.2. Development of transfer system Transfer station for Bayangol district; 12 long haul trucks including containers for Bayangol district; Feasibility study for transfer system in Ulaanbaatar	3,000,000 USD	1,900,000 USD	Municipal budget, national budget, international financing organizations
13.3. Improvement of disposal site at MDDS to sanitary landfill standards Construction (initial investment for new cells and rehabilitation of closed cells); Infrastructure; Equipment and installations; Semi-aerobic landfill system appropriate for oxidizing methane and reducing GHG; landfill cells	7,816,000 USD	1,140,000 USD	Municipal budget, national budget, international financing organizations

Implementation framework

Measure	Steps to be taken
13.1. Improvement of waste collection equipment	Confirm needs for additional containers and truck. GPS system and road planning software. Confirm needs for upgrade of existing equipment of containers and collection trucks in apartment areas (calculated to start at 50% of the apartment area). Launch tender for collection equipment purchase.
13.2. Development of transfer station systems	Develop a pilot project for transfer station and equipment in Bayangol district, including detailed design. Launch tender for construction of transfer station(s) and purchase of equipment for long distance transport of waste from Bayangol district to disposal site. Launch tender for operation of the collection system including transfer in the Bayangol district. Monitor performance of the collection and transfer system draw lessons learned. Conduct feasibility study for transfer station and long-distance transport for an efficient waste management system for the entire municipality.
13.3. Improvement of disposal site at MDDS to sanitary landfill standards	Tender civil works and reconstruction work of the disposal site, purchase of necessary equipment and facilities based on feasibility study and EIA that is under development for site extension. Tender and select operator for the disposal site. Monitor performance of the operator. Start site selection activities for a new sanitary landfill for the municipality.

Action 13

contributing to Strategic Objectives: air quality, climate mitigation

Measures	Implementing entity	Targeted results	Contribution to existing policies
13.1. Improvement of waste collection equipment	UB Mayor's Office: Service and Waste Management Division Cooperating stakeholders: District level communal enterprises as client for the services.	State of the art efficient collection service in 100% of the apartment area of Ulaanbaatar	National Air and Environmental Pollution Reduction Program;
13.2. Development of transfer station systems	Waste management operator, or the so called TUK in Mongolian, appointed to each zone and in charge of waste collection, removal and transportation services, as well as the cleaning of public spaces of their designated districts; MDDS disposal site operator.	Transfer system operational in Bayangol district and cost efficiency improved	Ulaanbaatar Waste Management Improvement Strategy and Action Plan
13.3. Improvement of disposal site at MDDS to sanitary landfill standards	Other stakeholders: Private utility companies, NGOs	MDDS disposal site brought to sanitary landfill standard, environmental permit in place	

Outcomes

Quantitative assessment

Measure	Environmental outcomes
13.1. Improvement of waste collection equipment	Waste collection is the backbone of the waste management system. Without this action the rest of the quantified benefits related to waste and resource management are not attainable.
13.2. Development of transfer station systems	
13.3. Improvement of disposal site at MDDS to sanitary landfill standards	72,000 tonnes CO ₂ equivalent reduced due to landfill gas collection and flaring Considerable environmental improvement at one of the most important contaminated sites of the city due to leachate control and control of open burning.

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 13 – all measures	Reduced air pollution due to modernized collection fleet Reduced littering and waste accumulation around containers and bins due to improved container infrastructure Reduced GHG emissions due to more efficient transport and transfer Quality of soil and ground water improved due to improvement measures at disposal site Reduced open burning at disposal site	Cost efficiency of waste management improved due to transfer system in the Bayangol district and later for the entire city as the transfer system is developed Decreased morbidity and health problems for waste pickers due to reduced pollution from fires at the disposal site

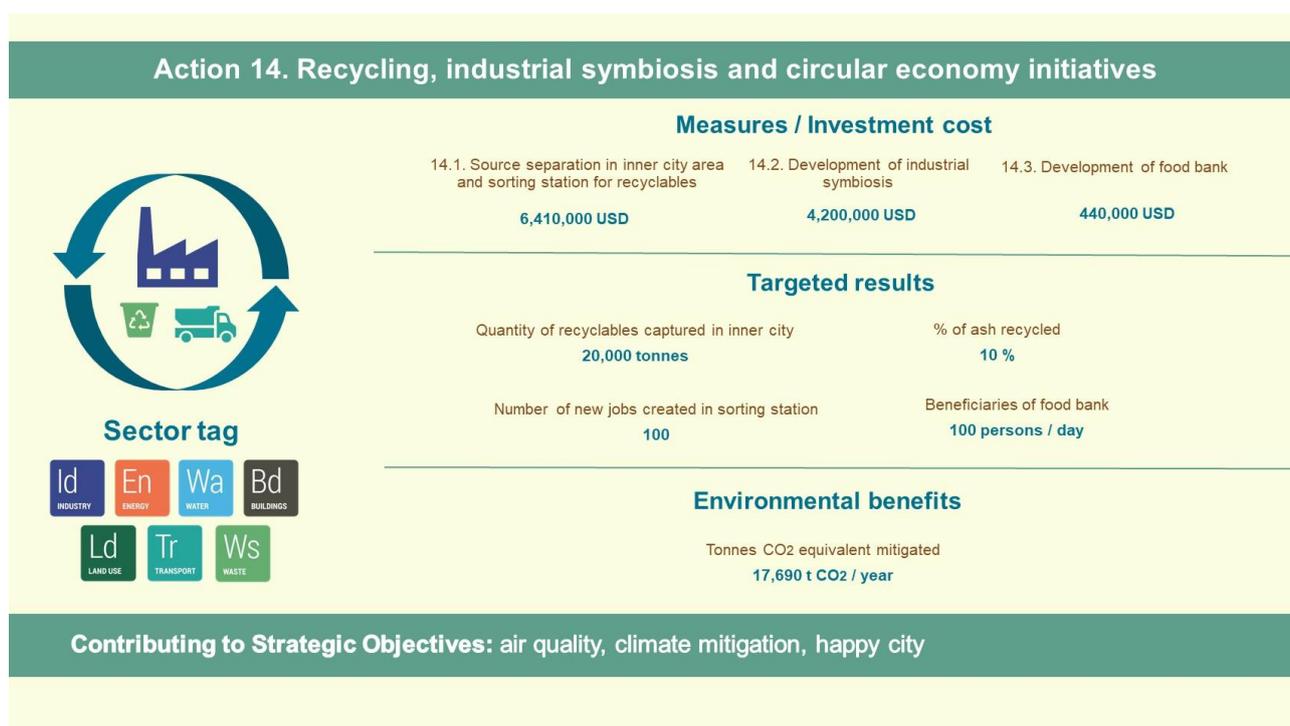
Action 14

Recycling, industrial symbiosis and circular economy initiatives



Action 14

contributing to Strategic Objectives: air quality, climate mitigation, happy city



Context and proposed measures

Current recycling rate in UB is approximately 5.5%, which is vastly accomplished by the informal sector collecting recyclables out of communal bins or at disposal sites. Sorted materials are plastics, paper, can, and glasses. However, the quantity of sorted materials is not known or recorded.

Circular economy is a rather new concept to UB and Mongolia in general, with only one known project towards circular economy being currently under implementation by the Asia Foundation, aimed at reducing GHG emissions. The project supports national and local governments in creating and enabling legislative, financial and technological environment for the uptake of Environmentally Sound Technologies in the sector. Only one small sorting station in one of three main disposal sites of UB city was functional up to recently. Capacity of this South Korea supported sorting station was 70 ton/day. However, after 3 years of functioning, it was unfortunately damaged by a fire this year (2019) and currently has seized operations.

We have established with the National Association for Waste Management (NAWM) – an umbrella organization of waste recyclers in 2019 – a MoU to allocate land parcels nearby two main disposal sites to its member entities for establishing sorting stations. These two sites are: Narangiin Enger (NE) located in North West and Tsagaan Davaa (TsD) located in North East of UB.

8 entities of NAWM have obtained land in the North West and 6 in the North East for establishing sorting stations. All these entities now work for attracting investment and it is expected that by the end of 2019, 2-4 sorting stations will be operational.

The current action proposes three pilot projects, as showcases for initiatives promoting circular economy.

About 40% of total population of Ulaanbaatar lives in the apartment area, generating MSW 1.12 kg per capita per day (408.82 kg per capita per year), 52% of this is recyclable waste. Mongolia is a lower-middle-income country, however, according to JICA's study UB's household waste composition had qualities of countries from all income levels. For instance, UB has only about 33.7% organic fraction, which is similar to high-income countries. The amount of paper (7.7%) and metals (2.1%) were comparable to lower-income countries. The percentage of plastic (14%) waste was in the higher range compared to all other income countries waste composition. The percentage of bottles and glass (29%) was significantly higher than the rest, this allows opportunities for a bring in (deposit refund) system and reuse of bottles.

The **Mongolian Law on Waste** (adopted in 2017) can serve as a comprehensive legal background for at least the first two project ideas, as it governs the collection, transportation, storage, and deposition in landfills of household, industrial waste, hazardous waste, and also the re-use of waste as secondary raw material. Furthermore, the Asian Development Bank grant for waste management and waste recycling could serve as

Action 14

contributing to Strategic Objectives: air quality, climate mitigation, happy city

a **good practice example** in Ulaanbaatar, as the goal of the project currently still under implementation is the reduction of GHG gases and SLCPs from the waste sector, based on circular economy concept. A further good practice to the re-use of waste and thus to the transition towards principles of circular economy and 3R is the European project SWITCH - Asia II “Improving resource-efficiency and cleaner production in the Mongolian construction sector through materials recovery”, currently under implementation by Caritas Czech Republic, even if it focuses on the recycling of construction waste.

The following short-term measures have been defined:

14.1 Source separation in inner city area and sorting station for recyclables

- Public consultation is needed to refine and choose the pilot area for source separation of recyclables.
- High rise buildings and households in small scale area in city centre/newly developed neighbourhood should be included in the pilot project at first.
- A sorting station for recyclables is foreseen for a capacity of 50,000 tonnes per year as a pilot project for the inner city. Investment will include containers, covered containers sites, trucks, sorting stations.

14.1.1 Industrial symbiosis; pilot project to focus on ash waste recycling, i.e. eco-core, replacement of fraction of Portland cement in concrete

- Source ash from source separated ashes from ger areas and/or from the coal-based power plants in the municipality
- Pilot ash recycling plant could be located in foreseen Nalaikh Industrial Technology Park (ITP) for uptake by construction businesses

14.2 Food bank for reducing organic fraction in municipal solid waste, with canteen for the poor

- Collecting near to term food from supermarket food industry, restaurants
- The action can be implemented as part of Corporate Social Responsibility (CSR) of food industry and retailers
- Cooking and serving in a social canteen
- Companies in city center/municipality departments/NGOs/ community can be involved in cooking and serving as a CSR/team building measure.
- Additional needs of food bank can be met through donations, crowd funding, etc.
- Cooperation of NGOs is needed, need to define pilot project location.

This action will be overseen by the municipality in the role of the coordinator but will be implemented by food industry players and NGOs active in the environment and social sphere.

In the medium to long term all these pilot projects could be rolled out if successful or tailored further and rolled out differently in different areas to improve results.

Cost estimate for short term measures

Measures	CAPEX	OPEX	Source of finance
14.1. Source separation in inner city area and sorting station for recyclables			Municipal budget, international financing institution, extended producer responsibility system
Feasibility study	410,000 USD		
8000 containers; 4000 covered container sites; 3 trucks; Sorting station @ 20,000 t/y facility; Awareness raising	6,000,000 USD	785,000 USD	
14.2. Industrial symbiosis		Net zero operation cost to the	Municipal in-kind contribution and

Action 14

contributing to Strategic Objectives: air quality, climate mitigation, happy city

Measures	CAPEX	OPEX	Source of finance
<p>Implementing the selected technical solution for recycling of waste ashes, first targeting ashes source separated in ger areas (cross reference 12.1, 9,500 tonnes of ashes)</p> <p>165 USD/t to 550 USD/t of ashes (competitive with cost of landfilling in the EU, average cost is taken)</p>	4,200,000 USD	municipality because of revenues to private recycler	private sector, co-financing from subsidy as incentive
<p>14.3. Food bank for reducing organic fraction in municipal solid waste (40 t per year)</p> <p>Feasibility study; refurbishing house, infrastructure; equipment for the communal kitchen; food waste sorting, pre-treatment, composting</p>	440,000 USD	15,000 USD (Cost to municipality only and assuming CSR, volunteers, in kind contribution)	Crowd Funding, Funds allocated to Corporate Social responsibility within the food industry sector, Grant financing

Implementation framework

Measure	Steps to be taken
14.1. Source separation in inner city area and sorting station for recyclables	<p>Feasibility study for source segregation, separate collection of recyclables and sorting for inner city area; including options for reuse recovery and repair</p> <p>Pilot project design for 50% of the population with a minimum of 30% recycling rate targeted</p> <p>Tender out operation of collection and sorting</p> <p>Operation of the system with awareness raising campaigns in parallel</p> <p>Monitoring performance</p> <p>Rolling out the recycling scheme to other parts of the city as appropriate</p>
14.2. Industrial symbiosis	<p>Feasibility study for technical alternatives for waste ash recycling in the Industrial park; study will include both power plant and Ger area generated ashes</p> <p>Tender out in a public private partnership arrangement recycling of ash (municipality will be able to deliver feedstock of separately collected ashes, supply ashes generated by of municipal owned power plant or power plants operated in the administrative territory of the municipality)</p> <p>Operation, monitoring, environmental compliance</p>
14.3. Food bank for reducing organic fraction in municipal solid waste	<p>Identify in kind contribution from the municipality in terms of suitable building for processing food waste, cooking and social canteen</p> <p>Develop project concept through a feasibility study, participative planning from businesses, communities, NGOs and people using the service is important</p> <p>Establish best organizational structure for implementation. Potentially best way to implement is to implement the concept in a participative manner, led by the municipality or a municipal enterprise.</p> <p>Equip the building with necessary equipment, including food waste sorting, storage, cooking equipment</p> <p>Operate the centre and monitor results, draw lessons learned</p>

Action 14

contributing to Strategic Objectives: air quality, climate mitigation, happy city

Measures	Implementing entity	Targeted results	Contribution to existing policies
14.1. Source separation in inner city area and sorting station for recyclables	<p>UB Mayor’s Office: Waste Management Department</p> <p>Cooperating organizations: Private recycling and construction sector; Food industry, food retailers, markets, NGOs and community-based organizations co-opted to contribute in kind and/or attract financing to the food bank project</p>	<p>20,000 tons of recyclables in inner city area is captured and diverted at sorting stations destined to post-source separated recyclables (30% recycling rate in 50% of the apartment area as part of the pilot project)</p> <p>At least 100 jobs created in the pilot sorting station</p>	<p>National Air and Environmental Pollution Reduction Program;</p> <p>Ulaanbaatar Waste Management Improvement Strategy and Action Plan</p>
14.2. Industrial symbiosis	<p>Other stakeholders: Mongolian National Recycling Association NGO, Homeowners associations, Waste to Energy project implementation unit, Construction materials retailers and manufacturing companies,</p>	<p>Start-up of an ash recycling business taking up at least 10% of all ash waste generated in the Ger area, that is estimated at minimum 100,000 t per year</p>	
14.3. Food bank for reducing organic fraction in municipal solid waste	<p>Food industry and produce retailers, Civil society organizations for 14.3 measure</p>	<p>Food bank having run an associated social canteen with at least 100 beneficiaries on weekdays</p>	

Action 14

contributing to Strategic Objectives: air quality, climate mitigation, happy city

Outcomes

Quantitative assessment

Measure	Environmental outcomes
14.1. Source separation in inner city area and sorting station for recyclables	10,000 t CO ₂ saved through diverting materials to recycling (virgin raw material substitution)
14.2. Industrial symbiosis	7,600 t CO ₂ avoided due to using ashes as part of cement production (9,500 tons of ashes from ger district)
14.3. Food bank for reducing organic fraction in municipal solid waste	90 t CO ₂ equivalent (avoided methane generation by diverting 40 tonnes of food waste from disposal)

Quantitative assessment

Measures	Environmental outcomes	Socio-economic outcomes
Action 14 – all measures	Improved air, soil and water quality as ashes, recyclables and food waste is diverted from disposal and illegal dumping Increased resource recovery ensuring a looping back to the market with waste-based outputs	Increased life expectancy or quality of life and decrease in illnesses related to coal ash disposal for residents of ger area Creation of jobs, green businesses and locally produced outputs for the market Especially the food bank project will lead to increased social inclusion and community development. Decreased morbidity and health issues due to food scarcity in case of vulnerable groups through the food bank measure

Chapter 5. Summary of GCAP actions and financial details

The majority of cost estimates are defined on the base of the feasibility studies, performed for Ulaanbaatar, such as:

- Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal Project, Concept note and Funding proposal, financed by Green Climate fund, 2017
- Second energy sector project, financed by Green Climate fund, 2017
- Feasibility study on “Service center” construction throughout Ulaanbaatar city’s ger area
- Ulaanbaatar City Bus Project Final Due Diligence Report, financed by EBRD 2019
- Mongolia: Ulaanbaatar District Heating - Feasibility Study - Rehabilitation of district heating distribution network, UBDHC and OSNAAUG package

Some of the cost estimates are based on literature sources, such as:

- Costs and Benefits of Installing Flue-Gas Desulfurization Units at Coal-Fired Power Plants in India, chapter 13 of Injury Prevention and Environmental Health. 3rd edition., 2017
- Cycle-friendly cities – How cities can stimulate the use of bicycles, Policy advice notes, CIVITAS.

For waste management measures (trucks, containers, sorting facilities, etc) heating appliances, air filters, e-bikes, etc, average international market prices are applied. Also, in order to calculate the CAPEX and OPEX for each action/measure we have also made expert based assumptions. All these are presented in Annex 4.

As sources of financing are identified those that have already been established in Ulaanbaatar and Mongolia.

The table summarises the investment costs (CAPEX) for the first five years – 2020-2024. OPEX, operational expenditures are annual costs, defined either as internationally accepted percentages to specific infrastructure cost or on the current data (market prices) in Ulaanbaatar.

Table 9 Summary of GCAP actions with financial details

Action	Code	Measure	Investment/ Policy	Implementing Body	CAPEX [USD]	OPEX [USD]	Potential Funding Sources	Timeline [USD]				
								2020	2021	2022	2023	2024
1. Develop green affordable housing in ger areas	1.1	Construction of energy efficient social housing										
		1.1. A - Feasibility study, financing scheme, tender specification, etc.	Investment	UB Mayor's Office through the Capital City Housing Corporation (NOSK)	110,000		International donors / Grants and loans / Local budget contribution	110,000				
		1.1 B - Annual construction (for 0.5% of the population in the gers or 1,150 flats / year)	Investment		220,800,000				55,200,000	55,200,000	55,200,000	55,200,000
	1.2	Develop the guide for social housing and the financial schemes which will enable the residents of ger areas to access housing	Investment	UB Mayor's Office	50,000		International donors	50,000				
	1.3	Provision of alternative heating solutions and retrofitting of houses										
		1.3 A - Provision of alternative heating solutions for 20,000 units	Investment	UB Mayor's Office through the Capital City Housing Corporation	10,300,000	100,000	International donors / Contribution from locals (beneficiaries)	300,000	3,000,000	3,000,000	4,000,000	
		1.3 B - Retrofitting houses, 5% or 283,830 m ²	Investment		28,385,500				5,677,100	5,677,100	5,677,100	11,354,200
	1.4	Provision of state-of-the-art emission reduction devices										
	1.4 A - Filters (10,000 for 4 years) or	Investment	Housing Infrastructure	16,000,000	16,000	International donors / Contribution		4,000,000	4,000,000	4,000,000	4,000,000	

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		1.4 B - Semi-coke briquette (10,000 households/year with 3 ton/household/year)	Investment	Department of the MUB		2,190,000	from locals (beneficiaries)						
2. Develop infrastructure in ger area	2.1	Development of independent or semi-independent infrastructure for accessing drinking water											
		2.1 A – Feasibility study for development of independent or semi-independent infrastructure for accessing drinking water	Investment	City Administration via the agency Housing Infrastructure Department	220,000				220,000				
		2.1 B – Infrastructure elements such as water tanks and pipes for 200 houses	Investment		400,000	10,000				400,000			
	2.2	Feasibility study for development of wastewater collection system and community scale wastewater treatment plants	Investment	City Administration via the agency Housing Infrastructure Department	220,000				220,000				
	2.3	Usage of dry toilets or septic tanks (20,000)	Investment	City Administration via the agency Housing Infrastructure Department	15,000,000					3,000,000	3,000,000	3,000,000	6,000,000
	2.4	Feasibility study and tender dossier for development of a system for rainwater harvesting	Investment	City Administration via the agency Housing Infrastructure Department	220,000				220,000				
2.5	Feasibility study for use of RES and	Investment	City Administration	170,000				170,000					

	power storage solutions including capacity building activities		via the agency Housing Infrastructure Department			organizations / Local budget						
	Awareness raising activities - actions 2.3, 2.4 and 2.5	Investment	City Administration via the agency Housing Infrastructure Department		25,000	Local budget						
3. Modernize district heating	3.1	Rehabilitation of district heating distribution network, UBDHC and OSNAAUG package	Investment	MUB, through the Ulaanbaatar District Heating Company; Housing and Public Utilities of Ulaanbaatar City	27,000,000	270,000	EBRD	350,000	6,662,500	6,662,500	6,662,500	6,662,500
	3.2	Heat-pump based district heating										
		3.2 A - Feasibility study and implementation of 33 MW capacity of heat pumps	Investment	MUB through the Ulaanbaatar District Heating Company; Housing and Public Utilities of Ulaanbaatar City	39,600,000	400,000	IFI, state and local budget		9,900,000	9,900,000	9,900,000	9,900,000
		3.2 B - Strategy to increase heat pump share in the district heating network	Policy	Housing and Public Utilities of Ulaanbaatar City	50,000		State and local budget	50,000				
	3.3	Strategy for Energy Tariffs Restructuring	Policy	MUB through the Ulaanbaatar District Heating Company; Housing and Public Utilities of	100,000		State and local budget	100,000				

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				Ulaanbaatar City									
4. Implement cross-sectorial green energy solutions	4.1	Installing solar car parks for public transport	Investment	Mayor's Office	5,010,000	25,000	Donor or blended finance			50,000	2,505,000	2,455,000	
	4.2	Capacity building, planning and investment for RES penetration											
		4.2 A – Study on Best Available Technology and mini-feasibility studies for RES pilot projects	Investment	Ministry of Energy, Energy Regulatory Committee	500,000		State budget, IFI, donor financing for technical assistance and capacity building	500,000					
		4.2 B – Implementing up to 10 MW RES pilot project investments	Investment		13,000,000	325,000			3,250,000	3,250,000	3,250,000	3,250,000	
		4.2 C – Capacity building component	Investment		750,000			250,000	250,000	250,000			
	4.3	Modernization of the electricity transmission and distribution network											
		4.3 A – FS on the rehabilitation of electricity distribution network	Investment	Ministry of Energy, Energy Regulatory Committee	220,000		IFI financing, local and national budget	220,000					
	4.3 B - Rehabilitation of grid capacity and power lines (30 km);	Investment	6,450,000		50,000			1,612,500	1,612,500	1,612,500	1,612,500		
	4.3 C - Substation in the central part of the city	Investment	15,000,000		75,000			3,750,000	3,750,000	3,750,000	3,750,000		
5. Energy Efficiency in buildings	5.1	Energy Efficiency Regulations for Buildings	Policy	Mayor's Office	200,000		Local and national budget, grant financing from IFI	200,000					
	5.2	Energy Efficiency in Public Buildings Programme, 140	Investment		4,200,000			IFI loan	420,000	945,000	945,000	945,000	945,000

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		USD/m ² ; @ 10,000 m ²										
	5.3	Energy Efficiency in Residential Buildings 110 USD/m ² @ 700 buildings @ 500 m ² each	Investment		38,500,000		Private sector / IFI loan	7,700,000	7,700,000	7,700,000	7,700,000	7,700,000
6. Water availability and efficiency	6.1	Opportunity assessment for Tuul River Complex	Investment	MUB through the Water Department, Sewerage and Drainage Department, Ulaanbaatar Water Supply and Sewerage Authority (USUG)	150,000		International donor, multi-funding sources	150,000				
	6.2	Rehabilitation of water distribution network	Investment		5,100,000	48,000	International donor, multi-funding sources		200,000	1,020,000	1,020,000	2,860,000
	6.3	Rehabilitation of wastewater collection systems	Investment		11,500,000	112,000	International donor, multi-funding sources		300,000	2,300,000	2,300,000	6,600,000
	6.4	Installing individual water meters	Investment		1,100,000		Contribution from beneficiaries / loans	220,000	220,000	220,000	220,000	220,000
7. Pollution control	7.1	Polluting emissions control technologies										
		7.1 A – Feasibility Study	Investment	Ministry of Energy, MUB, through the Mayor's Office, ERC	200,000		Private sector	200,000				
		7.1 B - Flue-gas Desulfurization unit	Investment		6,309,600	400,000			6,309,600			
	7.2	Higher standards for pollution control										
		7.2 A – Study on pollution control BAT	Policy	Ministry of Energy, MUB, through the Mayor's Office, ERC	100,000			100,000				
		7.2 B - Strengthen implementation of auditing scheme and co-finance initial third-party energy audits	Policy		300,000		Donor / state budget		75,000	75,000	75,000	75,000

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8. Sustainable Urban Mobility for Ulaanbaatar with focus on public transport system	8.1	Development of a Sustainable Urban Mobility Plan (SUMP)	Policy	Urban Planning and Development Department, MUB	500,000		International donor	500,000					
	8.2	Improvement of network planning and control, by making optimal use of available public transport data	Policy		300,000	120,000	International donor / Local budget contribution		300,000				
	8.3	Development of a mass transit system (BRT/metro), and specifically transfer terminals based on this system Investment											
		8.3 A - Preparatory studies for transport hubs (feasibility study on proposed locations, masterplans and conceptual design)	Investment	Urban Planning and Development Department, MUB	750,000		International donor / Local budget contribution		750,000				
		8.3 B - Construction cost for transfer terminal (including design cost, PM cost)	Investment	Urban Planning and Development Department, MUB	20,000,000	200,000	International donor / Local budget contribution			3,000,000	3,000,000	14,000,000	
	8.4	Improvement of traffic flows, with a focus on bus prioritization											
		8.4 A - Internal programme management and expertise + cost of external support	Policy	Urban Planning and Development Department, MUB	300,000		International donors / Local budget contribution	300,000					
		8.4 B - Adapting intersections	Investment	Urban Planning and Development Department, MUB	15,000,000		International donors / Local budget contribution		3,000,000	3,000,000	3,000,000	6,000,000	
		8.5	Investment in bus fleet improvement	Investment	Urban Planning and Development Department, MUB	70,000,000		International donor / loans	14,000,000	14,000,000	14,000,000	14,000,000	14,000,000

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9. Urban Safety and Accessibility	9.1	Adapting infrastructure for pedestrians	Policy /Investment	Traffic Planning, Coordination and Engineering Department of the Capital City	1,000,000	50,000	Local budget, grant finance	100,000	250,000	250,000	250,000	150,000	
	9.2	Preparing and implementing tariff-based differentiation policy in parking areas											
		9.2 A - Review of the existing parking regulations for urban development	Policy	Traffic Planning, Coordination and Engineering Department of the Capital City	250,000		Local budget, grant finance	250,000					
		9.2 B - Implement tariff-based differentiation parking and building the capacities for enforcement	Investment	Traffic Planning, Coordination and Engineering Department of the Capital City	1,400,000	600,000	Local budget		700,000	700,000			
10. Develop multipurpose green areas in the city	10.1	Development of multifunctional green spaces											
		10.1 A - Plan urban green space development	Policy		100,000			100,000					
		10.1 B - Develop 100 ha of green space	Investment	MUB through the Master Planning Department	60,000,000	1,000,000	Local budget		15,000,000	15,000,000	15,000,000	15,000,000	
		10.1 C – Develop of green roofs	Investment		560,000	20,000	Local budget / private financing		140,000	140,000	140,000	140,000	
	10.2	Development of green cycling lane; provision of (PV) charging, e-bikes and renting stations for e-bikes in rest areas along the cycling path											
		10.2 A - Feasibility study	Investment	MUB through the Master	50,000		Local budget		50,000				

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		10.2 B - Bicycle lane construction	Investment	Planning Department	4,020,000	40,000	Crowd funding, private sector financing, local budget		1,005,000	1,005,000	1,005,000	1,005,000
		10.2 C - PV charging, e-bikes stations	Investment		420,000					420,000		
11. Nature-based solutions towards a climate resilient 'sponge city'	11.1	Nature-based solutions towards a climate resilient 'sponge city'										
		11.1 A - (Re)forestation - river basins of Tuul and Selbe in suitable areas (120 ha)	Investment	MUB through the Land Use Department and Water Department	600,000		International donor organizations / Local budget	300,000	300,000			
		11.1 B - Green embankments applied to river basins of Tuul and Selbe in suitable areas (approx. 100 km)	Investment		13,000,000	30,000		2,600,000	2,600,000	2,600,000	2,600,000	2,600,000
	11.2	Development of a feasibility study for city-wide system for flood protection with nature-based solutions	Investment	MUB through the Land Use Department and Water Department	350,000		International donor organizations / Local or national budget			350,000		
12. Waste collection in "ger" areas with source separation of ashes	12.1	Improved collection systems in pilot ger areas with separate ash collection										
		12.1 A - Improved collection systems in selected pilot area, Khooro 10, Bayangal district with separate collection of ashes	Investment	UB Mayor's Office: Service and Waste Management Division, District level MUB as a service contractor	1,140,000	520,000	International donors / Grants and loans / Local budget contribution		1,100,000			
		12.1 B - Roll out of the piloted system to all "ger" areas, assuming 80% is underserved and needs modernization	Investment		25,610,000	8,700,000		6,402,500	6,402,500	6,402,500	6,402,500	6,402,500

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	12.2	Increased recycling in the “ger” areas by introducing bring-in centres for recyclables	Investment	UB Mayor’s Office: Service and Waste Management Division, District level MUB as a service contractor	3,355,000		Municipal budget and private sector	671,000	671,000	671,000	671,000	671,000
		Awareness raising campaigns for measure 12.1 and 12.2		UB Mayor’s Office: Service and Waste Management Division, District level MUB as a service contractor		10,000	Municipal budget and private sector					
13. Improve secondary waste collection, transfer and disposal	13.1	Improvement of waste collection equipment in the apartment area	Investment	UB Mayor’s Office: Service and Waste Management Division	4,940,000	2,750,000	Municipal budget, national budget, international financing organizations	988,000	988,000	988,000	988,000	988,000
	13.2	Development of transfer system	Investment		3,000,000	1,900,000		50,000	1,500,000	1,450,000		
	13.3	Improvement of disposal site at MDDS to sanitary landfill standards	Investment		7,816,000	1,140,000			1,954,000	1,954,000	1,954,000	1,954,000
14. Recycling, industrial symbiosis and circular economy initiatives	14.1	Source separation in inner city area and sorting station for recyclables	Investment	UB Mayor’s Office: Waste Management Department	6,410,000	785,000	Municipal budget, international financing institution, extended producer responsibility system		700,000	2,000,000	2,000,000	1,710,000
	14.2	Industrial symbiosis, implementing the selected technical	Investment	UB Mayor’s Office: Waste Management Department	4,200,000		Municipal in-kind contribution and private			1,400,000	1,400,000	1,400,000

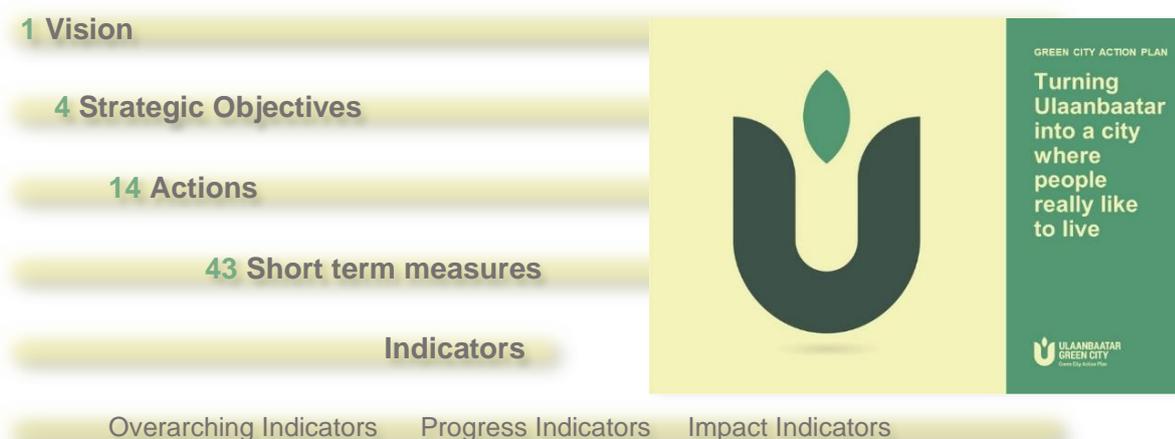
	solution for recycling of waste ashes					sector, co-financing from subsidy as incentive					
14.3	Food bank for reducing organic fraction in municipal solid was (40 t per year)	Investment	UB Mayor's Office: Waste Management Department	440,000	15,000	Crowd Funding, Funds allocated to Corporate Social responsibility within the food industry sector, Grant financing	44,000	396,000			
	Awareness raising campaigns for measure 14.1		UB Mayor's Office: Waste Management Department		10,000						
TOTAL				712,726,100	21,936,000		31,353,000	164,498,200	163,942,600	164,227,600	188,604,700

Section III. Monitoring, reporting and verification



Chapter 6. Monitoring framework, evaluation and reporting

Monitoring and evaluation of GCAP is designed to understand and assess the results and outcomes of implementing the plan. It aims at identifying the most effective actions and informing the implementation team on how to adjust the ones that are not bringing enough results. The main purpose is to measure the impact GCAP actions have over the quality of environmental factors in Ulaanbaatar. Also, it measures the progress towards achieving the established targets for each action. Thus, both progress and impact of implementation will be monitored. The rationale behind the monitoring framework (Annex 5. Monitoring framework for GCAP implementation) is presented in the below figure.



A monitoring tool – Progress Monitoring Plan - was already developed and is annexed to this report as a separate excel file being referenced within Annex 5. It includes 4 main spreadsheets presenting the monitoring and evaluation indicators. The first spreadsheet regarding the monitoring includes the overarching indicators that are aligned with the vision and the strategic objectives. These are also presented in the table below.

Table 10 Vision and strategic objectives – overarching indicators

Vision	Strategic objectives	Overall target	Overarching indicators
Turning Ulaanbaatar into a city where people really like to live	1. Improve air quality by changing the energy and transport paradigm	50% of all established targets within GCAP to be reached in 5 years	Number of GCAP projects initiated (per different stages - feasibility studies developed, tendering process completed, ready for implementation, under implementation, completed)
	2. Mitigate climate change while maximizing livelihood co-benefits		Update the database with GCAP state and pressure indicators
	3. Enhance climate resilience through nature-based solutions		Public perception of enhanced quality of life. Survey focusing on 7 sectors and overall perception of citizens on quality of life and improvements - one survey prior to GCAP implementation and then once/24 months
	4. Creating happy city		Level of awareness of beneficiaries for each measure envisaged in the below actions. Most of the measures include provisions for performing awareness raising

through an attractive, green environment and enhanced community cohesion

activities. Thus, we have included this general indicator that is referring to all actions. The level of awareness will be measured via following indicators:

- number of information materials produced and distributed;
- number of targeted persons that participated at the awareness raising campaign/ topic;
- number of grievances received during implementation of measure.

Each overarching indicator is referring to all strategic objectives due to the synergy between the vision, strategic objectives and actions defined within this GCAP. This is also explained in the introduction part of Chapter 4.

Beside the 4 overarching indicators, we will also constantly update the environmental indicators which will indicate the progress towards improving the quality of life in Ulaanbaatar. The main indicators included in the State-Pressure-Response dataset will be updated annually. These are included in a separate spreadsheet within the Progress Monitoring Plan.

The Progress Monitoring Plan is a dynamic tool and includes possibility of tracking down the progress in implementation of each action and corresponding measures. In case the implementation process starts for one action/measure, then we will use the supplementary indicators that have been defined in a separate spreadsheet for each measure. All the indicators included in the second spreadsheet are also focusing on understanding the progress and impact of each action/measure.

Each indicator has a format and measurement unit in which the data should be collected and processed, referred to the timeframe for accomplishment of related targets and/or defined frequency for data collection. Indicators' related data will be collected from official sources by the named responsible stakeholder and, as much as possible, gender segregated. Below is as an example, a snapshot of the monitoring framework database for the 1st measure from Action 1.

Action 1. Develop green affordable housing in ger areas

Measure 1.1. Construction of high-rise buildings

Specific Target	Indicator	Description	Type	Format	Timeframe/Frequency	Responsible for implementation
At least 2% of total population currently residing in ger areas will move to new housing units in the coming 4 years. On long term (15 years) at least 35% of ger area residents should relocate to improved housing units Energy performance of buildings shall aim to go beyond at least 20% of current norm and practices	1	Feasibility study approved and tender dossier published	Progress	Document	Within 1 year of GCAP approval	Capital City Housing Corporation (NOSK)
	2	Review of existing building code	Progress	Document	Within 1 year of GCAP	Capital City Housing Corporation (NOSK)
	3	Selection of pilot locations	Progress	Document	Within 1 year of GCAP approval	Capital City Housing Corporation (NOSK)
	4	Number of ger area residents moving to improved housing units	Impact	Excel Table	Annually	Social Services
	5	Number of new housing units constructed / year	Progress	Excel Table	Annually	Housing Infrastructure Department
	6	Number of new housing considered social housing	Impact	Excel Table	Annually	Housing Infrastructure Department
	7	Number of complaints received in relation with the ger redevelopment	Impact	Excel Table	Annually	Capital City Housing Corporation (NOSK)
	8	Energy consumption per square meter of construction	Progress	Excel Table	Annually	Housing Infrastructure Department
	9	Length of new district heating distribution network (km)	Progress	Excel Table	Annually	Housing Infrastructure Department
	10	Length of new primary and secondary drinking water distribution network	Progress	Excel Table	Annually	Housing Infrastructure Department
	11	Length of new primary and secondary roads (km) in newly developed areas	Progress	Excel Table	Annually	Capital City Housing Corporation (NOSK)

The Progress Monitoring Plan will be updated and optimised after the second year of GCAP implementation.

Evaluation and reporting

Within the Municipality, GCAP implementation will be closely monitored and evaluated by a Steering Committee (SC). The SC members will be decided by a Decision of the Mayor and will meet at least twice a year to analyse the progress and impact of implementation. The outcomes of the SC meeting will be shared with EBRD.

The Policy and Planning Department together with the Project Management Units, established at the municipality level for specific projects developed based on current GCAP, will lead the monitoring, evaluation and reporting process. The below table presents the leading sectoral municipal representatives in data collection and provision of reliable information to PMU.

Coordination of Monitoring Evaluation and Reporting	Policy and Planning Division within Ulaanbaatar Municipality
Transport	Traffic Planning, Coordination and Engineering Department
Buildings	Housing and Public Utilities Authority
Industry	Master Planning Department
Energy	Housing and Public Utilities of Ulaanbaatar City Ulaanbaatar District Heating Company
Water	Water and Sewage Authority
Solid waste	Waste Management Department
Land use & biodiversity	Master Planning Department

The Policy and Planning Department will compile all the data received from sectoral departments and will produce an annual progress report for the GCAP implementation period. A summary of this report will be also made available to the public.

The GCAP monitoring and evaluation process was also one of the key topics of training dedicated to MUB's staff during the GCAP development. Still, this activity might require some additional training and support during the first two years of implementation. Thus, an engagement of an external consultant was foreseen in order to support the Policy and Planning Department and the PMUs with the specific monitoring tasks, as well as optimising the data collections sheets.

Additionally, two types of audits are foreseen during the first 5-year period of GCAP implementation:

- internal audits – yearly, based on MUB internal procedures. This will focus on understanding whether the internal procedures have been properly followed and if the specific established targets at the level of municipality have been reached;
- third party audit – once in 5 years – this will focus on conducting a full assessment of GCAP implementation process, taking into consideration all elements, such as: technical, financial aspects and utilization of resources.

Annex 1. Indicator's Database. State Indicators

ID	Topic / Source	Indicator	Unit	Differentiation	Lastest year with available data	Indicator value (latest available)	Indicator flag
1	Air	Average_annual_concentration_of_PM2.5	µg/m3	apartment	2017	58	RED
1.1	Air	Average_annual_concentration_of_PM10	µg/m3	apartment	2017	117	RED
1.2	Air	Average_daily_concentration_of_SO2	µg/m3	apartment	2017	18	GREEN
1.3	Air	Average_daily_concentration_of_NOx	µg/m3	apartment	2017	54	YELLOW
1a	Air	Average_annual_concentration_of_PM2.5	µg/m3	ger	2017	82	RED
1.1a	Air	Average_annual_concentration_of_PM10	µg/m3	ger	2017	128	RED
1.2a	Air	Average_daily_concentration_of_SO2	µg/m3	ger	2017	30	YELLOW
1.3a	Air	Average_daily_concentration_of_NOx	µg/m3	ger	2017	33	GREEN
1.1.1	Air	Average_annual_concentration_of_TSP	µg/m3	all	NA	No Data	No Flag
2a	Water_bodies	Biochemical_Oxygen_Demand_BOD_in_rivers_and_lakes	mg/L	downstream	2017	91.6	RED
2b	Water_bodies	Biochemical_Oxygen_Demand_BOD_in_rivers_and_lakes	mg/L	upstream	2017	2.1	YELLOW
2.1a	Water_bodies	Ammonium_NH4_concentration_in_rivers_and_lakes	mg/L	downstream	2017	20.91	RED
2.1b	Water_bodies	Ammonium_NH4_concentration_in_rivers_and_lakes	mg/L	upstream	2017	0.08	GREEN
3	Drinking_water	Percentage_of_water_samples_in_a_year_that_comply_with_national_potable_water_quality_standards	%	all	2017	99%	GREEN
4	Soil	Number_of_contaminated_sites	CSs / 1000 inh (or km2)	all	NA	No Data	No Flag
4.1.a	Soil	Concentration_of_mercury_in_soil	mg/kg	all	2017	0.2	GREEN
4.1.b	Soil	Concentration_of_cadmium_in_soil	mg/kg	all	2017	0	GREEN
4.1.c	Soil	Concentration_of_zinc_in_soil	mg/kg	all	2017	318.1	YELLOW
4.2	Soil	Concentration_of_mineral_oil_in_soil_using_infrared_spectroscopy	mg/kg	all	NA	No Data	No Flag
5	Water_use	Water_Exploitation_Index	%	all	2017	55%	RED
6	Green_space	Open_green_space_area_ratio_per_100_000_inhabitants	m2/capita	all	2017	0.1201	RED
6.1	Green_space	Share_of_green_space_areas_within_urban_limits	%	all	NA	No Data	No Flag
7	Biodiversity_and_ecosystems	Abundance_of_bird_species_all_species	Annual % of change	all	NA	No Data	No Flag
7.1	Biodiversity_and_ecosystems	Abundance_of_other_species	Annual % of change	all	NA	No Data	No Flag
8	Mitigation_GHG_emissions	Annual_CO2_equivalent_emissions_per_capita	Tonne / year / capita	all	2014	11.50978872	RED
8.1	Mitigation_GHG_emissions	Annual_CO2_emissions_per_unit_of_GDP	Tonne / m. USD of GDP	all	2014	2.81952085	RED
9	Adaptation_Resilience_to_natural_disaster_risks	Estimated_economic_damage_from_natural_disasters_floods_droughts_e_earthquakes_etc._as_a_share_of_GDP	%	all	2017	2%	RED
9.1	Adaptation_Resilience_to_natural_disaster_risks	Percentage_of_public_infrastructure_at_risk	%	all	NA	No Data	No Flag
9.2	Adaptation_Resilience_to_natural_disaster_risks	Percentage_of_households_at_risk	%	all	2016	16.33%	YELLOW

Pressure Indicators

ID	Sector	Source of pressure	Indicator	Unit	Differentiation	Lastest year with available data	Indicator value (latest available)	Indicator flag
10	Transport	Energy_efficiency_and_type_of_energy_used	Average_age_of_car_fleet_total_and_by_type	Years	all	2016	13	RED
10.1	Transport	Energy_efficiency_and_type_of_energy_used	Percentage_of_diesel_cars_in_total_vehicle_fleet	%	all	2016	26%	YELLOW
10.2	Transport	Energy_efficiency_and_type_of_energy_used	Fuel_standards_for_light_passenger_and_commercial_vehicles	EURO	all	2016	4	RED
10.3	Transport	Energy_efficiency_and_type_of_energy_used	Share_of_total_passenger_car_fleet_run_by_electric_hybrid_fuel_cell_Liquefied_Petroleum_Gas_LPG_and Compressed_Natural_GasCNG_energy_total_and_by_type	%	all	2016	30%	GREEN
11	Transport	Choice_of_transport_mode	Transport_modal_share_in_commuting_cars_motorcycles_taxi_bus_metro_tram_bicycle_pedestrian	Private transport %	all	NA	No Data	No Flag
11.1	Transport	Choice_of_transport_mode	Transport_modal_share_in_total_trips	%	all	2014	35%	YELLOW
11.2	Transport	Choice_of_transport_mode	Motorisation_rate	Number of vehicles per capita	all	2016	0.2	GREEN
11.3	Transport	Choice_of_transport_mode	Average_number_of_vehicles_cars_and_motorbikes_per_household	Number of vehicles per household	all	2016	0.7	YELLOW
11.4	Transport	Choice_of_transport_mode	Kilometres_of_road_dedicated_exclusively_to_public_transit_per_100000_population	km	all	2016	1	RED
11.5	Transport	Choice_of_transport_mode	Kilometres_of_bicycle_path_per_100000_population	km	all	2016	1	RED
11.6	Transport	Choice_of_transport_mode	Share_of_population_having_access_to_public_transport_within_15min_by_foot	%	all	2016	81%	GREEN
11.7	Transport	Choice_of_transport_mode	Frequency_of_bus_service	Average number of passage at station per hour, in total bus network	all	2016	6.3	YELLOW
12	Transport	Road_congestion	Average_travel_speed_on_primary_thoroughfares_during_peak_hour	km/h	all	2012	20	YELLOW
12.1	Transport	Road_congestion	Travel_speed_of_bus_service_on_major_thoroughfares_daily_average	km/h	all	2012	13	RED
13	Transport	Resilience_of_transport_systems	Interruption_of_public_transport_systems_in_case_of_disaster	n.a.	all	NA	No Data	YELLOW
13.1	Transport	Resilience_of_transport_systems	Efficiency_of_transport_emergency_systems_in_case_of_disaster	n.a.	all	NA	No Data	YELLOW
14	Buildings	Buildings_electricity_consumption	Electricity_consumption_in_buildings	kWh / m2	all	NA	No Data	No Flag
14.1	Buildings	Buildings_electricity_consumption	Electricity_consumption_in_residential_building	kWh / m2	all	2016	43	RED
14.2	Buildings	Buildings_electricity_consumption	Electricity_consumption_in_nonresidential_buildings	kWh / m2	all	NA	No Data	No Flag
15	Buildings	Heat_fossil_fuel_consumption	Heating_cooling_consumption_in_buildings_fossil_fuels_residential_buildings_fossil_fuels	kWh / m2	all	2016	158	RED
15.1	Buildings	Heat_fossil_fuel_consumption	Heating_cooling_consumption_in_residential_buildings_fossil_fuels	kWh / m2	apartment	2016	285	RED
15.1.a	Buildings	Heat_fossil_fuel_consumption	Heating_cooling_consumption_in_residential_buildings_fossil_fuels	kWh / m2	ger	2016	625	RED
15.2	Buildings	Heat_fossil_fuel_consumption	Heating_cooling_consumption_in_nonresidential_buildings_fossil_fuels	kWh / m2	all	NA	No Data	No Flag
15.3	Buildings	Building_standards	Share_of_city_enterprises_with_ISO50001/EMAS_certification_or_similar	%	all	2016	0%	RED
15.4	Buildings	Building_standards	Total_value_of_projects_with_green_building_certification_as_a_share_of_the_total_value_of_projects_g ranted_a_building_permit_per_year	%	all	2016	0%	RED

Pressure Indicators (continued)

ID	Sector	Source of pressure	Indicator	Unit	Differentiation	Lastest year with available data	Indicator value (latest available)	Indicator flag
16	Industries	Industry_electricity_consumption	Electricity_consumption_in_industries_per_unit_of_industrial_GDP	kWh / 2010 USD	all	2016	0.338	YELLOW
17	Industries	Heat_consumption	Heat_consumption_in_industries_per_unit_of_industrial_GDP	MJ / 2010 USD	all	2016	3.73	RED
18	Industries	Consumption_of_fossil_fuels_in_industrial_processes	Heavy_metals_Pb_emission_intensity_of_manufacturing_industries	kg heavy metals equivalent released per million USD GVA	all	NA	No Data	No Flag
18.1	Industries	Consumption_of_fossil_fuels_in_industrial_processes	Fossil_fuel_combustion_in_industrial_processes_per_unit_of_industrial_GDP	MJ / USD	all	2016	4.4	RED
18.2	Industries	Consumption_of_fossil_fuels_in_industrial_processes	Share_of_industrial_energy_consumption_from_renewable_energy	%	all	2016	4%	RED
19	Industries	Industrial_waste_treatment	Share_of_industrial_waste_recycled_as_a_share_of_total_industrial_waste_produced	%	all	2016	1%	RED
20	Industries	Industrial_wastewater	Percentage_of_industrial_wastewater_that_is_treated_according_to_applicable_national_standards	%	all	2016	99%	GREEN
21	Energy	Electricity_provision	Share_of_population_with_an_authorized_connection_to_electricity	%	all	2016	99%	GREEN
21.1	Energy	Electricity_provision	Annual_average_number_of_electrical_interruptions_per_year_per_customer	# / year / customer	all	2016	7	GREEN
22	Energy	Thermal_comfort_provision	Share_of_population_with_access_to_heating_cooling	%	all	2016	44%	RED
23	Energy	Renewable_energy_provision_development	Proportion_of_total_energy_derived_from_RES_as_a_share_of_total_city_energy_consumption_in_TJ	%	all	2016	4%	RED
24	Energy	Resilience_of_the_electricity_network_to_climatic_extremes	Average_share_of_population_undergoing_prolonged_power_outage_in_case_of_climatic_extremes_over_the_past_5_years	%	all	2016	3%	GREEN
25	Water	Water_consumption	Water_consumption_per_capita	L / day / capita	apartment	2017	158.8	GREEN
25a	Water	Water_consumption	Water_consumption_per_capita	L / day / capita	ger	2017	4.7	RED
25b	Water	Water_consumption	Water_consumption_per_capita	L / day / capita	average	2017	73	RED
25.1	Water	Water_consumption	Water_consumption_per_unit_of_city_GDP	L / day / USD	all	2016	0.015	GREEN
25.2	Water	Water_consumption	Unit_of_water_consumed_in_power_plants_per_unit_of_primary_energy_generated	l / MW / h	all	2016	1840	GREEN
25.3	Water	Water_consumption	Industrial_water_consumption_as_percent_of_total_urban_water_consumption	%	all	2016	20%	YELLOW
26	Water	Efficiency_of_water_supply_networks	Non_revenue_water	%	all	2016	14%	GREEN
26.1	Water	Efficiency_of_water_supply_networks	Annual_average_of_daily_number_of_hours_of_continuous_water_supply_per_household	h/day	all	2016	24	GREEN

Pressure Indicators (continued)

ID	Sector	Source of pressure	Indicator	Unit	Differentiation	Lastest year with available data	Indicator value (latest available)	Indicator flag
27	Water	Wastewater_treatment	Percentage_of_residential_and_commercial_wastewater_that_is_treated_according_to_applicable_national_standards	%	apartment	2016	1%	RED
27	Water	Wastewater_treatment	Percentage_of_residential_and_commercial_wastewater_that_is_treated_according_to_applicable_national_standards	%	ger	2016	1%	RED
27.1	Water	Wastewater_treatment	Percentage_of_buildings_non_industrial_equipped_to_reuse_grey_water	%	all	2016	1%	RED
27.2	Water	Wastewater_treatment	Percentage_of_wastewater_from_energy_generation_activities_that_is_treated_according_to_applicable_national_standards	%	all	NA	No Data	YELLOW
28	Water	Resilience_to_floods	Percentage_of_dwelling_damaged_by_the_most_intense_flooding_in_the_last_10_years	%	all	2016	0%	GREEN
28.1	Water	Resilience_to_floods	Annual_number_of_storm_water_or_sewerage_overflows_per_100km_of_network_length	Number of events per year	all	2016	51	RED
28.2	Water	Resilience_to_floods	Awareness_and_preparedness_to_natural_disasters	n.a.	all	2016	Citizens are not aware of natural disaster risks and	RED
29	Solid_Waste	Solid_waste_generation	Total_solid_waste_generation_per_capita	kg / year / capita	total	2016	741	RED
29	Solid_Waste	Solid_waste_generation	Total_solid_waste_generation_per_capita	kg / year / capita	correction	2016	322	YELLOW
29.1	Solid_Waste	Solid_waste_generation	GDP_per_domestic_material_consumption	USD / kg		2016	0.059	RED
30	Solid_Waste	Collection_of_solid_waste	Share_of_the_population_with_weekly_municipal_solid_waste_MSW_collection	%		2016	91%	GREEN
31	Solid_Waste	Treatment_of_solid_waste	Proportion_of_MSW_that_is_sorted_and_recycled_total_and_by_type_of_waste_e.g._paper_glass_batteries_PVC_bottles_metals	%		2016	24%	YELLOW
31.1	Solid_Waste	Treatment_of_solid_waste	Percentage_of_MSW_which_is_disposed_of_in_open_dumps_controlled_dumps_or_bodies_of_water_or_is_burnt	%		2016	1%	GREEN
31.2	Solid_Waste	Treatment_of_solid_waste	Percentage_of_MSW_landfilled_disposed_of_in_EUcompliant_sanitary_landfills	%		2016	0%	RED
31.3	Solid_Waste	Treatment_of_solid_waste	Percentage_of_collected_MSW_composted	%		2016	0%	RED
32	Solid_Waste	Landfill_efficiency_capacity	Remaining_life_of_current_landfills	Years		2016	5	YELLOW
33	Land_Use	Density_Integrated_land_use	Population_density_on_urban_land	Residents/ km2		2017	299	RED
33.1	Land_Use	Density_Integrated_land_use	Average_commuting_distance	km		2016	9	YELLOW
33.2	Land_Use	Density_Integrated_land_use	Average_commuting_time	min		2016	40	YELLOW
33.3	Land_Use	Density_Integrated_land_use	Proportion_of_the_population_living_within_20_minutes_to_everyday_services_grocery_stores_clinics_etc	%		2016	80%	GREEN
34	Land_Use	Urban_sprawl	Average_annual_growth_rate_of_builtup_areas	%		2016	5%	YELLOW
34.1	Land_Use	Urban_sprawl	Percentage_of_urban_development_that_occurs_on_existing_urban_land_rather_than_on_greenfield_land	%		2016	1%	RED
35	Land_Use	Use_of_existing_built_up_areas	Vacancy_rates_of_offices	%		NA	No Data	No Flag
35.1	Land_Use	Use_of_existing_built_up_areas	Share_of_multifamily_houses_in_total_housing_units	%		2017	1.7%	RED

Response Indicators

ID	Sector	Topic / Source	Indicator	Data	Indicator flag
36	Transport	Energy_efficiency_and_type_of_ener gy_used_R	High-polluting_vehicles_are_regulated_Energy- efficient_vehicles_are_incentivised_through_fiscal_instruments	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
37	Transport	Choice_of_transport_mode_R	Extension_and_improvement_of_public_and_non- motorised_transport_is_planned_and_supported_through_investment_in_place	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
38	Transport	Choice_of_transport_mode_R	Public_and_non-motorised_transport_is_promoted_through_Information_and_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
39	Transport	Road_congestion_R	Traffic_demand_is_managed_congestion_charges_smart_technologies	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
40	Transport	Resilience_of_transport_systems_R	Public_transport_emergency_management_in_publicly_and_or_privately_run_networks_is_planned_and_tes ted	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
41	Buildings	Buildings_electricity_consumption_R	Green_building_is_promoted_through_standards_and_fiscal_Incentives	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
42	Buildings	Buildings_electricity_consumption_R	Public_and_private_investment_in_energy_efficiency_in_buildings	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
43	Buildings	Buildings_electricity_consumption_R	Metering_and_billing_for_personal_energy_use_is_regulated	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
44	Industries	Industry_electricity_consumption_R	Energy_efficient_industrial_machinery_is_regulated_and_incentivised_through_fiscal_instruments_electricity _heat_industrial_processes	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
45	Industries	Industry_electricity_consumption_R	Energy_efficient_industrial_technologies_electricity_heat_industrial_processes_is_supported_through_privat e_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
46	Industries	Industrial_waste_treatment_R	Material_efficiency_of_new_built_industrial_facilities_and_waste_recycling_is_regulated_and_incentivised_ through_fiscal_instruments	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
47	Industries	Industrial_waste_treatment_R	Industrial_wastewater_treatment_or_reuse_or_recycle_is_promoted_through_regulations_and_fiscal_incen tives_	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
48	Energy	Electricity_provision_R	Coverage_and_quality_of_electricity_and_heat_supply_is_improved_through_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
49	Energy	Renewable_energy_provision_develo pment_R	Renewable_energy_facilities_in_private_buildings_are_incentivised_through_fiscal_instruments	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
50	Energy	Renewable_energy_provision_develo pment_R	Renewable_energy_technologies_are_developed_and_supported_through_public_and_private_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
51	Energy	Renewable_energy_provision_develo pment_R	Renewable_energy_facilities_are_incentivised_through_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
52	Energy	Resilience_of_the_electricity_networ k_to_climatic_extremes_R	The_resilience_of_electricity_networks_in_case_of_disaster_is_tested_and_enhanced_through_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW

Response Indicators (continued)

ID	Sector	Topic / Source	Indicator	Data	Indicator flag
53	Water	Water_consumption_R	Metering_and_billing_for_water_use_is_regulated	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
54	Water	Water_consumption_R	Water_saving_reuse_is_encouraged_through_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
55	Water	Efficiency_of_water_supply_networks_R	Coverage_and_efficiency_of_water_supply_networks_is_improved_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
56	Water	Wastewater_treatment_R	Buildings_access_to_wastewater_collection_and_treatment_systems_is_improved_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
57	Water	Wastewater_treatment_R	Wastewater_treatment_is_promoted_through_regulations_and_fiscal_incentives	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
58	Water	Wastewater_treatment_R	Wastewater_billing_is_regulated	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
59	Water	Drinking_water_pretreatment_R	Drinking_water_pre-treatment_is_enhanced_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
60	Water	Resilience_to_floods_R	Drainage_facilities_are_developed_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
61	Water	Resilience_to_floods_R	Business_and_community_resilience_is_encouraged_through_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
62	Solid_Waste	Solid_waste_generation_R	Reduction_of_material_consumption_solid_waste_generation_is_promoted_through_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
63	Solid_Waste	Collection_of_solid_waste_R	Coverage_of_solid_waste_collection_system_is_improved_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
64	Solid_Waste	Collection_of_solid_waste_R	Littering_and_non-compliance_to_sorting_systems_is_dis-incentivised_through_fines_and_penalties	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
65	Solid_Waste	Treatment_of_solid_waste_R	Composting_recycling_and_waste-to-energy_facilities_are_developed_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
66	Solid_Waste	Treatment_of_solid_waste_R	Solid_waste_reuse_sorting_and_recycling_is_promoted_through_information_and_awareness_campaigns	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
67	Solid_Waste	Landfill_efficiency_capacity_R	Overcapacity_issues_in_landfills_are_tackled_through_plans_and_investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
68	Land_Use	Density_Integrated_land_use_R	Density_is_regulated	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
69	Land_Use	Density_Integrated_land_use_R	Transit-Oriented_Development_is_promoted	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW
70	Land_Use	Use_of_existing_built_up_areas_R	Mixed-use_development_is_promoted_through_zoning_regulations_or_incentives	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	YELLOW

Annex 2. Policy Review

No.	Title of document	Reference number	Relevant sector	Planning horizon or date of publication	Time horizon	Provisions relevant for GCAP (objectives/targets/actions)
1	Implementation Action Plan for Ulaanbaatar 2020 Master Plan and Development Approaches for 2030 (2016-2020)	174	Urban planning/land use	2016.03.28	2016-2020	There are six priority areas identified in the Master Plan and a following priority directions and investment projects and actions developed under the priority directions are relevant for GCAP which are: 1) Healthy, safe and green city (6 projects), 2) Liveable city (17), 4) City with multi-centres and based an appropriate settlements (1), 6) Internationally competitive city (6).
2	Ulaanbaatar Economic Development Strategy	26/08	General	2015.04.30	2015-2030	Development Strategy, Section I, emphasis Long Term Objective of creation of satellite cities with technology and industrial park and states to organize re-registering all lands of UB city and implement allocation system based on pure business nature. Section III - Infrastructure and Transportation Sector has Long Term Objectives such as housing and creating new living areas by re-planning "ger" areas. It emphasis on implementing i-City Housing Plan, Solution on infrastructure tackles for new housings, and re-planning or reorganizing lands of UB city. ii- seeking better solution which utilizes modern green technology and smart infrastructure for convenient living. It focuses on evaluation of energy sector and expansion or renovation of its capacity. And also mentions about planning for renewable energy and water management. iii- Development of environment friendly and economic city transportation system. It includes creation of new logistic terminals, railways, stations and renovation of in city roads for cars, bicycles and pedestrians.
3	Green Development Strategy and Action Plan for Ulaanbaatar 2020	-	Green development	2015-2016	2016-2020	Seven priority challenges and green objectives, for each of these actions are defined on p20 and following of the document: 1 Cleaner air 2 Sustainable transport 3 Improved solid waste management 4 Water security 5 Cleaner soil 6 Participation in sustaining the environment 7 Climate change resilient
4	Ulaanbaatar Waste Management Improvement Strategy and Action Plan (2017-2030)	-	Waste	2017	2016-2030	Strategy and action plan address the current challenges in solid waste management and related air, soil and water pollution issues, which are very relevant to identified key environmental challenges in GCAP

5	Mongolia Sustainable Development Vision 2030	19	General	2016.02.05	2016-2030	2.1.5. Strategy and Objectives for Energy and Infrastructure Sector is relevant to GCAP which is for expansion and development of roads and transportation logistics network. Also, objective on improvement to the legal environment for urban and land development. Especially, in this part, there is objective to create a healthy, safe and comfortable living environment for citizens, and improve urban planning in line with world-class green development model is relevant to GCAP objectives. Section 2.3 is all about Environmental sustainability which emphasizes on protection of water resources, aim to increase drinking water supply etc. Sub section 2.3.3 is for Ecosystem balance such as preserving the natural landscape and biodiversity which is indirectly related to GCAP objective and there are more directly related objectives such as improvement of planning of cities and urban settlement, enhance the quality of and accessibility to infrastructure facilities and waste management.
6	General Direction of Socio-Economic Development of Capital City 2019	19/16	General	2019	2019	General direction 2. City planning & Infrastructure, 3. Environment and Green Development are most relevant for GCAP
7	Energy Master Plan Ulaanbaatar	-	Energy	2018	2018-2050	The aim of modelling optimized energy systems for UB City for different scenarios has been, to identify the most cost-effective energy system, which provides a secure energy supply in each hour of the year, takes into account the expected development of population, economic growth, and technological improvements, uses as much as possible local energy sources and will be in line with the requirements resulting from the Paris Agreement. The modelling results show clearly, that UB City's future energy supply has mainly to be based on photovoltaic plants, wind turbines and electric heating since no other relevant local energy sources with low or zero GHG emissions are available. PV becomes the most important supply technology, covering 38%-51% of the electricity demand in 2050.
8	Implementation Action Plan for National Green Development Policy (2016-2030)	35	Green development	2016.01.11	2018-2050	The aim of modelling optimized energy systems for UB City for different scenarios has been, to identify the most cost-effective energy system, which provides a secure energy supply in each hour of the year, takes into account the expected development of population, economic growth, and technological improvements, uses as much as possible local energy sources and will be in line with the requirements resulting from the Paris Agreement. The modelling results show clearly, that UB City's future energy supply has mainly to be based on photovoltaic plants, wind turbines and electric heating since no other relevant local energy sources with low or zero GHG emissions are available. PV becomes the most important supply technology, covering 38%-51% of the electricity demand in 2050.

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9	State Policy on Energy	63	Energy	2015.06.19	2015-2030	UB consumes over 1/3 of electricity generated in the country, thus the tasks defined in this document will directly impact on UB energy supply. Particular tasks relevant for GCAP which are improvement of energy supply security, energy efficiency, increase share of renewable energy, establishment of smart energy system, and transfer state owned large energy companies into public companies to create competitive market.
10	National Biodiversity Program (2015-2025)	325	Biodiversity	2015.08.04	2015-2025	the biodiversity program reflects the challenges outlined in the GCAP, peculiar relationship of biodiversity and ecosystems with the other environmental dimensions. It is a cross-cutting, overarching dimension affected by all the others (i.e. biodiversity is affected by air and water pollution)
11	Water National Program (2010-2021)	24	Water	2010.05.20	2010-2021	3.1.10; 3.2.3; 3.3.2; 3.3.11 -13 (improve water supply in urban areas); 3.3.18 (); 3.3.28 - 29(); 3.4.5 - 7()); 3.4.13 (flood protection); 3.4.14 (Extension of Wastewater Station in Baganuur district);3.6.11 (involve citizens for clean-up, improve surroundings, protection of water sources within 20-35 km radius of UB at least twice per year)
12	Ulaanbaatar Air Quality Improvement Program	-	General	2017		Ulaanbaatar is experiencing an unprecedented air pollution level that (i) harms citizens' public health, disproportionately children and poor people; and (ii) results in significant health and economic costs, a long-term burden on the already weak national economy. The problem can only be controlled by a multisector approach for strengthening environmental governance; short- to medium-term gap-filling policies for curbing emissions from key sectors and for health protection measures; and long-term, integrated urban and energy plans. The first tranche will be allocated to the most urgent policy actions; the second tranche, while enabling monitoring of the first tranche implementation, will lay the foundation for long-term policies.
13	National Air and Environmental Pollution Program (2017-2025)	98	General	2017.03.20	2017-2025	GCAP related Provisions: 4.1.3- Create legal environment for mobilisation, re-planning and implementing projects on road, railway and highway. 4.1.7-Low priced Housing plan, infrastructure for housing in "ger" areas. 4.1.8-Adopt renewable energy technology for the areas which is lack of central heating and waste system. 4.1.12- Progressively prohibit mining operations nearby city and remediate mined areas, 4.1.13-Creating green zones, gardens by re-planning "ger" areas, Provision 4.2 is entirely relevant to GCAP. It is all about reducing waste sources by using high technology and progressively reduce and prohibit usage of raw coal; 4.3 is also entirely related to GCAP. It covers incentive program for anti-air pollutions, car emissions, also talks about adoption of prohibition mechanism for air polluting materials and actions, and expansion or development of road, transportation, green development.

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14	National Energy Efficiency Program (2018-2022)	274	Energy	2017.09.20	2018-2022	The aims described within the document are energy saving, energy efficiency, reduce transmission and distribution loss, improve legal environment for energy generation, transmission and distribution, reduce of GHG emission.
15	City Finances of Ulaanbaatar	-	General	2013	Not specified	This document is important for assessing the UB City budget as a financing source for the actions and projects proposed by GCAP
16	Hydro-economic analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap	-	Water	2016	2016-2030	The 2030 Water Resource Group Mongolia Partnership aims to enable sustainable water resource management in Mongolia. The partnership's Memorandum of Understanding was signed between the Government of Mongolia and 2030 WRG on 16 September 2013. This report focuses on Ulaanbaatar. Based on the water supply demand gap identified in the previous project phase, an inventory of implementable solutions to close the gap have been identified and prioritised to allow for sustainable economic development. The report addresses the water supply demand gap which will appear in 2021 and proposes an inventory of implementable solutions to close the gap. Water demand was estimated for three scenarios: low, medium and high demand until 2030.
17	Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal Project (AHURP-FP077)	-	Urban planning/land use	2017	2018-2026	The project will have three outputs: (i) resilient urban infrastructure, public facilities, and social housing units in ger areas constructed (public sector component); (ii) long-term financing to developers for low-carbon affordable housing, market rate housing, and economic facilities in ger areas and to households for green mortgages increased (financial intermediation loan [FIL] component); and (iii) sector policy reforms implemented and capacity strengthened. The carbon emission reduction estimated for the project is 200,000 tons of carbon dioxide equivalent per year, equal to 8 million tons of carbon dioxide equivalent during the project lifetime (40 years).
18	Urban Development Assessment of the CHP 5 Neighbouring Area in Ulaanbaatar	-	Urban planning/land use	2016	2016-2020(2030)	There are two main objectives to this project that are relevant for GCAP: the construction of the CHP plant in itself, and all the other proposed concurrent actions/developments that are proposed in the study, as they all would have significant impact over strategic indicators of the EBRD methodology.
19	Implementation Action Plan of Action Program of the Government of Mongolia for 2016-2020	121	General	2016.10.26	2016-2020	There are five main components identified in the Implementation Action program of Action Program of the Government of Mongolia for 2016-2020 and related components and number of actions for GCAP are: 1) Sustainable economic growth policy (31 actions), 4) Environment and green development policy (25).

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20	Action Program of Ulaanbaatar city Mayor for 2016-2020	3/08	General	2016.09.29	2016-2020	There are five main components identified in the Action program of Ulaanbaatar City Mayor for 2016-2020 and related components and number of activities for GCAP are: 1) Economic development growth for households (3 activities), 2) Urban planning and infrastructure (58), 3) Environment and green development (28).
21	Housing and infrastructure development of Capital City Sub-program	14/01	Building	2018.02.27	2018-2022	The objective 9. Retrofitting of per-cast panel apartments are related to GCAP
22	Ulaanbaatar Urban Services and Ger Areas Development Investment Program	-	Water	2014	until 2022	The Program will be a ten-year investment in three tranches, aimed at improving the quality and coverage of urban infrastructure and basic services, and implementing a sustainable and inclusive process of urban development for middle ger areas of Ulaanbaatar.
23	Investment Program of Mongolia for 2018-2021	140	General	2018.05.23	2018-2021	Provisions or projects relevant for GCAP are: 1.Housing and infrastructure, 2. Engineering pipelines of city and 21 provinces, 14. High way to new airport projects, 36. Development project for 4th thermal plant UB, 38. Project for reduction of UB city air pollution, 40.Development project for UB city "Ger" district, 41. Project on UB city public transportation, 44. Decentralization project, 51. Project on UB city central waste cleaning complex, 55.Tuul pool foundation project, 66.Tunnelling project, 88. Highway project between Altanbulag-UB-ZamiinUud, 97. Expansion of 3rd Thermal Plant by 250mb. 109.Smokeless UB project, 110.Project on Creating solid waste point and complex for recycling wastes, 111. Re-planning and housing of UB, 113. Project for building bridges at Bayanzurkh district and Sonsgolon areas over the Tuul river.
24	Implementation Action Plan of Citizens Water Safety and Sanitation Usage Improvement Sub-program	A/909	Water	2018.09.28	2018-2021	The subprogram objectives and actions are in line with GCAP goals and actions
25	Three pillars development policy	42	General	2018.02.06	2018-2020	There are 9 activities under Target 9. To establish liveable environment for citizens by developing integrated infrastructure, logistics and transportation related to GCAP.
26	State Policy on Industry (2015-2030)	62	Industry	2015.06.19	2015-2030	Main framework policy document for industrial development of Mongolia. The document aims to develop industry with main principles of 1) hazard, safety, environment, 2) export oriented and import substitute, 3) knowledge based, 4) public private partnership with involvement of science organizations.
27	Rental Housing Program (2015-2021)	248	Building	2015.05.15	2015-2021	Not related to GCAP

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28	Sub Program of the Public Transportation Development of Capital City by 2020	151	Transportation	2013.12.13	2013-2020	There are 18 actions are identified and the relevant provisions are 6.1 To renovate mid and large capacity public transport buses park by steps 6.2 To establish GPS system and smart payment system 6.4 To encourage high efficiency types of vehicles 6.5 To ensure the preparation and implement BRT and metro system 6.14 To adapt international standard to public transport service 6.15 To renew public transport service tariff.
29	Municipal Policy on Public Transportation and Implementation Action Plan	118	Transportation	2014.07.08	2014-2020	The relevant provisions are 1.1-1.3 To improve legal framework of public transportation 3.2.1 To reduce air pollution by using gas and electric vehicles for public transport service 4.1.15. 4.2.2, 4.2.3 To ensure the preparation and implement BRT and metro system 5.1.1, 5.1.2 To renew public transport service tariff and application of electronic payment system.
30	Construction Material Manufacturing Support Program	171	Building	2012.12.15	2013-2016	
31	Ulaanbaatar Flooding Drainage Development Program up to 2020	224	Water	2014.12.15	2015-2020	The program content is relevant to GCAP objectives, targets and actions on water resource, quality and healthy and safe living of inhabitants.
32	Industry and Technology Park Development Program of Capital City (2015-2025)	133	Industry	2015.08.17	2015-2025	Develop export-oriented industry in the form of industrial parks based on environmentally friendly and advanced technology.
33	Khatan-tuul national program	203	Water	2012.06.13	2012-2016; 2017-2020	The program content is relevant to GCAP objectives, targets and actions on water resource, drinking water quality, water supply and healthy and safe living of inhabitants.
34	Water resource management action plan	389	Water	2013.11.30	2014-2021	
35	State policy on disaster protection	22	Environment	2011.05.13	2011 - 2020	National policy on disaster prevention covers Ulaanbaatar as well.
36	National Disaster Protection Capacity Building program	22	Environment	2011.05.13	2012-2020	It provides a detailed national action plan with clear objectives, target dates and responsible organisations.
37	National community-based disaster risk reduction program 2015-2025	303	Environment	2015.07.20	2015-2025	It defines, in general terms, objectives, targets, and actions which can easily be translated for a city level.
38	National earthquake risk reduction program 2009-2020	157	Environment	2009.05.27	2009-2020	The mid-term audit report found that (a) Network for Earthquake registration stations has been expanded, (b)Public knowledge is sufficient on prevention from earthquake risk, (c) No detailed operation plan of implementation of re-development planning the city and the works to demolish earthquake-intolerant buildings and include them in

						re-development planning are being delayed, (d) Insufficient monitoring of national program implementation and of its results, (e) There is no respective and independence budget to implement national program.
39	Mid-term strategy for implementing disaster risk reduction within the Sendain framework in Mongolia	355	Environment	2017.12.27	2017-2030	Provides suggestions for strategy development of disaster risk assessment & reduction
40	Health and urbanization	4	Urban planning/land use	2016.01.04	2016-2020	There are 5 major targets are set and relevant target to GCAP is 2.2.3 To improve living conditions of citizens in urban areas including solid waste landfill elimination, plan and implement green spaces, pedestrian and bicycle roads according to the standard in new development areas in ger area.
41	National program for mid-term implementation of State Policy on Energy for 2023	325	Energy	2018.10.24	2018-2023	Mid-term program represents as list of actions to expand generating capacity to catch up the growing demand, minimum possible investment instead of starting new power plant projects which require big investment. In October 2018, "mid-term plan for development of energy sector" was approved by the Government according to which at least several hundreds of MW new capacities will be introduced through expansion of existing power plants.
42	Green development Policy of Mongolia Action Plan				2020 and 2030	Mongolia needs to change "Grow first and Clean-it up later" axiom by turning it into environmentally friendly, waste less and effective production with increased productivity, create an inclusive and participatory economic growth aimed to increase quality of life. 2020 and 2030: First phase: Establishment of foundation for green development phase, 2014-2020 Second phase: Transition to a green development phase, 2021-2030

Annex 3. Full list of stakeholder events

1 st Mission (15 – 19 October 2018)	Technical Kick-off. Objective of this mission was to get to know the city, MUB and key stakeholders in order to introduce GCAP project. In this regard, 9 direct meetings have been carried out with MUB representatives and others such as: Department of Green Development, Policy and Planning; National Development Agency; Environment Department; Statistics Department; Water and Construction Department; Mayor's Office; etc.).
2 nd Mission (27 November – 5 December 2018)	Official Inception. The official Kick-off Meeting took place in November 30th, 2018, where the overall approach of the Green Cities Programme, GCAP methodology and development process have been presented and discussed. No. of 50 participants were registered, out of which 3 NGOs (NGO Khashaandaa saikhan amidarya; Ger Mapping Center and one from another NGO). The meeting was opened by the Deputy Governor of Ulaanbaatar. The official launch event was followed up by the Traffic Light Workshop (4th of December 2018) where the indicators database has been validated with key MUB stakeholders. Total no. of participants: 14, out of which 1 NGO (Mongolian National Association for Waste Recycling).
3 rd Mission (28 February – 6 March 2019)	Stakeholder Consultation Workshop on identified green city challenges. The consultation meeting for prioritizing challenges took place on 6th of March 2019. The exercise was completed through a stakeholder-based analysis of green city challenges, where external experts, citizen representatives, key stakeholders (31 participants) engaged during the GCAP development process have confirmed or disputed the relevance of the green city identified challenges. Out of the total no. of participants, 5 NGOs from different sectors such as transportation, water, waste management and urban development have participated as well ("Unen Hatamj"; "Planning, Research and Education Center of Non-Urban Area"; "Transparency Foundation"; "Water Education Center"; Mongolian National Association for Waste Recycling"). This exercise has led to a list of key priorities for each sector which have been addressed in the current GCAP, priorities which are listed in Sub-chapter 2.2 City baseline. This formed the basis for defining the strategic objectives and developing long list of possible actions.
4 th Mission (1- 5 April 2019)	Consultative sectoral meetings on actions. The objective of this mission was to bring the different MUB departments in a technical consultation to briefly present key challenges, aiming to review the strategic development objectives per each sector and select ideas from the long list of actions. Therefore, 10 sectoral meetings were organized in this regard with the representatives of MUB. Also, a meeting with Ministry of Finance (Budget Investment Department) took place, where several topics have been discussed such as: procedural ways of approving projects; main laws related to funding; criteria of project selection by line ministries; etc.
5 th Mission (25 June – 2 July 2019)	Consultation meeting for prioritizing actions. The meeting took place on June 27th, 2019 where about 22 participants, representing local and national authorities and other interested parties (including 3 NGOs: "Unen Hatamj"; "Transparency Foundation"; "Planners Group"), discussed in detail the proposed actions to be included in the GCAP. Participants have formed two groups and expressed their opinion on the short list of proposed actions and prioritized them in terms of urgency. This mission also focused on additional data collection in filling the gaps for detailing the prioritized actions as much as possible (detailed action sheets).
6 th Mission (29 October – 4 November 2019)	High-level and technical meetings for fine-tuning the actions. The objective of this mission was to present the GCAP detailed actions to the MUB departments and carry out technical meetings to discuss the final details of the envisaged actions. The mission also included meetings with high-level MUB officials to present the development status of the GCAP and discuss its approval process.

Annex 4. GCAP measures - calculations based on assumptions

Calculation steps

Please note that this is a table only for those measures which required calculations based on assumptions

Measure	Component within measure	Unit	Surface/unit	Price/unit	CAPEX per component
1.1. Construction of energy efficient social housing	Annual construction for 0.5% of the population in the gers	1,150 flats	60 m2/flat	800 \$/m2	\$55,200,000
1.3. Provision of alternative heating solutions and retrofitting of houses	Provision of alternative heating solutions	20,000 heaters		515 \$	\$10,300,000
	Retrofitting of approx. 5% of houses	5,161 houses	55 m2/house	100 \$/m ²	\$28,385,500
1.4. Provision of state-of-the-art emission reduction devices	Filters	10,000 filters		1,600 \$	\$16,000,000
2.3. Usage of dry toilets or septic tanks		20,000 toilets		750 \$	\$15,000,000
3.2. Heat-pump based district heating	Feasibility study and implementation of 33 MW capacity of heat pumps	33 MW		1,200,000 \$/MW	\$39,600,000
4.1. Install solar car parks for public transport	Building roofs		10,000m2/flat	300 \$/m2	\$3,000,000
	Above parking areas		6,000 m2/flat	335 \$/m2	\$2,010,000
4.2. Capacity building planning and investment for RES penetration	Implement up to 10MW RES pilot project investments	10 MW		1,300,000 \$/MW	\$13,000,000
4.3. Modernisation of the electricity transmission and distribution network	Rehabilitation of grid capacity and power lines (30 km);	30 MW		215,000 \$	\$6,450,000
	Substation in the central part of the city	1		15,000,000 \$	\$15,000,000
5.2. Energy Efficiency in Public Buildings Programme			30,000 m2	140 \$/m2	\$4,200,000
5.3. Energy Efficiency in Residential Buildings			350,000 m2	110 \$/m2	\$38,500,000
6.4. Installing individual water meters		50,000 water meters		22 \$/meter	\$1,100,000
7.1. Polluting emissions control technologies	Flue-gas Desulfurization unit	1,434 tSO ₂		4,400 \$/tSO ₂	\$6,309,600
8.5. Investment in bus fleet improvement		400 buses		175,000 \$	\$70,000,000
8.4. Improvement of traffic flows, with a focus on bus prioritization	Adapting intersections	5 intersections		3,000,000 \$	\$15,000,000
9.1. Adapting infrastructure for pedestrians		5 km		200,000 \$/km	\$1,000,000
10.1 Development of multifunctional green space	Development of green space		1,000,000 m2	60 \$/m2	\$60,000,000
	Development of green roofs per year	5 years	2,000 m2	70 \$/m2	\$140,000

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10.2. Development of green cycling lane and provision of (PV) charging and renting stations for e-bikes in rest areas along the cycling path	Bicycle lane construction		60,000 m	67 \$/m	\$4,020,000
	PV charging, e-bikes stations	15 stations		20,000 \$/station	\$300,000
	e-bikes	75 bikes		1,600 \$/bike	\$120,000
11.1 Nature-based solutions towards a climate resilient 'sponge city'	(Re)forestation - river basins of Tuul and Selbe in suitable areas		120 ha	5,000 \$/ha	\$600,000
	Green embankments applied to river basins of Tuul and Selbe in suitable areas		100 km	130,000 \$/km	\$13,000,000
12.1. Improved collection systems in pilot Ger areas with separate collection of ashes	Improved collection systems in selected pilot area, Khooro 10, Bayangal district with separate collection of ashes	3 trucks		200,000 \$/truck	\$600,000
		1,200 containers		300 \$/container	\$360,000
		600 containers		300 \$/container	\$180,000
	Roll out of the piloted system to all "ger" areas	52 trucks		200,000 \$/truck	\$10,400,000
		50,700 containers		300 \$/container	\$15,210,000
13.1. Improvement of waste collection equipment in the apartment area (assume 50% improvement needed)	Trucks	16 trucks		200,000 \$/truck	\$3,200,000
	Containers	5,800 containers		300 \$/container	\$1,740,000
13.2. Developing transfer system	Trucks	12 haul trucks		250,000 \$/truck	\$3,000,000
13.3. Improving disposal site at MDDS to sanitary landfill standards (costs from Japanese feasibility study)	Construction (initial investment for new cells and rehabilitation of closed cells)			4,500,000\$	\$4,500,000
	Infrastructure			66,000\$	66,000\$
	Equipment and installations			2,750,000\$	2,750,000\$
	Semi-aerobic landfill system appropriate for oxidizing methane and reducing GHG			500,000\$	500,000\$
14.1. Source separation in inner city area and sorting station for recyclable	Trucks	3 trucks		200,000 \$/truck	\$600,000
	Containers	8,000 containers		300 \$/container	\$2,400,000
	Covered containers	4,000 containers		300 \$/container	\$1,200,000
	Sorting station	1		1,800,000 \$	\$1,800,000
14.2. Industrial symbiosis	Tonnes of ashes recycled	9500		442\$	\$ 4,200,000

Annex 5. Monitoring framework for GCAP implementation

The main indicators to be monitored during the GCAP implementation process are presented within this annex and in the corresponding excel file (monitoring tool). The excel file includes a database ready to be filled in.

The following indicators will be monitored during whole GCAP implementation period:

Vision	Strategic objective	Level of implementation	Indicator		Type	Format	Timeframe / Frequency	Responsible for implementation
			ID	Description				
Turning Ulaanbaatar into a city where people really like to live	Strategic Objective 1. Improve air quality by changing the energy and transport paradigm		V1	Number of GCAP projects initiated (per different stages - feasibility studies developed, tendering process completed, ready for implementation, under implementation, completed)	Progress	report	annually ³⁰	Mayor's office
	Strategic Objective 2. Mitigate climate change while maximizing livelihood co-benefits		V2	Update the database with state and pressure indicators - see spreadsheet State and Pressure Indicators	Impact	report	annually	Project Management Unit within Mayor's office with the support of Environmental Authorities
	Strategic Objective 3. Enhance climate resilience through nature-based solutions		V3	Public perception of enhanced quality of life. Survey focusing on 7 sectors and overall perception of citizens on quality of life and improvements - one survey prior to GCAP implementation and then once/24 months	Impact	report	once /24 months	Mayor's office
	Strategic Objective 4. Creating happy city through an attractive, green environment and enhanced community cohesion		V4	Level of awareness of beneficiaries for each measure envisaged in the below actions. Most of the measures include provisions for performing awareness raising activities. Thus, we have included this general indicator that is referring to all actions. The level of awareness will be measured via following indicators: - number of information materials produced and distributed	Impact	report	6 months after implementation of a measure	Relevant department/measure

³⁰ Reports to be submitted before end of each year

- number of targeted persons that participated at the awareness raising campaign/ topic
- number of grievances received during implementation of measure

As indicated under V2 indicator, the database with environmental indicators for state and pressure (as in the State-Pressure-Response framework) are to be updated annually. The update will focus mainly on the following indicators:

Topic/Indicator	Unit
QUALITY OF ENVIRONMENTAL ASSETS	
Air quality	
PM10	µg/m ³
PM2.5	µg/m ³
Water bodies	
Biochemical Oxygen Demand (BOD) in rivers and lakes	mg/L
Drinking water	
Percentage of water samples/year complying with national potable water quality standards	%
Land/Soil quality	
Number of contaminated sites	CSs / 1000 inh. (or km ²)
Concentration of heavy metals (Pb) in soil (Mercury, cadmium, zinc, other)	mg/kg
Water	
Water Exploitation Index	%
Green spaces	
Open green space area ratio per 100 000 inhabitants	Hectares
Mitigation (GHG Emissions)	
Annual CO ₂ emissions per capita	Tonne / year / capita
Annual CO ₂ emissions per unit of GDP	Tonne / USD of GDP
Adaptation (resilience to natural disaster risks)	
Estimated economic damage from natural disasters as a share of GDP	%

PRESSURE INDICATORS

Transport	
Average age of car fleet (total and by type)	Years
Kilometers of road dedicated exclusively to public transit per 100 000 population	km
Kilometers of bicycle path per 100 000 population	km
Share of population having access to public transport within 15 min by foot	%
Frequency of bus service	Average # of service at station per hour in total bus network
Average travel speed on primary thoroughfares during peak hour	Km/h
Interruption of public transport systems in case of disaster	qualitative assessment
Buildings	
Electricity consumption in buildings	kWh / m2
Electricity consumption in residential building	kWh / m2
Electricity consumption in non-residential buildings	kWh / m2
Heating / cooling consumption in buildings, fossil fuels	kWh / m2
Heating / cooling consumption in residential buildings, fossil fuels	kWh / m2
Heating / cooling consumption in non-residential buildings, fossil fuels	kWh / m2
Industries	
Electricity consumption in industries, per unit of industrial GDP	kWh / 2010 USD
Share of industrial energy consumption from renewable energy	%
Share of industrial waste recycled as a share of total industrial waste produced	%
Energy	
Share of population with an authorised connection to electricity	%
Proportion of total energy derived from RES as a share of total city energy consumption	%
Water (supply, sanitation, drainage)	
Water consumption per capital (source: GWP)	L / day / capita
Non-revenue water	%
Annual average of daily number of hours of continuous water supply per household	%
% of buildings (non-industrial) equipped to reuse grey water	%
Percentage of dwellings damaged by the most intense flooding in the last 10 years	%
Annual number of storm water/sewerage overflows per 100km of network length	Number of events per year

Solid waste	
Total solid waste generation per capita	Kg / year / capita
Share of the population with weekly municipal solid waste (MSW) collection	%
Proportion of MSW that is sorted and recycled (total and by type of waste)	%
Percentage of MSW landfilled disposed of in EU-compliant sanitary landfills	%
Percentage of collected MSW composted	%
Remaining life of current landfill(s)	Years
Land-Use	
Population density on urban land	Residents / km2
Average commuting distance	km
Average commuting time	min

Beside the above-mentioned strategic indicators each action and corresponding measures will be closely monitored, and its implementation process will be indicated by selecting the “level of implementation” in the below table. A set of supplementary indicators will be monitored once the action/measure will start to be implemented. These indicators are defined in a separate spreadsheet.

Action/Measure	Level of implementation	Start date	Implementing entity	Indicator
	Please choose between the following: feasibility study in progress tender in progress not under implementation under implementation completed			In case under implementation, see spreadsheet with supplementary indicators and fill in relevant indicators for each action